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KNOWLEDGE TRANSFER in merger and acquisition processes in the metallurgical industry

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*To my dear parents
and beloved children,
Julia and Mateusz
with love and gratitude*

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INTRODUCTION

Knowledge and information have now become a major factor of innovation, development and competitiveness of enterprises. Therefore they are of greater and greater interest of the management. Underestimating the role of knowledge and information, and their insufficient use pose a threat to the company and can destroy its competitiveness¹.

Knowledge has also become one of the key motives for conducting mergers and acquisitions.

Merging and acquisition processes generate natural challenges and the accompanying risks both for management and shareholders, as shown by numerous publications and studies, indicating low rates of achieving the planned effects of the above-mentioned processes, as well as the very high costs of carrying them out.

For many years, one of the basic means of achieving external growth by companies operating in different sectors of the economy is their amalgamation through mergers and acquisitions. As an example, a strong consolidation trend in the US banking sector, dating back to the 1920s, can be presented. Between 1960 and 1965, about 900 commercial banks were consolidated in various forms.

According to S. Sudarsanam², it is generally believed that companies³ are acquiring or want to merge with other companies cannot provide their shareholders with benefits of this process.

Similar position is taken by N. Danon-Boileau⁴, arguing that large-scale mergers and acquisitions (over USD 1 billion) led to a decline in the value of consolidated companies, devaluating shareholders' incomes.

The author of *The Basics of Mergers and Acquisition* claims that „it is no secret that a lot of mergers did not work ... Historical trends indicate that approximately two thirds of large mergers are disappointing, which means they will lose on the

¹ J. Rokita, *Organizacja ucząca się*, Wydawnictwo Akademii Ekonomicznej w Katowicach, Katowice 2003, p. 76.

² S. Sudarsanam, *Fuzje i przejęcia*, WIG-Press, Warszawa 1998, p. 5.

³ For the purposes of this dissertation, the terms: company, enterprise and organization are treated as synonyms.

⁴ N. Danon-Boileau, *Will the new wave of M&A create more value?* Bearing Point, 22.07.2015.

stock market”⁵. This failure means, firstly, a negative effect not only on the parties to the merger process, and above all on the shareholders and managers, and, secondly, social costs unnecessarily incurred for integration-related activities that do not add value.

Organizational and management literature references broadly describe the forms and phases of merger activities, concerning strategy, pre-selection, short-listing and *due diligence*. In the above mentioned analyses relatively little attention is paid to the problem of knowledge transfer.

In the age of progressive globalization and a visible increase in the intra-EU relations, merger processes will more be often than before applied in business practice, and one of the key motives will be the transfer of new knowledge between the entities, opening the door to researching this process in the context of mergers and acquisitions. „In this way, knowledge has become the most important element that influences the development and success of organizations in the global economy”⁶.

Knowledge transfer is usually not distinguished by definition from the transfer as a general concept. In encyclopaedias, the notion of transfer is often referred to as economic and psychological transfer.

For the purposes of this paper it is assumed that the transfer of knowledge will mean the exchange of knowledge between organizational entities.

Knowledge transfer should not, however, be reduced the flow within merger. Transfer may involve sale (acquisition) of knowledge, cooperation within alliance, franchise or, according to the subject of the paper, merger of companies.

In the psychological sense it refers to an individual message, which is usually part of the transfer of knowledge between business units. In this meaning, it is also examined in this paper.

In the monograph, a successful attempt has been made to supplement the existing research results in the scope of knowledge in the context of its transfer by the issues of bilateral knowledge transfer between merging companies. The overall merits of the merger process were identified, both for the acquiring and the acquired companies. Attention was also paid to the phenomenon of knowledge integration and an attempt was made to investigate the differences in knowledge potential of the merging partners, which determine the successful course of merger. A condition necessary for creating motivation to acquire knowledge through an amalgamation of entities is the difference in knowledge potential.

⁵ B. McClure, *The Basics Of Mergers And Acquisitions*, www.investopedia.com, s. 12.

⁶ J. Brzóska, J. Pyka (red.), *Nowoczesność przemysłu i usług w warunkach kryzysu i nowych wyzwań*, TNOiK, Katowice 2013, s. 28.

Transfer of knowledge in mergers and acquisitions processes will ultimately improve the market position of companies and gaining competitive advantage by them. This means that the main objective of the paper was to identify the relation between knowledge transfer and merger and acquisition transactions of metallurgical enterprises, indication of the key determinants of the transfer process, and its characteristics over time. Hence, it was considered that specific objectives shall be:

- development of a knowledge transfer model in the merger and acquisition process;
- analysis of the merger and acquisition process with particular focus on knowledge transfer;
- establishment of specialized research methods suitable for analysis of knowledge transfer between consolidated companies;
- development of a tool for assessing susceptibility to knowledge transfer, extending the *due diligence* analysis in the integration process;
- development of a knowledge transfer research activities grid.

A paper thesis has been formulated, according to which determining the main determinants of knowledge transfer in the merger and acquisition process allows to determine the necessary time of this operation.

Past discussions and observations allowed us to formulate the following research questions of the thesis:

- Which type of knowledge (explicit or tacit) is more important in the context of its transfer in the merger or acquisition process?
- How to practically determine the type and meaning of knowledge?
- What factors influence the success of mergers and acquisitions in terms of knowledge transfer?

Individual parts of this monograph concern the following issues:

Chapter I – takes into account the market context of motives for mergers and acquisitions. The causes of mergers and acquisitions have been identified, depending on the strategy. The motives for mergers and acquisitions were also presented, highlighting their multifaceted nature. The economic phenomenon has been characterized – the concentration of entrepreneurs with the discussion of the forms of its manifestation. Discussed were vertical and horizontal forms of mergers that can influence the scope and importance of knowledge transfer. This part also includes issues related to knowledge as a separate motive for acquisition.

Chapter II – contains issues of knowledge and its transfer in general and structural approach. It covers issues related to knowledge in the organization and the forms of its manifestation. On the basis of literature research the definition of knowledge is discussed, which is the starting point for further defining its potential, which is

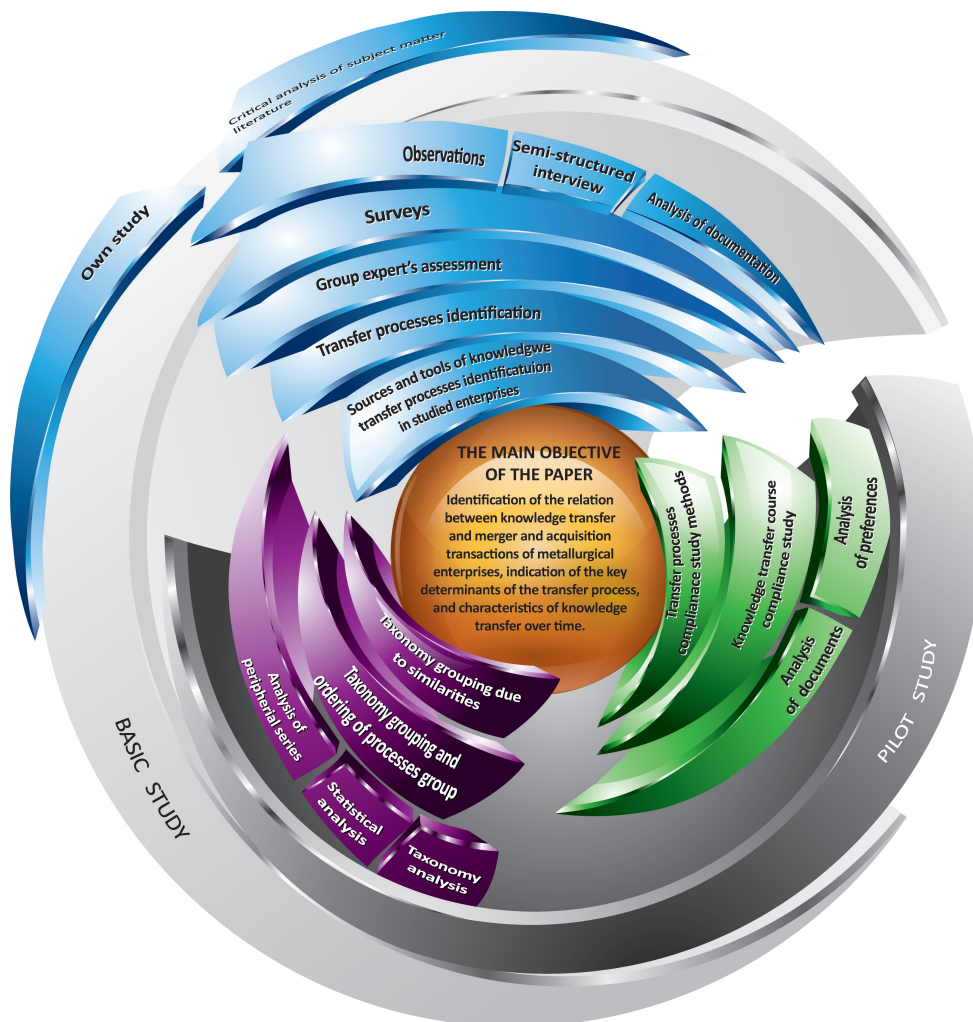
essential in empirical research. It defines the concept of components, types and the nature of each type of knowledge. The concept of knowledge transfer in creating the value of a new organization is presented. The ability to create knowledge through various ways of its conversion is indicated. A map of the knowledge possessed and desired in the new merged enterprise and the steps of knowledge transfer in the merger and acquisition process are presented. The chapter contains issues related to integration and classification of knowledge as well as the presentation of explicit and tacit knowledge in particular stages of its transfer.

Chapter III – describes the success factors in the scope of mergers and acquisitions in relation to knowledge transfer between consolidated companies. Within this issue, the main success factors for knowledge transfer have been identified, indicating the structural, systemic and cultural conditions of matching. The role of *transition team*⁷ and its importance in the integration process were also discussed. The method of *due diligence* has been characterized, including its role in the merger and acquisition processes. The chapter concludes a review of the mergers and acquisitions of metallurgical enterprises against the background of the world economy, with the distinction of intra-EU amalgamations.

Chapter IV – covers methodology and organization of own research. Knowledge transfer model in the merger and acquisition process was presented in it. The characteristics of selected research methods presented in Figure 1 were described. The applied methodological triangulation assumed the use of 19 research methods, both quantitative and qualitative, including: observations, partially structured interviews, document analysis, questionnaires, group evaluation of experts, Johnson's nearest neighbour method, Wrocław taxonomy – the method of the shortest dendrite, the median method, the Berry method, the centre of gravity method, the group average method, the *on-line* method, the furthest neighbourhood method, Taylor method, Kendal method, Kullback-Leiber method, Goodman-Kruskal method, Gini's method, Spearman's method. Their summary presentation is shown in Figure 1.

This chapter contains a description of the research sample and the characteristics of the surveyed companies. It shows the course of the research process. The conducted research focused primarily on the selection of important factors, determining the transfer of knowledge in the merger and acquisition process and determining the factors influencing the success of this process.

⁷ As the *transition team* in the study any type of team established within or outside the organization to transfer knowledge should be understood.

Figure 1. Outline of research methodology

Source: own study.

Chapter V – contains an analysis of empirical research. It presents the summary results and their interpretation. The chapter presents good practices—recommendations for participants in the processes of business integration in terms of methodological assumptions for transfer of knowledge in the processes of mergers and acquisitions of metallurgical companies. Particular attention has been paid to optimization of knowledge transfer time in mergers and acquisitions of metallurgical companies. Practical recommendations were also indicated in the field of *due diligence* analysis, which, after appropriate expansion, may also be applied for knowledge transfer

examination. The procedure concerning the knowledge transfer knowledge grid has also proved to be important.

The combination of theoretical knowledge with experience gained through a broader economic perspective allows for a deeper insight into the details of the problem. The need to reach the smallest items was noticed by P.M. Senge⁸, a researcher who within system approach suggested that „complex things should be investigated in their complexity”. This wisdom has been used and practically applied by the Author collecting and processing the acquired knowledge into the science and practice of economic activity.

⁸ P.M. Senge, *Piąta dyscyplina. Teoria i praktyka organizacji uczących się*, Dom Wydawniczy ABC, Warszawa 1998, p. 48.

Chapter I.

MARKET CONTEXT OF MOTIVES FOR MERGERS AND ACQUISITIONS

1. Motives of mergers and acquisitions

Various factors influence amalgamation of organisations, in this work those factors have been divided into objective (causes, reasons) and subjective (motives and goals). Most authors identify motives with goals of mergers and acquisitions. In some cases, the objective factors of enterprise functioning, both internal and external, force a specific strategy. In others, the subjective motives of individual groups of actuaries (managers, shareholders, intermediaries, employees) influence the setting of goals, which are not always consistent with objective needs of the company involved in merger or acquisition. From the point of view of knowledge transfer, the first of them is usually of greater importance.

A significant number of authors indicate situations in which a company needs to grow in a certain direction. „In modern organizations, the knowledge and competences of human capital are becoming more and more crucial [...]”⁹.

According to H. Johnson, such situations include:

- Globalization, which „by reducing labour costs and opening up markets to greater number of producers is important for competitiveness of industry;
- Operation of financial markets which „have become more integrated, allowing for easier conduct of merger transactions [...]”;
- Privatization of state-owned enterprises, which has enabled the merger of companies from different sectors, including some so far closed to private capital;
- The threat of a recession that „draws more attention to the issues of competitiveness, the result of which is striving to eliminate some of the costs of consolidation”¹⁰.

⁹ H. Dźwigół, *Business Management*, Alpha Science International Ltd., Oxford 2015, p. 1.3.

¹⁰ H. Johnson, *Fuzje i przejęcia. Narzędzie podejmowania decyzji strategicznych*, Liber, Warszawa 2000.

The above-mentioned reasons for amalgamation of enterprises are mainly of external character but there are also internal causes. These are primarily premises arising from the analysis of the company's situation.

Internal reasons are associated by H. Johnson with the company strategy. In case of portfolio strategy, it points to the possibility of diversifying activities that will ensure the stability of the company. „This means that two entities with monetary flows that are not related with each other can give the entity a more stable income”¹¹.

However, in case of a non-financial portfolio strategy, the merger will concern key players and their economies.

Various causes of mergers and acquisitions, depending on the horizontal, vertical and concentric strategies, or the creation of conglomerates, in particular in relation to the key (in the discussed case) horizontal and vertical strategy, have been presented in the further part. It is the horizontal strategy that is the subject of discussion in the paper, with reference to the problem of knowledge transfer between amalgamated metallurgical processing companies.

More specifically, the internal causes of the mergers are identified by A. Herdan and they are:

- Limited opportunities for independent development,
- Fear of hostile takeover,
- Improvement of competitive position¹².

Among technical and organizational reasons, the same author gives:

- Increased management efficiency,
- Gaining more effective leadership,
- Operational synergies (economies of scale, complementarity of resources and location, reduction of transaction costs, benefits of technical integration).

The market and marketing reasons overlap (to some extent) with the above-mentioned reasons, which are timeless. The other reasons are:

- Increase in added value,
- Elimination of competition,
- Complementarity of products,
- Risk diversification¹³.

Regarding financial reasons – they occur, i.a. when the acquiring enterprise is experiencing a lack of liquidity and has difficulty in obtaining credit:

- Use of surplus funds,

¹¹ Ibidem.

¹² A. Herdan (red.), *Fuzje, przejęcia..., Wybrane aspekty integracji*, Uniwersytet Jagielloński, Kraków 2008, p. 15.

¹³ Ibidem.

- Increase in debt capacity,
- Reorganization of the investment portfolio,
- Takeover of cash,
- Decrease of the cost of capital,
- Tax benefits,
- Underestimation of the acquired company value,
- Stock market value increase¹⁴.

Hooke classifies reasons for amalgamation of companies slightly differently¹⁵. He does not deal directly with showing the causes, but indicates the candidates to take over, who will be able to generate certain benefits for the companies. He recommends taking over companies that constitute competitors for the purchaser, which indicates buyer's insufficient market share.

Further he proposes to purchase companies with the same distribution channels, which is a base for the assumption that the purchaser is looking for cost savings. The pursuit to increase productivity induces the search for a candidate with more advanced production lines.

On the other hand, the search for liquidated companies, seized by court or taken over by their own management leads to the view that the reason for merger or acquisition is an „opportunity search,” which proves the excessive cash resources in the period of company maturity.

By P.J. Szczepankowski¹⁶ we find three types of reasons that he not very precisely calls motives of a merger or acquisition:

- market,
- related to profit and cost,
- regarding securing raw materials and energy.

So far, the above mentioned authors did not directly point to the last of these reasons. It is, however, very important in the iron and steel industry in Poland. Mergers and acquisitions were often made precisely for these reasons.

Acquisition of a raw steel steelworks secured the needs of steelworks without their own bases or with inadequate production of crude iron. Also, by taking over steelworks with an expanded rolling mill, pipe or wire-drawing machine, the acquiring enterprise, in this case e.g. Polish Steel Works or the ArcelorMittal holding, were able to obtain a more complete production cycle and additional profits from processing of raw materials and semi-finished products. Therefore reasons for mergers and acquisitions are different according to different authors. They place particular emphasis on the reasons resulting from internal and offensive business

¹⁴ Ibidem.

¹⁵ J.C. Hooke, *Fuzje i przejęcia*, Liber, Warszawa 1998, p. 8–9.

¹⁶ P.J. Szczepankowski, *Fuzje i przejęcia*, PWN, Warszawa 2000, p. 53.

strategies. In the conditions of Polish steel industry, however, internal factors dominate – seeking to acquire new capital and synergies in production, technology, logistics and distribution, as well as liquidity.

„New technologies have led to development of a knowledge-based economy, where enterprises are increasingly taking steps towards building an intelligent organization”¹⁷.

The above-mentioned reasons for mergers and acquisitions are mainly objective, and result from situation of the merged companies.

Motives for mergers or acquisitions, which are rather subjective, may be considered, although they are usually presented as proposals resulting from an objective analysis of the entity’s business. This does not mean that such motivation is not due to the needs of the enterprise, but may be modified by the interests of actuaries, i.e. groups having their own interests in the enterprise (managers, shareholders, intermediaries, employees).

Lewandowski mentions the following motives¹⁸:

- increase in management remuneration,
- increase in prestige and power,
- reduction of the management risk,
- increase in freedom of action.

Such list points to the decisive voice of the managers. Since they know the company very well, both the shareholders, represented by the Supervisory Board and the employees have to take their opinions into account. In many cases, the Supervisory Board shares views of the management on the proposed merger, as they are no strangers to the motives driving the managers. Under Polish conditions, the employees’ representatives also favour opinion of the management, as the first ones gain a great deal, for example when the acquisition or merger is at the same time associated with the privatization of the state-owned company. Employees then receive 15% of the company’s shares and numerous social and employment guarantees.

Motivation for mergers and acquisitions is more generally captured by S. Sudarsanam¹⁹. Although as a primary aim he lists to an increase in the value of assets, but conditionally recognizes it as indirect, stating that „the primary objective may be to increase of shareholder wealth”, stating however that the objective of maximizing shareholder wealth may be distorted by managers’ pursue to gain their own benefits. In conclusion, it must be stated that in view of the fact that bulk of the mergers in the metallurgical industry has a horizontal character, further research performed in

¹⁷ H. Dźwigoł, *Business...*, op. cit., p. 27.

¹⁸ M. Lewandowski, N. Kulpa, *Integracja przedsiębiorstw*, in: W. Frąckowiak (ed.), *Fuzje i przejęcia przedsiębiorstw*, PWE, Warszawa 1998, s. 23.

¹⁹ S. Sudarsanam, *Fuzje i przejęcia...*, op. cit., p. 5.

the paper concentrates on this type of merger of metallurgical organizations, taking into account primarily objective reasons. The above-mentioned considerations, concerning the types of business mergers and their relation to the motives that govern the decision makers have made it possible to determine the types of amalgamations that are bound to particular motivation that arise both from the objective situation and the interests of the decision-makers. However, in the literature we cannot find a wider study on the motivation of business amalgamations resulting from the desire to acquire new knowledge.

B. Mierzejewska²⁰ states that „knowledge is certainly not always the main motive for amalgamation of businesses.” The above-quoted views of various authors confirm this view.

2. Multifacetedness of mergers and acquisitions

Used in the literature of the subject matter, the expression **mergers and acquisitions** is a literal translation of the English term²¹, which defines the forms of transactions carried out in an active, albeit with different intensity, market that has functioned in these transactions for many years. Mergers and acquisitions as commonly used terms do not represent their legal form, though some authors erroneously seek such an interpretation. In the management sciences that devote a great deal of attention to these processes and examine them in many aspects, it should once again be clarified that the terms mergers and acquisitions do not define their legal form, even though they function in different sources of law and in different legal systems. Prior to moving on to presenting their various forms described and provided for by law it is worth to present a meaningful interpretation of mergers and acquisitions from the point of view of management science. You can present a view that describes the merger as an action aimed at combining business organizations in a situation of parallel, balanced and a unanimous initiative of the parties, while the acquisition as the initiative of the acquiring against the acquired.

The nature of these activities, especially in case of acquisitions, is of secondary character and leaves aside the fact whether the takeover is hostile or not, and what are its motives. Taking into account legal aspect of these transactions, for the sake of scientific considerations in management sciences, the above explanation

²⁰ B. Mierzejewska, *Transfer wiedzy w procesach fuzji i przejęć*, “E-mentor”, No. 1(18), Zarządzanie wiedzą 2007, p. 2.

²¹ M&A (*Mergers and Acquisitions*) – capital transactions between enterprises, which result in the merger of two or more economic entities or the acquisition of one company by other and as a result a new economic entity is formed. KPMG Polska, Glossary of terms, <http://www.kpmg.com/pl/pl/strony/glossary.aspx#16>, 2016.

will facilitate their isomorphic treatment in various legal regimes in which these transactions took place. Due to the research area that has been designated in the paper, the sources of law relevant to the discussed issues, set for member countries of the European Union, will be discussed in detail below.

2.1. Concentration of entrepreneur

Concentration of entrepreneurs is a natural economic phenomenon that does not interfere – in principle – with competition in the market. As a result, entrepreneurs have a chance to strengthen their market position, e.g. by increasing their market share or expanding their offer to new markets. Business consolidation can also have a number of positive effects on functioning of the entire economy and on all consumers i.a. thanks to increased availability and novelty of products and their diversification. Acquisition or merger may also lead to restructuring of unprofitable entities, or may constitute a reaction to competition from another company with high potential.

There are two basic groups of business activities²², which are of a concentration nature – merger (consolidation) and acquisition. The essence of business mergers is the creation of one entity out of two or more entities. Examples of consolidation may be mergers or incorporations. However, in the event of an acquisition control over the functioning of one economic entity is transferred to another. Transfer of control has two dimensions. Firstly, it concerns the control over activity of the enterprise and, secondly, the control over the enterprise itself. A factor that qualifies a transaction as a concentration is the change of control over the entrepreneur or entrepreneurs, regardless of the fact whether it is made through acquisition or merger.

The forms of concentration include:

- merger (consolidation) – it takes place when two or more independent entrepreneurs combine to form a new legal entity (as a result they lose their former legal personality and cease to formally exist) or as a result of the transfer of all the assets of the company (acquired) to another company (acquiring) for shares that the acquiring company issues to shareholders in the acquiring company (the acquired company ceases to exist);
- acquisition of control – the entrepreneur obtains the possibility to exercise a decisive influence on economic activity conducted by another independent entity. Most often, it takes place in the form of acquisition of a majority stake or share;
- creation of a joint venture by two or more independent entrepreneurs while preserving their existing subjectivity;

²² *Mergers and Acquisitions*, CFA Institut, New York 2015, p. 4.

- acquisition by an entrepreneur of part or entire property of another entrepreneur – if the turnover realized by that property in any of the two financial years preceding the registration exceeded the equivalent of EUR 10 million in Poland.

From the point of view of the market level in which the merging companies operate and the portfolio of their products and services, the following types of concentrations can be distinguished²³:

- **horizontal** – a transaction involving entrepreneurs working in the same industry up to now (e.g. cosmetics manufacturers for women). As a result, an entity with significant market power may emerge or few entrepreneurs shall remain on the market who shall stop competing and are satisfied with the existing *status quo*;
- **vertical** – transaction between entrepreneurs operating on different levels of marketing with the same product (e.g. between manufacturer and distributor of paints). In such a situation, the potential threat to competition may be hampering competitors' access to products or services offered by the entrepreneur participating in concentration, operating at a lower higher level of trading;
- **conglomerate** – a transaction in which there are neither horizontal nor vertical relations between its participants. The products or services they offer are usually complementary and are purchased by consumers for a similar purpose (e.g. washing powder and fabric softener). Possible consequence of such concentration may be appearance of the phenomenon of the so-called cross selling i.e. making purchase of one product subjected to the purchase of other products as well as the opportunity to offer several products at attractive prices.

Taking into account the company's strategic objectives, we can distinguish defensive and aggressive concentrations²⁴. Due to motives of the entity's activity, strategic and speculative concentrations can be distinguished, and from a territorial dimension of the transaction, concentrations are divided into national and international (transnational). For antitrust analysis, the first division is of the utmost importance because the various types of concentration are differently classified due to their effects on the structure of the market and consumers.

²³ F. Röder, *Strategic Benefits and Risks of Vertical Integration in International Media Conglomerates and Their Effect on Firm Performance*, University of St. Gallen, Graduate School of Business Administration, Economics, Law and Social Sciences (HSG), St. Gallen, October 15, 2007, p. 38.

²⁴ A. Kaleta, *Strategia konkurencji we współczesnym przemyśle*, in: *Współdziałanie strategiczne w gospodarce. Materiały konferencyjne*, Akademia Ekonomiczna, Wrocław 1998, p. 78–90.

Unlike vertical or conglomerate concentrations, the immediate effects of horizontal concentration, i.e. transactions involving competitors operating in the same market, are:

- decrease in the number of market participants after concentration,
- increase in the market share of the acquiring entity, in relation to the pre-concentration situation.

In addition, the acquiring company gains more market power, allowing it to use higher prices (sometimes even monopoly ones). Increased market concentration makes it possible to enter into explicit or implicit agreements that violate competition rules. But there are potential opportunities, and the horizontal concentration itself does not necessarily threaten competition, although it undoubtedly limits it. On the contrary, threats can be seen in the occurrence of unilateral and coordinated effects. Unilateral effects refer directly to the position of the entrepreneur itself as a result of the concentration. Thanks to this transaction, it receives individually very high market power, which it can use to limit competition. In particular, thanks to this market power, it can unilaterally raise prices, reduce production, deteriorate quality or reduce product choice and innovation. Coordinated effects concern change in the market structure. After concentration, the number of competitors decreases, thus they gain the ability to coordinate their activities to achieve additional profits.

The mechanism of competition is replaced by the coordination mechanism. Thanks to such cooperation opponents gain collective market power, which allows to take actions that reduce social welfare. This collective coordination may be the result of a conscious or non-cooperative oligopoly.

Concentrations can lead to formation of large industrial conglomerates. From a political point of view, the strength of such groups is likely to be significant, and thus may jeopardize the existence of civil society and contribute to barriers to the proper functioning of the democratic system. Importantly, the existence of such strong economic entities will likely adversely affect the possibility of other entities to function, making them unable to benefit from their economic freedoms. An example of such thinking is one of the judgements of the US Supreme Court, which considering concentration of two entrepreneurs as illegal, pointed out that one of the objectives of anti-trust activity is to protect small family businesses even if it were to take place at the expense of higher prices for consumers. Another version of this view is the opinion that in corporate mergers sees the mechanism of concentration of welfare and violation of social equilibrium.

From the above findings, it is clear that from the point of view of knowledge transfer both the notion of merger and acquisition can be taken into account. The latter, provided that it will lead to a real merger of enterprises, because only then can knowledge transfer can occur. Of course, also after take over without consolidation,

knowledge transfer may occur under certain circumstances, but these are relatively rare situations when it comes to obtaining valuable inventions, patents, etc. In this case, however, certain organizational actions are required to achieve them. Consequently, when in the text a transfer of knowledge within a merger or acquisition context shall be referred, it will always be a situation in which an organizational action is taken, aimed at real consolidation of enterprises.

2.2. Horizontal and vertical types of mergers and acquisitions

Depending on the adopted criterion, different forms and types of the processes of mergers and acquisitions are differentiated. Division of forms encompasses the structures of business mergers, whereas classification by type takes into account the type of merger in each of its forms²⁵. Basic forms include business concentration, integration of operations and coordination. Within the aforementioned forms, there are several types of mergers, the number of which varies according to the views of the authors. For the purposes of this paper, types of mergers are important, as they contain the problem of knowledge transfer in a more visible manner. P.J. Szczepankowski gives five types of mergers²⁶: horizontal, vertical, product, conglomerate and geographical, but for example H. Johnson²⁷ limits to four types: horizontal, vertical, concentric combination and conglomerate. In turn, M. Lewandowski and N. Kulpa²⁸ examine even more limited number of types – integration: horizontal, vertical and conglomerates. Knowledge transfer issues are most likely to occur in two types of business combinations: vertical and horizontal. As horizontal merger understood is a merger of two or more companies, operating in the same sector (industry) aimed at increasing market share and/or building a more profitable business using common *know-how*, patents and operational processes²⁹. The elements of knowledge mentioned in the definition clearly indicate the role of knowledge transfer in the horizontal consolidation of organizations. Of course, horizontal type mergers can also take place in different sectors for diversification purposes, but it is less interesting from the point of view of knowledge transfer. In contrast, horizontal fusions, so-called circulation, occurring when merging companies use the same distribution channels, are of particular relevance to knowledge transfer because they can be carried out not only in the scope of production but also in marketing. The horizontal merger type dominates the iron and steel industry.

²⁵ P.J. Szczepankowski, *Fuzje...*, op. cit., p. 12.

²⁶ Ibidem, p. 43.

²⁷ H. Johnson, *Fuzje i przejęcia...*, op. cit.

²⁸ M. Lewandowski, N. Kulpa, *Integracja...*, op. cit., s. 56.

²⁹ P.J. Szczepankowski, *Fuzje...*, op. cit., s. 21.

Metallurgical companies are often not at the same level of technical and organizational knowledge, therefore the knowledge components (*know-how*, patents, etc.) mentioned above should be transferred between the merging companies. This phenomenon is particularly evident when merger has international character and its participants are such large organizations as e.g. Mittal, which has taken over and merged Polish metallurgical enterprises with foreign organizations often standing at a higher technical and technological level.

Synergy plays a special role in the merger process. It can occur in various forms, strengthening market, operating (lower costs by increasing scale, scope of joint action), financial and management forces. Listed as the last „managerial role” gives complementary benefits³⁰. These are mainly management techniques and methods and *know-how*. A significant transfer of knowledge in management techniques and methods can be observed in the consolidated metallurgical companies in Poland. Vertical type of merger is a situation in which „entities involved are next to each other in the value chain. The aims here are the synergy benefits and extending to the entire technological process from the acquisition of raw materials to the retail sale of finished products [...]”³¹. P.J. Szczepankowski³² complements, or rather extends this definition by mergers of enterprises related through similar market segments (similar customers)³³. With these types of consolidations, knowledge transfer due to natural reasons will be performed on a smaller scale than in case of horizontal mergers, although knowledge creation can be expected at the interface between the stages of the added value creation process. It will be a knowledge creation phase referred to as a combination that defines knowledge creation in organizations by transforming conceptual knowledge into knowledge system by combining it. An example may be the case given by I. Nonaka and H. Takeuchi³⁴ that the concept of a new product, obtained in the combination phase, leads to construction of a prototype. This product, by simulation, is transformed through internalisation into mass production. Of course, in vertical integration of organizations combining knowledge that is also part of its transfer³⁵ looks somewhat different. Knowledge is connected at the interface between the two phases of the added value creation process, e.g. metallurgical raw material suppliers and processing companies (steel mills) or consumers, demanding proper profiles of metallurgical products. In this particular case of steel-making,

³⁰ Ibidem.

³¹ M. Lewandowski, N. Kulpa, *Integracja...*, op. cit., p. 43.

³² P.J. Szczepankowski, *Fuzje...*, op. cit., p. 34.

³³ Ibidem, p. 56.

³⁴ I. Nonaka, H. Takeuchi (eds.), *The Knowledge – Creating Company*, Oxford University Press, New York 1995.

³⁵ B. Mierzejewska, *Transfer wiedzy...*, op. cit., p. 23.

there is a situation where, for example, the knowledge externalized in a company supplying the metallurgical industry will be used by a combination with the explicit knowledge that the steelworks already has, which the supplier has been consolidated with through a merger. The transfer of knowledge also appears in other types of mergers, but it is either marginal character or does not occur at all. An example here may be (according to M. Lewandowski³⁶), for example, an enterprise acquired under a family business strategy when the acquired companies are associated with the purchasing company, which may lead to acquisition of patents. There is a link between the incentives for mergers and the types of mergers and acquisitions selected for this purpose. A. Herdan³⁷ in the paper on selected aspects of integration examined the mentioned relation, which was presented in Table 1.

Table 1. Relation between the reasons and the used form of consolidation

Motives	Forms of consolidation
Minimizing costs	Horizontal integration Foreign consolidations
Maximize sales	Vertical integration Foreign consolidations
Risk reduction	Conglomerate Foreign consolidations
Implementation of the assumed strategy	Horizontal integration Vertical integration Conglomerate Foreign consolidations
Control of cash flow	Horizontal integration Vertical integration Conglomerate Foreign consolidations

Source: A. Herdan (ed.), *Fuzje, przejęcia... Wybrane aspekty integracji*, Uniwersytet Jagielloński, Kraków 2008, p. 23.

In practice, these actions had to cause changes in the organizational structure of the integrated companies. These changes occurred in configuration of organizational units (groups) due to amalgamation of logistics and distribution services, as well as management of the integrated enterprises. On one hand, they were aimed at broadening the scope of activity and, on the other, slimming down the organizational structure, which, in the second stage of integration (formation of the Polish Steel Works Holding), had gained one level of management. However, efforts to streamline decision-making processes have introduced centralization tendencies, resulting in a certain limitation of autonomy at the lower levels of management. Undoubtedly, centralization of certain functions (logistics, distribution, R&D)

³⁶ M. Lewandowski, N. Kulpa, *Integracja...*, op. cit., p. 76.

³⁷ A. Herdan (ed.), *Fuzje, przejęcia...*, op. cit., p. 52.

resulted in reduction in fixed costs, thus fulfilling the purpose of the undertaken merger. However, strengthening of R&D has resulted in creation of new knowledge, through its transfer between the merged organizations. Vertical integration in the metallurgical industry has also resulted in other changes, such as cash flow, but in this case did not significantly disrupt the integration of organizational structures.

All reasons for mergers and acquisitions discussed in the literature³⁸ had objective character, and stemmed from the company's situation and the thus defined strategy.

3. Knowledge as a separate motive for acquisition

The management related information that can be found in the literature show that the fact of acquiring knowledge is neither a major cause nor an official reason of merger (at least not included in specification and discussion of reasons for mergers and acquisitions).

On the other hand, literature directly related to knowledge management clearly indicates that knowledge is the primary cause of merging organisations and at least one of the important reasons.

In order to prove this claim data from the article by A. Polak³⁹ were used, concerning map of knowledge. The list of areas and elements of company organization knowledge contained there can be used as a basis for combining specific motives for consolidation of organization with specific elements of knowledge that are included in resources of the enterprise. The result may be the setting the actual motive of consolidation, which is hidden behind the official motif. If there are several such motives (which is not uncommon), it is possible to establish the share of knowledge in the individual motives. The basis of these activities is the table contained in the above-mentioned article (Table 2).

Table 2 requires adaptation to the purpose and content of the analysis. In case of knowledge, there is no need to expand or reduce their number, except for the removal of point 10 (documenting work), which falls entirely within the concept of formalization, which is part of the basic features of the organizational structure (field No. 1). However, certain nomenclature changes need to be made in order to correctly and appropriately assign the knowledge associated with it to the relevant type of activity. Therefore, to the name „Preparation of production” the phrase „and products” has been added. In point 6 the name „Projects” a phrase „in the field of procurement” has been added, because there may be various projects in various fields. For the purposes of the study, however, the elements of knowledge were subjected to

³⁸ M. Lewandowski, N. Kulpa, *Integracja...*, op. cit., p. 31.

³⁹ A. Polak, *Nauczanie organizacji przedsiębiorstw za pomocą mapy wiedzy*, „Przegląd Organizacji” 2012, No. 3, p. 10.

change. There have been some deletions, annotations, and changes to the names of the knowledge elements. For example, it is difficult to regard „Mission and goals of a company” as a separate element. They fit perfectly in the term of „Organizational Structure”, as part of the formalization. If this path was followed, one could create any number of components such as company statutes, organizational chart, service book, documentation flow. This, in turn, would not lead to achievement of the objective, for example due to competition of elements in attribution to a particular motive, and consequently would lead to lack of clarity of the situation picture.

Table 2. List of areas and elements of enterprise organization knowledge

Fields of knowledge	Elements of knowledge
1. System and environment	1. Mission and goals of the company 2. Organizational structure 3. Environment (offices) 4. Suppliers and contractors 5. Competitors
2. Threats	1. Quality threats 2. Workplace safety threats 3. Environmental hazards
3. Resources	1. Human resources 2. Material resources 3. Intangible resources
4. Technical preparation	1. Products 2. Technical specifications
5. Processes	1. Management processes 2. Manufacturing processes 3. Supporting processes
6. Projects	1. Customer orders 2. Order pick up (orders)
7. Logistics	1. Loads flow 2. Inventories 3. Storage 4. Transport
8. Planning	1. Production plans 2. Management plans 3. Auxiliary plans
9. Finances	1. Estimates of the product 2. Financial settlements
10. Documenting work	1. Supervision over documents 2. Document templates
11. Utility indications	1. Literature and textbooks 2. Standards and regulations 3. Requirements (market and customer)
12. Expressive content	1. Calculations, analysis and synthesis 2. Ideas, patents, innovations 3. Changes in organization

Source: A. Polak, *Nauczanie organizacji przedsiębiorstw za pomocą mapy wiedzy*, „Przegląd Organizacji” 2012, No. 3, p. 10.

The field 4 should contain the following elements: product cost estimate, transferred from item 7 (finance), which is an integral part of production preparation, production documentation and product technology. In the process-related field, the process of investment implementation was added, which is not placed elsewhere, and is important for knowledge transfer. In point 7, a completely redundant element of knowledge (flows) was deleted, as there is a separate point – transport, than the flows mirror it. At the same time, they cannot mean the flow of a product in the production process, as it is discussed in the field of „Processes”. In the field of „Planning” instead of the „Management Planning” element, which is unclear, introduced was „Cost and output planning” (balance sheet result), which is in the field of „Planning”. In this field, instead of „Product Cost Estimates”, „Cash Flow” was introduced, which is typical for this activity, important for the role of knowledge. Other elements do not require any corrections. After these amendments, Table 2 is as follows (Table 3).

It seems that to such list of areas of organizational knowledge and basic elements of knowledge constituting part of the corresponding, specific knowledge can already be assigned. It must be underlined that, despite considerable approximation, neither the field nor the above-mentioned elements are sufficiently operational to be used in the course of further analysis, aimed at assigning knowledge to a specific motive for merging companies. In the presented list, attempts were made to assign specific knowledge elements to its manifestations, generally occurring in the metallurgical industry.

As the first element of knowledge in Table 3, there is an organizational structure. According to the author, it is a medium of both practical knowledge (tacit) and, above all, explicit knowledge expressed in formalization of the company’s activity. Organizational structure as a multidimensional object is defined by many traits, the number of which varies from a few to even a few hundred. In practice, and in particular in the case examined here, it is impossible to use a large number of features. Therefore, when considering the organizational structure as an element (rather it should be referred to as the carrier) of knowledge, the author decided to limit themselves to the features formulated by K. Mreła⁴⁰ in his paper on the multidimensional analysis of organizational structure. The same range of features is also reported in other studies, such as S. Pugh and his colleagues⁴¹. These are: configuration, centralization (or decenalization), specialization, formalization and standardization. These features focus a wealth of organizational knowledge that plays a significant role in the process of the consolidated companies’ integration.

⁴⁰ K. Mreła, *Struktury organizacyjne. Analiza wielowymiarowa*, PWE, Warszawa 1988, p. 78.

⁴¹ S. Pugh, D.J. Hickson, G.R. Hinnings, C. Turner, *The context of Organizations Structure*, “Administrative Science Quarterly” 1969, No. 14.

Table 3. List of areas and elements of enterprise organization knowledge

Fields of knowledge	Elements of knowledge
1. System and environment	1. Organizational structure 2. Environment (offices) 3. Suppliers and contractors 4. Competitors
2. Threats	1. Quality threats 2. Workplace safety threats 3. Environmental hazards
3. Resources	1. Human resources 2. Material resources 3. Intangible resources
4. Technical preparation	1. Estimates of the product 2. Manufacturing product documentation 3. Production technology of
5. Processes	1. Management processes 2. Manufacturing processes 3. Supporting processes 4. Investment implementation processes
6. Procurement projects	1. Customer orders 2. Orders pick up
7. Logistics	1. Inventories 2. Storage 3. Transport
8. Planning	1. Production plans 2. Cost and output plans 3. Auxiliary plans
9. Finances	1. Cash flow 2. Financial settlements
10. Utility indications	1. Literature and textbooks 2. Standards and regulations 3. Requirements (market and customer)
11. Expressive content	1. Calculations, analysis and synthesis 2. Ideas, patents, innovations 3. Changes in organization.

Source: A. Polak, *Nauczanie organizacji przedsiębiorstw za pomocą mapy wiedzy*, „Przegląd Organizacji” 2012, No. 3, p. 10.

As far as configuration is concerned, this knowledge is quite limited. It is reduced to differences in arrangement of organizational units and their interrelations, which are important in case of merger between companies of different production scales and in a vertical mergers, for example in the consolidation of raw material and processing units. However, in the metallurgical industry, horizontal consolidation are predominant, therefore the knowledge on configuration is slightly differentiated. However, knowledge of these differences can help in integration of the organizational structure.

In turn, on the degree of centralization depends, i.a. knowledge creation in the enterprise – broad autonomy fosters creation of technical and organizational ideas, allowing certain risks in the undertaken projects. In particular, this concerns the knowledge of technology and production organization, implementation of which depends to some extent on the freedom of operation of different levels of units. Decentralization is also conducive to emergence of virtual teams, established to solve emerging problems. Essentially in these matters, knowledge is needed in the area of the organizational structure that is included in the scope of centralization. Therefore, the merger of a company that is heavily centralized with an enterprise characterised by a loose organizational structure can lead to the use of experience (knowledge), which has so far been foreign to a centralized enterprise.

Another aspect of knowledge is included in the company's specialization. It is very often precisely the desire to take over a special technology or specialists who are rare on the job market is one of the most important reasons for the merger. The most important – from the point of view of knowledge transfer – characteristic of the organizational structure is formalization. This is usually explicit knowledge. Companies merging often differ in details. Knowledge stored in organizational documents, analyses, payroll documentation, and used systems are extremely important to the acquiring entity due to the possibility of avoiding errors. It should be noted that the employees of the acquired enterprise have knowledge encoded in their minds and they are applying it. Sudden destruction of this consciousness and imposition of new knowledge without taking into account the individual experience of employees may interfere with the course of integration (primarily in the sphere of production). It is worth remembering that some of this knowledge can also be of value to the acquiring entity. Hence the transfer of knowledge by consolidations is, „and actually should be” bilateral. This issue will be discussed in greater detail in the next chapter.

Organizational structures are also characterized by the degree of standardization⁴². Standardization is very specific and very useful knowledge, both due to costs and productivity, and overall operational efficiency. The level and type of products and other aspects of running business vary. Therefore, the transfer of standards may be one of the hidden goals of the acquisition. It is worth stressing that the flow of knowledge contained in standards can also work the other way, in different proportions. Therefore it also creates added value in the acquired company. This is a clear example that the

⁴² W. Zheng, B. Yang, G.N. McLean, *Linking organizational culture, structure, strategy, and organizational effectiveness: Mediating role of knowledge management*, „Journal of Business Research” 2010, Vol. 63, Iss. 7, p. 763–771, EBSCOhost: Academic Search Complete, <http://web.ebscohost.com>.

goals placed under the notion of minimizing costs and maximizing sales are in fact the pursuit to acquire knowledge (in this case standards).

In the discussed area of knowledge, the elements that are hidden under the term „suppliers and partners” play a significant role. It is interesting that knowledge is understood here not only as knowledge of the most advantageous sources of supply and sales markets, but, above all, relations established by people employed in organizational cells that deal with it. The personal relations of these people with their counterparts in supply and sales are valuable knowledge, useful in relations with the environment. Its acquisition together with the company is very difficult, however, as it is a typical tacit experience, which is carried by individual employees. Therefore in the integration process the consolidation should be protected against their outflow. Knowledge of the competition, expressed by of information gained and analyses conducted is also valuable, but the sources of information are also employees specialized in the field, who have access to it on the private relation basis. This latter knowledge is nowhere written and is a typical *tacit* knowledge. In the field of „threat”, quality threat is of major importance. It can be understood in two ways – as a threat of overtaking in terms of quality by the competition or as a threat to a decline in the quality of their own products. In the first case we are dealing with a similar situation as with the knowledge of competitors. The quality service has or ought to have knowledge of the quality level by the competition or research and innovation processes carried out there, obtained attestations and awards, etc. This knowledge, rather secret, enables the company’s management to signal hazards. Acquiring this knowledge is often a matter for individual employees, and its rapid acquisition will allow management to take appropriate pre-emptive actions. In the second case, the knowledge of quality is *explicit* one, which does not diminish its value. Knowledge of this knowledge element is essential for loss prevention, resulting from deficiencies and complaints, and for „showing” the company on the market.

The knowledge of work safety is of different character. As a rule, it is transparent, written in regulations, post-accident reports, analyses; although there is also a margin of tacit knowledge – in individual experience of employees and executives. The acquisition of knowledge in the scope of workplace hazards, however, is of particular importance when it comes to different knowledge in both consolidated companies, as the potential increased number of work-related accidents can have an impact on the integration process.

Environmental risks have other character. These are usually problems with emissions of gasses, land and water contamination. There are a number of publications, regulations, and institutions preventing these phenomena. They may be different in the enterprises that consolidate. Failure to transfer this knowledge may lead to e.g.

new managers being less alert in the area of environmental pollution, which not only means additional costs, but also possible conflicts with local authorities and impediments to business continuity.

Knowledge of the resources at the company disposal is very important. Among them priority have human resources, „and knowledge is the attribute of individuals [...]”⁴³.

Hence the conclusion that the knowledge core resources is the key skills and competences of the employees. For the purposes set in this part of the paper important is identification of knowledge resources for assigning them to specific elements and fields of knowledge. First of all, it must be stated that they are recorded in all discussed fields and elements of knowledge. For example, the elements of knowledge related to the organizational structure were previously specified. The same applies to the knowledge elements in question, concerning hazards, etc. This bear a question, what remains to be assigned to human and other resources? Probably only quantitative knowledge estimation, which is a very difficult matter (and unworkable in a very precise manner). The resource of knowledge can, however, be approximated by: the number of employees showing high competences and skills, their structure according to the degree of their knowledge value and the possibility of expanding human resources through establishment and development of the human resources reserve. However, precise details of these sizes require separate studies.

The knowledge contained in the material resources is mainly documented and includes such documents as: designs, technical descriptions, operating instructions, equipment usage records, performed overhauls, etc. However, its reception requires employment of qualified personnel, if it is impossible to use the existing service, e.g. when specialists who are dissatisfied with the merger depart, which sometimes happens when the integration process is not well prepared. Intangible assets are works, solutions and markings. For example, the group of works covers computer forecasts, solutions are e.g. inventions, industrial designs, innovations; signs are, e.g. trademarks, etc. In addition to the above-mentioned there are intangible assets that are free from legal restrictions and are therefore often published in the media or intangible goods protection of which has expired⁴⁴. In the process of integration knowledge is available, but in implementation of merger there is a problem of staff, as described above.

In the field of production preparation, explicit and tacit knowledge is included in the cost estimates of products. Cost estimators have not only a broad knowledge

⁴³ B. Kogut, U. Zander, *Knowledge of the firm and the evolutionary theory of the multinational corporation*, “Journal of international business studies” 1992, No. 34(6), p. 516–529.

⁴⁴ J. Lichtarski (red.), *Podstawy nauki o przedsiębiorstwie*, Akademia Ekonomiczna we Wrocławiu, Wrocław 2001, p. 45.

in the field of regulations in force, technology and standardisation but also their own interpretative skills and knowledge of how to maximize their use to improve product profitability. They are also a source of knowledge about the possibilities of cost reduction. Loss of professionals with such skills is often very painful for the new leadership of the consolidated companies. Other elements of knowledge in the field of production preparation, i.e. product manufacturing documentation and production technology, are also important in the transfer process, although their role is limited. However, it is worth adding that while mastering the details of the product execution and technology cost estimates are, or rather can be, one of the most effective sources of innovation and rationalization of production. Knowledge in the „Management processes” element is mainly the skills recorded in management science, but also the individual skills of the management, trained by practice. The same applies to manufacturing and support processes, with the difference that they relate to middle and lower levels of staff. This is somewhat different with regard to the investment process, where, besides broad knowledge in various fields, the ability to work with the environment is required – not on the basis of subordination, but above all cooperation.

A customer’s order involves marketing, which, for its effectiveness, requires a broad knowledge of the customers, their attitudes and the ability of the business to meet their needs. In this scope there is documentary knowledge, deep acquaintance with which is a prerequisite for effectiveness, and knowledge hidden in individual marketing skills, including, above all, relations with sales force and customers. The term „Order pick-up” should be understood as meaning formation of a portfolio of orders. This is explicit knowledge but requiring market knowledge and the manufacturing capacity of the company.

Logistics, besides material measures for implementation, such as means of transport, warehouses, handling equipment, requires substantial knowledge resource. This applies in particular to the thorough knowledge of the materials purchasing market in terms of prices, stability and reliability of suppliers, both dynamically and in terms of the optimal use of material resources. In particular, the ability to optimize stock levels to secure uninterrupted production processes and avoid stock redundancy, which in turn leads to reduced cash flow and increased costs. These are key competences, especially when the business is experiencing problems in the financial management. The departure of professionals who have this knowledge in the context of week post-consolidation integration leads to the loss of invaluable (at this stage) knowledge.

Other types of key skills are required from specialists in the planning field. Unlike the methods applied in the previous economic system, consisting mainly in planning on the basis of the past (implementation of the plan in the past period) and

the needs arising from the state's economic problems, currently the use of the so-called *foresight* methods is required. In Polish there is no equivalent of this concept. It mainly involves the use of statistical and econometric tools, analogy and heuristic methods, mainly based on expert opinions⁴⁵.

The knowledge that planners should have must be very spacious in these conditions. There is also experience, which is very difficult to find in Polish conditions. Knowledge encoded in planners' minds about production and costs is of particular importance because of the need to adjust the production schedule in the horizontally consolidated enterprises to the new requirements, but meeting the not risen cost level at the same time. Experienced planners, relying on the knowledge based on many years of experience, should cope with the task. As it can be seen, the concern to prevent the outflow of highly qualified staff in the integration process is often a *sine qua non* condition for the transfer of knowledge required to prevent the failure of merger or acquisition.

Another area where knowledge transfer is important is corporate finance. The most important element of financial knowledge, the transfer of which determines the normal day-to-day operation of the company, is the ability to regulate cash flows. In this case, as a rule, enterprise knowledge or instructions are not enough, although necessary, do not replace the many years of experience in which intuition and psychology play an important role. This is particularly evident in cash settlements and relations with creditors and debtors. An experienced financial specialist knows when to press a debtor or give way and how to deal with creditors. This knowledge cannot easily be transferred, as often an employee is not always aware of it, knowing primarily the specificity of their own company and its surroundings. Since each of the merged entities is in a specific situation, therefore it is extremely difficult to reconcile financial policies conducted so far. This knowledge is more difficult to convey, as it concerns very sensitive matter, which is cash payments.

Under the notion of **usable recommendations**, introduced by A. Polak⁴⁶, all data and information taken from outside the organization is meant. As far as „literature and textbooks are concerned, the transfer of knowledge elements is relatively simple but not very effective. On the other hand, norms and provisions of law are of great importance”, which may be important in consolidated companies and require interpretation. Their mastery is a condition for their effective use. The most important requirements in this area – market and customer – are not sufficiently clear. According to the author, this is information coming primarily from customers, regarding wishes concerning quality, features and price of the product. This is a valuable knowledge

⁴⁵ N. Brown, B. Rappert, A. Webster, *Foresight jako narzędzie zarządzania wiedzą i innowacją*, Polska Agencja Rozwoju Przedsiębiorczości, Warszawa 2010, p. 63.

⁴⁶ A. Polak, *Nauczanie...*, op. cit., p 10.

and its possible precise transfer is the condition for the company's development. It is encoded not only in documentation, but mainly in the minds of employees, and is a typical tacit knowledge. The most important source of knowledge, which in essence constitutes one of the most important motives for merger, is the content, referred to by A. Polak, as expressive. Calculations, analyses, and syntheses are invaluable sources of knowledge, if they are, of course, accurate, thorough, reliable and honestly prepared. Knowledge of these studies, appropriate for analytical and units partially for the company management (sometimes also the supervisory board), saves the effort involved in taking up different tasks that create costs and waste time. Particularly important are the results of calculations concerning the chances and threats and development prospects of the company. The second group of expression elements are ideas, patents and innovations. The names of elements translate directly into concretes. Transfer of this knowledge is perhaps the most important, as it is often the main, though usually concealed, motive of merger. The last item considered in the group of expressive content is organizational change. They can be understood in two ways – either as knowledge of the changes made, which rather has the nature of historical past, or as a source of knowledge about failures of the acquired company, and this will also reveal organizational gaps in other parts of the company and even make changes to the acquiring entity.

The specific content of the knowledge elements described in that manner, assigned to its specific areas allow for their indirect connection with the consolidation motives described in the two preceding points of Chapter I. It may be difficult to determine which reasons should be chosen for the planned comparison. Contrary to appearances, it is not easy, as there is no agreement in this regard. In this situation, it was decided to primarily select motives of an objective nature, as they refer to knowledge transferred under the merger. On the other hand, subjective motives – an increase in managerial salaries, prestige, authority, etc. – are certainly not linked to knowledge-based motives or knowledge-based motives. Ultimately, the author decided on a synthesis that took into account views of most researchers and focused on a certain degree of aggregation of motives. As a result the following motives were selected for further consideration:

- market,
- decreasing costs,
- maximizing sales,
- synergy with the use of common manufacturing potential,
- financial,
- technology and infrastructure.

The presented selection made was based on the criterion of knowledge, which means that the in list included were motives, which are related to the transfer of

knowledge between the consolidated companies. Excluding for the moment the issue of defining knowledge and problems related thereto, which will be discussed in chapter II of the dissertation, at this point we must, however, characterize the knowledge that is the subject of assigning to particular motives. As it was assumed at the beginning (and generally in literature of the subject), knowledge is the reason for consolidation, only hidden behind officially given other motives. In this case, it will not be knowledge that is unrelated to the consolidated companies, e.g. university, textbook, journalism, or knowledge resulting from state legislation e.g. constitution, statutes, regulations, etc. However, it will be included in all corporate documents that should be provided, and are in force in existing normative acts in the area of merging economic entities. Here you can include all elements related to the applied technology of products and internal processes. The most important of these will be knowledge, covering especially: employee competences and technical achievements in the form of e.g. patents, utility models and innovations. One difficulty is that the specific manifestations of knowledge can be hidden behind two or more motives at once. For example, employees with specific competencies may be the reason for acquisition due to the need to secure workforce and the synergy that exists, but also due to lowering costs, e.g. by increasing productivity. This also applies to other cases. The detailed elaboration of the knowledge elements formulated by A. Polak⁴⁷ is presented in Table 2 and assigned to individual acquisition motives in Table 3. Whereas Table 2 is a bridging material for formulating practical organizational knowledge. Analysis of Table 3 provides important conclusions for assessment which elements and specific manifestations of knowledge lay under officially formulated acquisition motives. The choice of components may vary, but the rules for assigning particular specific components to the elements of knowledge⁴⁸ are preserved. In addition to the collective paper under ed. A. Stabryła⁴⁹ elements were used, related to the subject matter. This source, however, was limited by the research subject, because it considered elements of knowledge and their components, but in the scope of examining organizational structures, which only slightly corresponds to the presented paper.

As a result of the conducted analysis, 57 components of knowledge were obtained, which however are part of different motives for mergers of enterprises. The knowledge components are presented in Table 4.

⁴⁷ A. Polak, *Nauczanie...*, op. cit., p. 24.

⁴⁸ Ibidem, p. 2.

⁴⁹ A. Stabryła (ed.), *Doskonalenie struktur organizacyjnych przedsiębiorstw w gospodarce opartej na wiedzy*, C.H. Beck, Warsaw 2009, p. 87.

Table 4. Knowledge components

1.	Explicit knowledge of competitors and markets
2.	Suppliers' market knowledge
3.	Personal relations with suppliers and buyers
4.	Information and analysis of competition quality
5.	Knowledge of R & D by the competition (inventions, innovations, quality, patents)
6.	Marketing knowledge of customers
7.	Complaints analysis
8.	Portfolio of orders and ability of its shaping
9.	Knowledge in the scope of <i>foresight</i>
10.	Knowledge of statistical and econometric tools
11.	Standards and regulations
12.	Analyses, calculations and synthesis
13.	Forecasts of research cells
14.	R & D works of research and development units in enterprise
15.	Quality documentation
16.	Personal knowledge of specialized staff
17.	Ability to optimally shape stocks
18.	Product, technology and organizational standards
19.	Operating records of machinery and equipment
20.	Record of inspections, periodic and capital repairs
21.	Knowledge of costing
22.	Knowledge of production technology
23.	Materials for analysis, calculation and cost synthesis
24.	Ideas, patents, innovations
25.	Product documentation
26.	Employees with valuable skills and competencies
27.	Technical descriptions and manuals
28.	Computer programs, utility models, trademarks
29.	Planning experience
30.	Practical experience of employees in the sphere of sales
31.	Skills and competences in collaboration with the environment
32.	Relations with customers and sales representatives
33.	Customer information on the quality, features and prices of the products
34.	Current R & D works within the company
35.	Knowledge of production capabilities and delivery dates
36.	Knowledge of optimum stock shaping
37.	Knowledge of laws and regulations and internal instructions
38.	Relations with debtors and creditors
39.	Tacit knowledge of financial workers
40.	The ability to regulate financial flows
41.	Configuration of organizational units
42.	Principles and organization of autonomous units
43.	Knowledge of quality regulations
44.	Specialization of divisions and organizational units
45.	Health and safety regulations, inspection and accident reports
46.	Fire Regulations
47.	Sanitary and epidemiological reports.
48.	Personal experience in occupational safety and health, fire, sanitary and epidemiological fields.

49.	External and internal regulations on the protection of the air, land and water
50.	Standards for emissions of gases, land contamination and water pollution
51.	Instructions for behaving in the event of hazards
52.	Production technology of
53.	Projects, technical descriptions, manuals
54.	Intangible goods protection period of which has expired
55.	Practical experience of supervisory staff
56.	Tacit knowledge of executive workers
57.	Information and analysis of product characteristics

Source: own study.

The same skills or documents can be associated with different motives, so the number of components is greater and amounts to 93 items. Considering the sum of individual components shown in Table 4, it can be stated that about 10 components fall on average per one motive. In fact, these components are not evenly distributed between motives and even the phenomenon of cumulating on individual motives occurs. To illustrate the situation, however, it was necessary to use the sum of components with repetitions list of which, together with attribution to the motives, is given in Table 5.

Table 5. Zestawienie i sumy składników wiedzy z powtórzeniami

COMPONENTS	Motives						
	Market	Lowering costs	Maximising sales	Synergy with the use of common manufacturing potential	Financial	Technology and infrastructure	Number of motives
1	x	x	x				3
2	x						1
3	x		x				2
4	x						1
5	x						1
6	x		x	x			3
7	x		x				2
8	x						1
9	x		x	x			3
10	x		x	x	x		4
11	x		x		x		3
12	x		x	x	x		4
13	x						1
14	x						1
15		x	x	x		x	4
16		x		x			2
17		x				x	2
18		x		x	x		3
19		x				x	2

COMPONENTS	Motives						
	Market	Lowering costs	Maximising sales	Synergy with the use of common manufacturing potential	Financial	Technology and infrastructure	Number of motives
20		x					1
21		x					1
22		x					1
23		x					1
24		x				x	2
25		x	x			x	3
26			x	x			2
27			x	x			2
28			x	x	x		3
29			x	x			2
30			x				1
31			x	x			2
32			x	x			2
33			x				1
34			x				1
35			x	x			2
36				x		x	2
37						x	1
38						x	1
39						x	1
40						x	1
41						x	1
42						x	1
43						x	1
44					x		1
45						x	1
46						x	1
47						x	1
48						x	1
49						x	1
50						x	1
51						x	1
52						x	1
53						x	1
54					x		1
55						x	1
56						x	1
57						x	1
Number of components	14	12	20	15	7	25	

Source: own study.

The preliminary analysis of Table 5 leads to the conclusion that the components are large and unevenly distributed. You can clearly see the components that create the consolidation motives. The next table (Table 6) shows the general picture of the knowledge components, showing the absolute numbers and the share of components in knowledge creation, which is the reason for consolidation actions.

Table 6. Comprehensive summary of the share of knowledge components in the motives for mergers

Consolidation motives and knowledge components	Knowledge components	Share %
Market	14	15,1
Lowering costs	12	12,9
Maximize sales	20	21,5
Synergy and the use of common manufacturing potential	15	16,1
Finances	7	7,5
Technology and infrastructure	25	26,9
Total	93	100,0

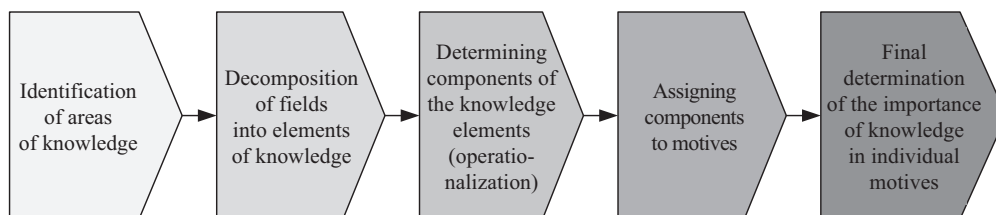
Source: own study.

For the total number of 93 knowledge components allocated, 45 refer to two motives: technology and infrastructure (25) and maximizing sales (20). Other components are scattered and do not play such role in the examined motivation.

A more reliable assessment is given by structure (share) ratios presented in the table. The share of knowledge in the scope of technology and infrastructure and maximizing sales covers 48.4% of the total motivation, whereas the knowledge of production technology and infrastructure dominates, amounting to 26.9% of the total. This also demonstrates the importance of these two motives, in which knowledge motive is tacit. This confirms the hypothesis put forth by B. Mierzejewska⁵⁰ that even if it is not said explicitly, both for market and financial motives, ultimately, there is a desire for companies to strengthen their intellectual capital. It will be knowledge about customers and their needs, relations with clients and stakeholders, competence in organizational governance, technological *know-how*, patents, etc. This is the manner in which components of knowledge were described in detail in the above-mentioned materials. As for the motives mentioned in Table 6, the author has decided to separate the maximizing of sales from the market motive, since not all of the increase leads to market advantage – sometimes other reasons are also important.

Figure 2 shows the overall process of reaching the obtained results.

⁵⁰ B. Mierzejewska, *Transfer wiedzy...*, op. cit., p. 2.

Figure 2. The path to determination of relations between motives and their components

Source: own study.

In conclusion, the following assumptions can theoretically be derived:

- the motives behind the acquisition of knowledge are hidden behind official motives;
- knowledge is mainly contained in content of motives: technology and infrastructure and maximizing sales;
- the share of technology and infrastructure and sales maximization is close to 50%;
- other motives have less impact on knowledge transfer.

Chapter II.

KNOWLEDGE TRANSFER ISSUES

1. Knowledge in an organization and forms of its manifestation

The issues of knowledge transfer requires prior definition what is knowledge and what kinds of it are there, what is its place in organization of the enterprise. Hence, it is above all necessary to define the notion of knowledge. It is important to distinguish general definitions, referring to knowledge at any time and place, without distinction of its extent and depth, and specific definitions relating to a specific area, type, need or purpose⁵¹.

The most general are encyclopaedic definitions of knowledge. New Comprehensive Encyclopaedia⁵² defines knowledge as a broad set of information, views, beliefs, etc., which cognitive and/or practical values are attributed to.

The same publication under the same term gives definition of knowledge in a narrower sense: „knowledge is the totality of reliable information about reality with ability to use them in modern society. Knowledge in this sense is above all, but not limited to, scientific knowledge”⁵³.

Even more specifically knowledge is defined by J. Apanowicz⁵⁴ who writes that human knowledge is observation, information and phenomena that constitute facts about the existing (surrounding us) reality. There is a clear difference between the two definitions of knowledge (encyclopaedic and the one given by J. Apanowicz). Knowledge in the latter phrasing is not only a collection of information, views and beliefs which are cognitively and practically valuable, but reliable information about reality together with the ability to use them currently.

Even more restrictive definition concerns marking its boundaries in specific disciplines of knowledge. Such are the definitions of organizational knowledge. Some of the terms of knowledge can for example be quoted from collective paper edited by A. Stabryła⁵⁵:

⁵¹ P.F. Boono, *Managing Intracorporate Knowledge Shaning*, Eburon, Delft 1977, p. 54.

⁵² *Nowa Encyklopedia Powszechna*, volume VI, PWN, Warszawa 1997, p. 23.

⁵³ *Ibidem*, p. 58.

⁵⁴ J. Apanowicz, *Metodologiczne uwarunkowania pracy naukowej*, Difin, Warszawa 2005, p. 1.

⁵⁵ A. Stabryła (ed.), *Doskonalenie struktur...*, op. cit., p. 255–260.

- knowledge as a resource of an organization (resource of a person) of varying degree of reification;
- knowledge as a category related to information („information along the manner of its use”)⁵⁶.

In turn, J. Kang⁵⁷ and his colleagues further clarify the definition of knowledge – „Knowledge is a critical resource for organizations competing for competitive advantage.” This definition omits, however, situations in which knowledge is an asset of a company not seeking market advantage but, for example, only maintaining its position or struggling to remain in the market at all. „Organizational knowledge creates a useful methodological and practical basis, and therefore a thesis must be assumed that the successful organizations are only those which consistently and consciously acquire new knowledge, disseminate it throughout the organization and rapidly transform themselves into intelligent organizations.”⁵⁸

Treating organisational knowledge in the enterprise as a resource seems sufficient to use this term in further research. The same problem – of certain indeterminacy – occurs when it comes to defining knowledge transfer in the next subsection of Chapter II. The definition of knowledge alone, however, is not sufficient, as in particular analyses we deal not with knowledge at all but with its specific forms and manifestations. One of the basic divisions of knowledge, first introduced by M. Polanyi⁵⁹ and G. Probst⁶⁰, and later developed by J. Nonaka and H. Takeuchi⁶¹, is the distinction between *tacit knowledge* and *explicit knowledge*, together different manners of their conversion.

As tacit knowledge understood is „experience, skills and relations often expressed through the notion of *know-how*”⁶². On the other hand, explicit knowledge is defined as knowledge articulated, often to a large degree codified, in a part of the literature of the subject matter referred as the information or *know-what*. In later chapters, the division of knowledge into explicit and tacit will have important implications due to the significant differences in the difficulty of transfer of both types of knowledge.

⁵⁶ J. Baliczyński, Cz. Mesjasz, A. Stabryła, *Interpretacja pojęcia wiedzy i gospodarki opartej na wiedzy*, w: A. Stabryła (ed.), *Doskonalenie struktur...*, op. cit., p. 165.

⁵⁷ J. Kang, M. Rhee, K.H. Kang, *Revisiting Knowledge transfer: Effects of Knowledge characteristics organizational effort for knowledge transfer*, „Expert Systems With Application” 2010, No. 37, p. 81.

⁵⁸ H. Dźwigoł, *Podejście systemowe w procesie restrukturyzacji przedsiębiorstwa*, Politechnika Śląska, Gliwice 2010, p. 64.

⁵⁹ M. Polanyi, *The Tacit Dimension*, Garden City, Anchor Books, New York 1967, p. 87.

⁶⁰ G. Probst, S. Raub, K. Romhardt, *Zarządzanie wiedzą w organizacji*, Oficyna Ekonomiczna, Kraków 1993, p. 76.

⁶¹ I. Nonaka, H. Takeuchi (eds.), *The Knowledge...*, op. cit., p. 59–61.

⁶² B. Mierzejewska, *Transfer wiedzy...*, op. cit., p. 32.

Hence, it is important to examine the state of the knowledge in this regard, in companies that are involved in the knowledge transfer process.

In this situation, it was possible to take advantage of the knowledge sets established in the preceding chapter, brought to the most elementary form of its manifestation, carried out for the purpose of examining the motives for mergers of enterprises. The same experts who decided to allocate individual fragments of knowledge to various motives attempted to classify them as tacit and explicit knowledge.

Table 7 shows the specific knowledge expressions broken down by *tacit* and *explicit* knowledge, and which may belong to both types simultaneously. For this purpose, data from Table 4 was used, where individual components of knowledge without repetitions, necessary by assigning to motives in which the same component could be found more than once. Types of components are labelled: j – explicit knowledge; c – tacit knowledge; j + c – explicit and tacit knowledge at the same time. This last designation requires clarification. Sometimes, the component contains intertwined explicit and tacit information in different proportions. For example, the component – information and qualitative analysis of competition – consists of available documents and complementary confidential information, provided in the context of mutual relations between employees of both companies.

Table 7. Components of knowledge – explicit and tacit

No.	Component name	Component character
1.	Explicit knowledge of competitors and markets	explicit
2.	Suppliers' market knowledge	tacit
3.	Personal relations with suppliers and buyers	tacit
4.	Information and analysis of competition quality	explicit + tacit
5.	Knowledge of R & D by the competition (inventions, innovations, quality, patents)	explicit + tacit
6.	Marketing knowledge of customers	tacit
7.	Complaints analysis	explicit
8.	Portfolio of orders and ability of its shaping	explicit + tacit
9.	Knowledge in the scope of <i>foresight</i>	explicit + tacit
10.	Knowledge of statistical and econometric tools	explicit
11.	Standards and regulations	explicit
12.	Analyses, calculations and synthesis	explicit
13.	Forecasts of research cells	explicit
14.	R+D concerning development of the enterprise	explicit
15.	Documentation and unofficial news concerning quality	tacit
16.	Personal knowledge of specialised employees	tacit
17.	Ability to optimally shape stocks	tacit
18.	Product, technology and organizational standards	explicit
19.	Operating records of machinery and equipment	explicit
20.	Record of inspections, periodic and capital repairs	explicit
21.	Knowledge of costing	explicit + tacit

No.	Component name	Component character
22.	Knowledge of production technology	tacit
23.	Materials for analysis, calculation and cost synthesis	explicit
24.	Ideas, patents, innovations	explicit
25.	Product documentation	explicit
26.	Employees with valuable skills and competencies	tacit
27.	Technical descriptions and manuals	explicit
28.	Computer programs, utility models, trademarks	explicit
29.	Planning experience	tacit
30.	Practical experience of employees in the sphere of sales	tacit
31.	Skills and competences in collaboration with the environment	tacit
32.	Relations with customers and sales representatives	tacit
33.	Customer information on the quality, features and prices of the products	explicit
34.	Current R & D works within the company	explicit
35.	Knowledge of production capabilities and delivery dates	explicit + tacit
36.	Knowledge of optimum stock shaping	explicit + tacit
37.	Knowledge of laws and regulations and internal instructions	explicit + tacit
38.	Relations with debtors and creditors	tacit
39.	Tacit knowledge of financial workers	tacit
40.	The ability to regulate financial flows	tacit
41.	Configuration of organizational units	explicit
42.	Principles and organization of autonomous units	explicit
43.	Knowledge of quality regulations	explicit
44.	Specialization of divisions and organizational units	explicit
45.	Health and safety regulations, inspection and accident reports	explicit
46.	Fire Regulations	explicit
47.	Sanitary and epidemiological reports.	explicit
48.	Personal experience in occupational safety and health, fire, sanitary and epidemiological fields.	tacit
49.	External and internal regulations on the protection of the air, land and water	explicit
50.	Standards for emissions of gases, land contamination and water pollution	explicit
51.	Instructions for behaving in the event of hazards	explicit
52.	Production technology of	explicit
53.	Projects, technical descriptions, manuals	explicit
54.	Intangible goods protection period of which has expired	explicit
55.	Practical experience of supervisory staff	tacit
56.	Tacit knowledge of executive workers	tacit
57.	Information and analysis of product characteristics	explicit

Source: own study.

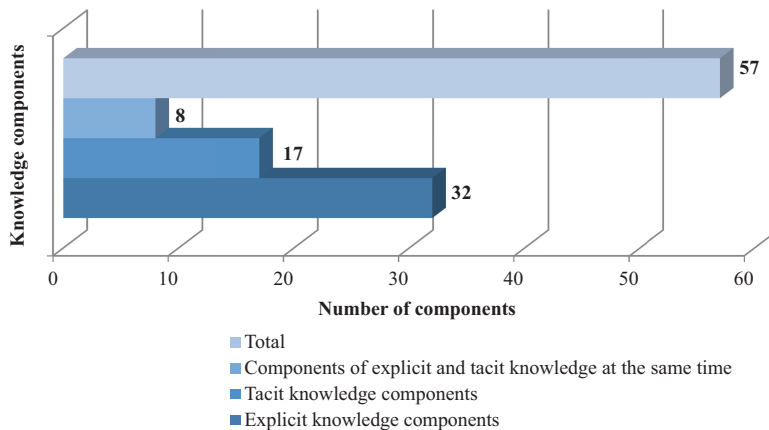
Based on the data in Table 7, a new compilation, containing data on the number of knowledge components, their respective types and their structure was prepared.

Table 8. Number of components in each type of knowledge and their structure

Types of components	Number of components	Share %
Explicit knowledge components	32	56,1
Tacit knowledge components	17	29,8
Explicit and tacit knowledge components at the same time	8	14,1
Total	57	100

Source: own study.

The spatial structure of the types of knowledge is presented in Figure 3.

Figure 3. Number of components in each type of knowledge and their structure

Source: own study.

Figure 3 shows that explicit knowledge constituted an overwhelming majority, covering more than half of the examined components; however tacit knowledge also has a significant share in the examined set of components. Components that are composed of explicit and tacit knowledge have a lot smaller share.

The data above allow do draw a rather optimistic conclusion that the transfer of knowledge in mergers of enterprises will be facilitated due to participation of explicit knowledge, which is inherently easier to transfer. For this reason, one more transformation of the analytical material was performed, by attaching weights to data, indicating their importance for intellectual capital and the economy of the studied enterprises. Due to the lack of the possibility to perform accurate estimation, the weights were rounded to natural numbers, representing the average, larger, and large meaning of individual components. The results obtained can be used to show their corrected percentage structure or at least to rank them on the order scale if the structural data did not seem sufficiently convincing.

Table 9 presents comparative data of primary and adjusted knowledge components and their structure.

Table 9. Components of knowledge – primary and adjusted

Types of components	Number of components	Share %	Value of adjusted components	Share %
Składniki wiedzy jawnej	32	56	32	36
Składniki wiedzy cichej	17	30	34	38
Składniki wiedzy jawnej i cichej jednocześnie	8	14	24	26
Total	57	100	90	100

Source: own study.

After the weighing operation has been performed, the number of components in each type of knowledge has changed. While the primary data pointed to a clear advantage of the explicit knowledge, after the use of scales, explicit knowledge is essentially equal to the tacit one. The expression „in principle” is to indicate that, using the estimation method, the advantage of two components in favour of tacit knowledge is irrelevant. This will indicate problems in estimation of the tacit knowledge that will be presented in the following parts of the paper.

Apart from the division into the above-mentioned basic types of knowledge one has to take into consideration the additional distinction, which is important due to the nature of the indicators.

This means the formal aspect of components. It is not indifferent what kind of knowledge is converted or transferred. There are elements of knowledge that are communicated more easily and briefly, e.g. explicit knowledge, while tacit knowledge, otherwise hidden, for understandable reasons, is much more difficult. These difficulties are even greater when knowledge is transferred within the merger of business, than besides the problems arising from the conversion rules, organizational barriers arise, as a result of overcoming barriers in the form of two different organizational structures.

The difficulties described above, concerning the transfer of tacit knowledge as a whole are not entirely exhaustive, as some groups of tacit knowledge can be distinguished, externalization of which is very diverse. Three types of tacit knowledge are distinguished in this paper: skills, experience and relations. In each of these groups, externalisation progresses with varying intensity. Passing skills is difficult, anyway different, depending on which level it involves, for example, contractors, middle management or top management. Characterizing the constituents of the tacit knowledge components, one can state that skills can be relatively easily acquired at the lowest level; on the other hand it is much harder on higher levels of management.

Experience requires the same as acquiring skills, i.e. observation and imitation, but in a sufficiently long period, which is, in fact, a feature of experience.

Relations are the most difficult to communicate. In order to transfer them, alongside skills and experience, one must have a specific knowledge of psychology as well as the internal abilities needed to establish, sustain, use, bearing in mind that these are usually bilateral relations. For example, if a logistics specialist wants to ensure flow of means under the most difficult market conditions using private relations, he must remember the principle of reciprocity. The division of tacit knowledge into these groups of components seems to be fully justified.

Much more possible divisions may occur by the attempt to divide explicit knowledge. However, the division is simpler here, as the knowledge itself is explicit, usually codified. Based on the principle of clear separation of particular groups of explicit knowledge components and taking into account the criterion of difficulty in transferring knowledge, the following set of groups of explicit knowledge components was proposed:

- internal rules and instructions,
- standards,
- analyses,
- reports,
- forecasts,
- patents, ideas and innovations,
- documents.

The next step was to assign individual knowledge components to them.

Table 10 contains the knowledge components grouped according to the above-defined criteria, covering the tacit and explicit knowledge. In this case, the division of cognitive knowledge **j+c** has been dispensed with; these components of knowledge are classified into the corresponding generic groups, guided by the assumed advantage of one of the components – **j** or **c**.

The results of the division are shown in Table 11.

Table 10. Components of tacit and explicit knowledge grouped by types

Tacit knowledge		
Skills	Experiences	Relations
<ul style="list-style-type: none"> – Ability to optimally shape stocks – Employees with valuable skills and competencies – Skills and competences in collaboration with the environment – Regulation abilities on financial flows – Knowledge of employees executives 	<ul style="list-style-type: none"> – Market knowledge of suppliers – Marketing knowledge about customers – Knowledge of <i>foresight</i> – Knowledge of production technology – Planning experience – Practical experience of sales staff – Individual experience in the fields of occupational safety and health, fire-protection, Sanitary and epidemiological – Practical experience of supervisory staff – Documentation and news unofficial concerning quality 	<ul style="list-style-type: none"> – Personal relations with suppliers and buyers – Relations with customers and sales representatives – Relations with debtors and creditors – Tacit knowledge of financial workers
Explicit knowledge		
Internal regulations, records, instructions and standards	Standards	Analyses
<ul style="list-style-type: none"> – Operating records of machinery and equipment – Record of inspections, periodic and capital repairs – Technical descriptions and manuals – Knowledge of laws and external and internal instructions – Knowledge of quality regulations – Fire protection regulations – Internal instructions In case of threats to the protection of air, land and water 	<ul style="list-style-type: none"> – Standards and legislation – Product, technological and organizational standards – Knowledge of costing – Knowledge of optimum stock shaping – Standards for emissions of gases, land contamination and water pollution 	<ul style="list-style-type: none"> – Explicit knowledge of competitors and markets – Information and analysis of competition quality – Complaints analysis – Knowledge of statistical and econometric tools – Analyses, calculations and synthesis – Materials for analysis, calculation and cost synthesis – Customer information on the quality, features and prices of the products – Current R & D works within the company – Information and analysis of product characteristics
Forecasts	Patents, ideas and innovations	Documents
<ul style="list-style-type: none"> – Knowledge in the scope of <i>foresight</i> – Forecasts of research cells – Knowledge of production capabilities and delivery dates 	<ul style="list-style-type: none"> – Knowledge of R & D by the competition (inventions, innovations, quality, patents) – R+D concerning development of the enterprise – Ideas, patents, innovations – Computer programs, utility models, trademarks – Intangible assets, protection period of which has expired 	<ul style="list-style-type: none"> – Portfolio of orders and ability of its shaping – Product documentation – Configuration of organizational units – Principles and organization of autonomous units – Specialization of divisions and organizational units – Production technology – Projects, technical descriptions and manuals
Reports		
<ul style="list-style-type: none"> – Health and safety regulations, inspection and accident reports – Sanitary and epidemiological reports. 		

Source: own study.

Table 11. Knowledge in terms of genre

No.	Tacit knowledge			Explicit knowledge			Total	
	Group name	Number of components	%	Group name	Number of components	%	Number of components	%
1.	Skills	5	30	×	×	×	5	9
2.	Experiences	9	50	×	×	×	9	16
3.	Relations	4	20	×	×	×	4	7
4.	×	×	×	Internal regulations, records, instructions and standards	8	20	8	14
5.	×	×	×	Standards	5	13	5	9
6.	×	×	×	Analyses	9	23	9	16
7.	×	×	×	Reports	2	5	2	3
8.	×	×	×	Forecasts	3	8	3	5
9.	×	×	×	Patents, ideas and innovations	5	13	5	9
10.	×	×	×	Documents	7	18	7	12
Total	×	18	100	×	39	100	57	100

Source: own study.

Table 12. Podział wiedzy pod względem rodzajowym (formalnym)

Tacit knowledge						
Skills		Experiences			Relations	
9		5			4	
50%		30%			20%	
Explicit knowledge						
Internal regulations, records, instructions and standards	Standards	Analyses	Reports	Forecasts	Patents, ideas and innovations	Dokuments
8	5	9	2	3	5	7
20%	13%	23%	5%	8%	13%	18%

Source: own study.

Intuitive conviction that the basic type of tacit knowledge is experience is confirmed. It follows that the bonus for long-term employees is justified by the fact that they are primarily a source and a carrier of knowledge. As far as knowledge is concerned, experience takes first place with analyses (open knowledge). Also the other two categories of tacit knowledge (skills and relations). The picture of explicit knowledge is slightly more diverse. Among its constituents, there are three categories that together account for over 40% of explicit knowledge. These are (mentioned above): analyses (16%), internal regulations, records, manuals and standards (14%), documents (12%). Among them the most important role is played by analyses. Compared to the other two categories contain a lot of basic knowledge (combinations

of knowledge) that can be directly used by the acquiring entity. Rules, manuals and documents are less important, as they contain a lot of commonly known facts, not very useful for the acquiring entity in the process of enterprises consolidation. A significant share of total knowledge has the item „patents, ideas and innovations” (13%). The market value of knowledge under this item is actually significantly higher than in the other categories, but it is practically impossible to value it, at least in its other types, therefore comparisons are impossible. Also standards have high share (9%). Properly established all kinds of standards, such as labour inputs, material consumption, labour productivity, are a valuable source of knowledge that can be used in a new enterprise. It should be emphasized that only well-designed and successful standards can be fully used in a new company (most is probably commonly used in many companies and is not a particularly valuable acquisition).

Other categories of general knowledge are of lesser importance, although in the in correctly prepared forecasts (8%) there may be important guidelines for management of the newly established consolidated enterprise. Reports have the smallest share. Sometimes they are drawn by independent controllers (especially external ones) and may contain important information that can significantly improve the integration process of the two consolidated companies. The effort required to pick this knowledge out of banal and typical events is often unprofitable.

The above-described fields, elements and components of knowledge grouped according to different criteria (tacit, explicit knowledge, types of knowledge) give a very detailed and varied picture, denying the often popular imagination. An image of a knowledge creating enterprise is often reduced to inventions and innovations in large corporations. This brings consequences in considering knowledge transfer that is actually more complicated than what it appears to be and contains not only a „big transfer”, but also one that is not an explicit or concealed subject of transactions involving mergers or acquisitions.

The above-described division and structure of knowledge by elements, components and categories will be presented in depth in the knowledge transfer analysis, described in the next subsection of the paper.

2. Transfer of knowledge in creation of value in new organization

The New Comprehensive Encyclopaedia gives two concepts of knowledge transfer: economic and psychological. For the research undertaken in the presented paper they only fit to a limited extent. Under the economic approach, two other variants are distinguished: international transfer and transfer of income. The transfer of knowledge is not mentioned by the source. International transfer, which also occurs

in mergers and acquisitions, is defined as transfer of money, gold, capital from one country to another⁶³. While the term „capital” also includes intellectual capital, the definition would be relevant to the transfer in question here. On the other hand, the psychological definition of transfer is more complicated – the influence that the ability acquired earlier exerts on acquiring other skill. This corresponds in some extent to one of the forms of knowledge conversion, namely the combination of knowledge. Nevertheless, these partial similarities to the actual course of the transfer cannot be the reason to recognise encyclopaedic definitions as helpful in multilateral knowledge transfer. In general, researchers avoid explicit definition of the concept of transfer, perhaps because of its obviousness, which discusses displacement, transfer, etc. Therefore, many authors consider that it is appropriate to define the concept of transfer by its function.

B. Mierzejewska believes that „various variations present in the literature on the subject matter of knowledge transfer (and thus combination of knowledge, knowledge sharing, knowledge transfer, learning, etc.) can be broadly defined as transfer”⁶⁴. It would appear that the differences between the definition of knowledge and knowledge transfer would practically involve the creation of knowledge that does not fall within the definition of transfer.

It is slightly differently presented by J. Kang, M. Rhee and K.H. Kang, who also define transfer through its functions, but also include the creation of knowledge to it⁶⁵. Then knowledge and transfer would be conceptually coherent. A. Ring and H. Öfverström⁶⁶ believe that the different terms for knowledge transfer used in literature come down to epistemological differences, i.e. using different terminology. The point is that such concepts as: combination of knowledge, its combination and creation or „teaching” describes practically the same thing. They further argue that the views expressed in this case, expressed e.g. by C. Bartlett and S. Ghoshal⁶⁷, I. Nonaka and H. Takeuchi⁶⁸, G. Hedlund⁶⁹, Kogut and U. Zander⁷⁰, show discrepancies only in

⁶³ *Nowa Encyklopedia Powszechna*..., op. cit., v. 6, p. 433.

⁶⁴ B. Mierzejewska, *Transfer wiedzy*..., op. cit., p. 2.

⁶⁵ J. Kang, M. Rhee, K.H. Kang, *Revisiting*..., op. cit., p. 25.

⁶⁶ A. Ring, H. Öfverström, *Contextualised View of Knowledge Transfer in Mergers and Acquisitions*, Göteborg University, Göteborg 2000, p. 54.

⁶⁷ C. Bartlett, S. Ghoshal, *Re-conceptualizing Bartlett and Ghoshal's Classification of National Subsidiary Roles in the Multinational Enterprise*, „Journal of Management Studies”, March 2011, p. 254.

⁶⁸ I. Nonaka, H. Takeuchi (eds.), *The Knowledge*..., op. cit., p. 31.

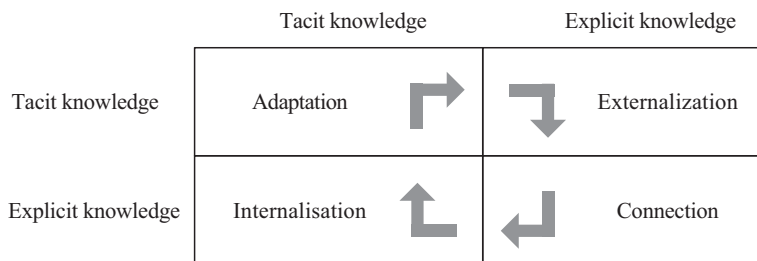
⁶⁹ G. Hedlund, *A model of knowledge management and the N-form corporation*, „Strategic Management Journal” 1994, No. 15, p. 73–90.

⁷⁰ B. Kogut, U. Zander, *Knowledge*..., op. cit., p. 76.

literature, as the transfer is considered from different points of view. This only shows some confusion in terminology in this matter. Therefore, it should be assumed that the above mentioned scientists treat the terms knowledge and knowledge transfer as identical, they differ only in different approach to the topic. By agreeing with this approach, it is doubtful whether acquisition of knowledge through acquisitions or mergers, which today is a typical case of knowledge transfer between companies, corresponds to the actual creation of knowledge. This approach may be justified when we deal with a situation where the acquired knowledge is expanded (combined) through combination with another element of knowledge. However, in specific cases, the purpose of its acquisition is simply to gain access to licenses, innovations, etc. without its immediate further improvement by combining with other elements of knowledge. In this case it is difficult to talk about creating knowledge.

Using the known knowledge conversion scheme shown by J. Nonaka and H. Takeuchi⁷¹, it is worth to trace the transfer of knowledge from the point of view of its transfer under merger of enterprises, as shown in Figure 4.

Figure 4. Creating knowledge through different manners of conversion



Source: I. Nonaka, H. Takeuchi (eds.), *Knowledge Creating Company*, Oxford University, New York 1995, p. 78.

As it can be seen from analysis of the above-presented knowledge conversion model, knowledge transfer can be done only through sales or the same thing, and in practice is absolutely prevailing, by consolidation companies with automatic knowledge transfer⁷². Virtually its direct use can only affect insights (in the original internalized knowledge) and then merging it and re-internalizing.

A similar approach is demonstrated by G. Probst⁷³ and others, who among the knowledge management place gaining knowledge on the first place. They consider acquiring knowledge through acquisition of companies as a kind of process in

⁷¹ I. Nonaka, H. Takeuchi (eds.), *The Knowledge...*, op. cit., p. 62.

⁷² Automatism occurs here only as a right to use the acquired knowledge. Its actual use depends on the speed of passing through subsequent integration stages, as will be seen in the next subsection of Chapter II.

⁷³ G. Probst, S. Raub, K. Romhardt, *Zarządzanie wiedzą...*, op. cit., p. 31.

knowledge management. Likewise, L. Barton⁷⁴, who represents the view that import of knowledge from the environment, is an important means for acquiring key skills. Enterprises are faced with an increasing amount of knowledge that needs to be mastered, and the basis for the operation and development of organizations under such conditions is knowledge⁷⁵. Considering the knowledge conversion contained in Table 7, it is concluded that it is taking part inside an enterprise or companies merged into a new organization within merger or acquisition. In the latter case, the transfer inevitably extends over time and goes through several separate stages, primarily due to cultural differences and other causes of organizational nature. The details of this problem – postponing knowledge acquisition – will be discussed in the next step of the paper. At this point it must be emphasized that the conversion of knowledge within an organization is more effective than by merger of companies, at least in the first stage, in particular with regard to *tacit* knowledge. This is indicated by the findings of B. Kogut and U. Zander, who say that „it must be stated that by technology transfer one can expect it to be less profitable than within a company”⁷⁶. Of course, this does not mean that a well-calculated purchase of a company is unprofitable in this respect, but that transitional steps are needed to achieve the full effect. Knowledge transfer requires several essential conditions. One should first of all pay attention to the potential difference between the consolidated organizations. It makes no sense to merge enterprises to obtain new knowledge, if differences in its level are not relevant. In the opposite case, i.e. when the enterprises differ in terms of knowledge resources, the need for transfer increase. The following knowledge flows can be distinguished:

- the acquiring entity obtains the knowledge that was the main or at least one of the main reasons for merger (often occurring within the framework of another official reason for acquisition);
- the acquiring entity receives additional knowledge (not planned);
- the acquired within the acquisition satisfies its problems with the surplus in knowledge potential by the acquired entity.

The above statements on the existence of bilateral flow of knowledge have been confirmed by Swedish researchers⁷⁷, i.e. H. Bresman, J. Briskinshaw and R. Nobel. However, they assume that during the first stage an increased flow of

⁷⁴ L. Barton, *Źródła wiedzy*, Harvard School Business, Boston 1995, p. 39.

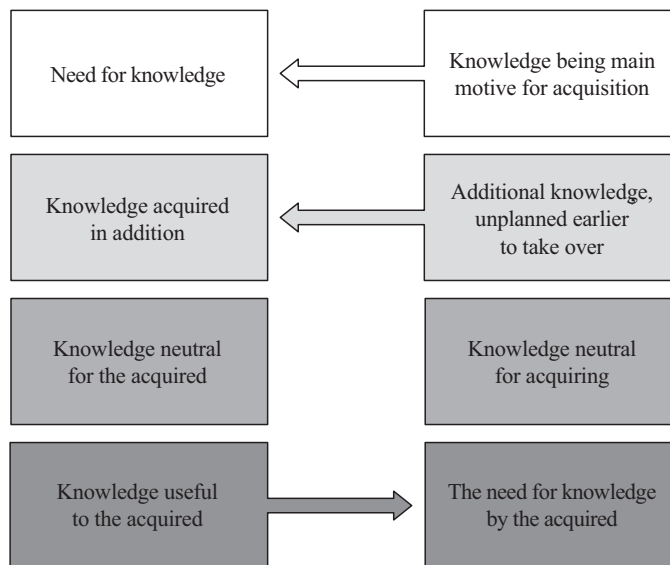
⁷⁵ M. Dzwigoł-Barosz, *Niwelowanie luki kompetencji menedżerów w procesie przekształcania przedsiębiorstwa w organizację inteligentną*, Politechnika Śląska, Gliwice 2013, p. 51.

⁷⁶ B. Kogut, U. Zander, *Knowledge...*, op. cit., p. 98.

⁷⁷ H. Bresman, J. Briskinshaw, R. Nobel, *Knowledge transfer in Innovation Acquisition*, “Journal of Informational Business Studies” 1999, No. 30(3).

knowledge from the acquiring entity to the acquired one occurs. This is in line with the assumption that in many cases acquisition of a company aims to acquire a particular technology, innovation, etc. Regardless of the quantifiable flows there are non-transferable (neutral) knowledge resources, generally identical or very similar in both companies. Figure 5 illustrates a situation in which the primary motive for merger is to gain knowledge by taking over an enterprise or when it is hidden under other official motives.

Figure 5. Creating knowledge through different manners of conversion



Source: own study.

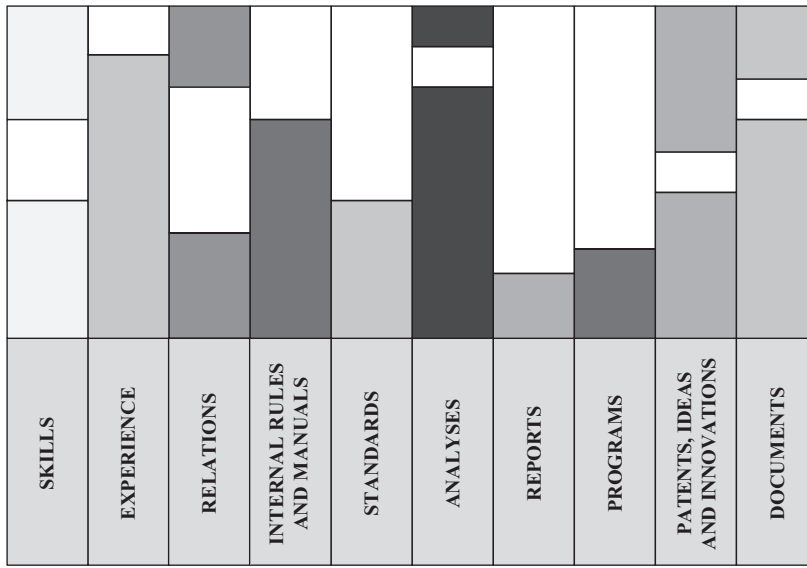
One of the elements of this model, built on the basis of research of companies' similarity in terms of potential, is the analysis of the knowledge flow. The principle of the procedure is as follows: the more the companies differ in the potential of knowledge, the more likely they are suitable for consolidation. Of course, the potential difference is not the only condition, but it is a necessary condition. It does not make sense to consolidate companies with the same or very similar knowledge.

It follows that a diagnosis of knowledge identification should be performed before merger. For this purpose a kind of „knowledge map” may be used that identifies the situation in this regard. This is not a knowledge map in the sense of training aid described by A. Polak⁷⁸. In this case, knowledge identification can be used in the enterprise selected to be taken over and possibly also by the initiator of

⁷⁸ A. Polak, *Nauczanie...*, op. cit., p. 10–13.

the acquisition in order to obtain the size of the knowledge potential difference. An example map of this knowledge is shown in Figure 6.

Figure 6. A theoretical map of knowledge that is owned and desired in a new (consolidated) enterprise



Legend:

Colour marked rectangles from the left = acquired knowledge

Colour marked rectangles from the right = own knowledge

White rectangles = potential (missing) knowledge

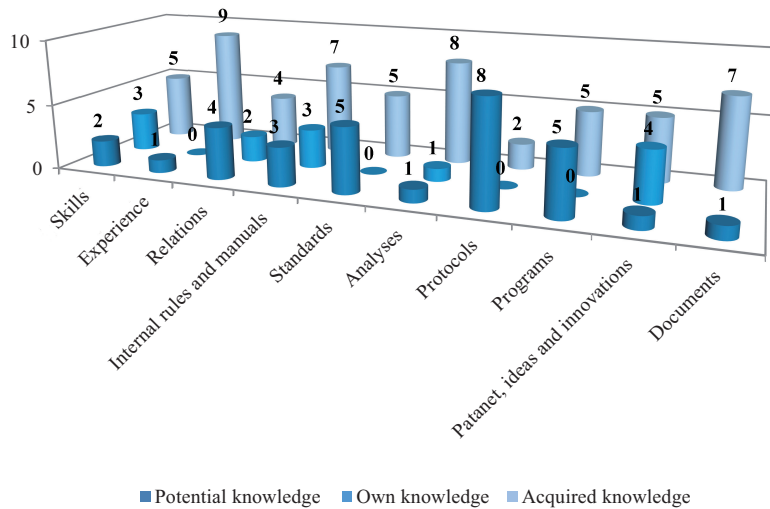
Source: own study.

One must remember that these are fictitious quantities and only a thorough analysis of the actual data on both sides of the transaction can provide a more accurate response, obtained with the application of the method described.

It should be added that in fact maps of knowledge are generally of a different nature and if they are created, than rather for the purpose of training at universities. They have different construction then, and another manner of collecting information is used.

The above-described division and structure of knowledge by elements, components and categories, and the knowledge map constructed on their basis, will be useful in analysing the stages of knowledge transfer.

Figure 7. A theoretical map of knowledge that is owned and desired in a new (consolidated) enterprise



Source: A. Polak, *Nauczanie organizacji przedsiębiorstw za pomocą mapy wiedzy*, „Przegląd Organizacji” 2012, No. 3, p. 10–13.

3. Stages of knowledge transfer in mergers and acquisitions

The transfer of knowledge cannot be separated from the integration process within mergers and acquisitions. It is part of this process and although it shows certain specific characteristics, it cannot be considered without a link to the whole.

The process of enterprise integration is not a one-time act. It starts well before the contract is signed and its implementation takes a long time before the merger of the enterprise organization is completed. However, from the point of view of knowledge transfer study, it is not important what stages the acquisition process passes through before its official and formal completion. However, the stage of integration is important. „The integration of two companies after acquisition significantly decides the success of the entire company”⁷⁹. It is implemented at every level of management, and also covers all functional areas, and thus also the knowledge management area.

⁷⁹ M. Lewandowski, *Znaczenie integracji w procesach fuzji i przejęć przedsiębiorstw*, in: W. Frąckowiak (ed.), *Fuzje i przejęcia przedsiębiorstw*, PWN, Warszawa 1998, p. 335.

3.1. Knowledge integration

There are three main stages in the process of knowledge integration:

- immediate action,
- stabilization of the acquired company,
- adjustments and assimilation.

Of course, the indicated breakdown into stages should be tailored to the specificity of knowledge management during its takeover in merger or acquisition.

The stages of enterprise organization integration are shown in Figure 8.

The means of integration are primarily determined by the motives of acquisition. Among the listed four motives, from the point of view of knowledge transfer analysis, the motive for technology (capability) acquisition⁸⁰ is interesting, whereby on the first stage it is recommended to maintain key personnel in this field and to maximize the use of the acquired technology. In the next step it is recommended to look for an opportunity to expand the use of this technology. The problem whether to do it within one or on the basis of technology importance, entire context of the acquisition must be resolved in more stages. This stage can be called the instantaneous action step (first). The second stage involves balancing the company's leadership, maintaining the necessary staff, renewing the right relations with the environment, and identifying key players in the management. In the third stage, some actions are taken to achieve the final integration of companies. At the end of the development actions phase, it is aimed at integration, mainly cultural. Similar (but not identical) stages concern knowledge transfer. First of all it is important to emphasize that the type of transfer depends on the type of knowledge. This has a significant impact on its staging. This is emphasized by B. Kogut and U. Zander⁸¹ claiming that „the characteristics of knowledge determine the cost and the manner of transfer”. As the manner order in the integration process can be understood. For example, explicit knowledge of production procedures is most often transferred using existing databases, while operational improvement through practice in workshops⁸². Of course, it is much easier to decode the explicit, documented knowledge than laborious observation and imitation of tacit knowledge. However, one should not draw conclusions about a clear boundary separating these types of knowledge. The above-mentioned researchers point that there is space between these two types of knowledge (*tacit, explicit*), which is not constant, and where various processes of transmitting both types of knowledge take place at the same time. Even more firmly

⁸⁰ M. Lewandowski, *Znaczenie integracji...*, op. cit., p. 335.

⁸¹ B. Kogut, U. Zander, *Knowledge...*, op. cit., p. 626.






⁸² A. Ring, H. Öfverström, *Contextualised...*, op. cit., p. 27.

express K. Lahti and M. Beyerlein⁸³ who consider this dichotomy (*tacit* and *explicit*) to be unreal and propose to consider knowledge as occurring in different shades of grey, and anchored in pure form in both ends (poles) of the continuum. However, in figure 7 the above mentioned case of acquiring mixed knowledge (explicit + tacit) was not taken into account, to avoid excessive complication of the lead. All of these cases are included in explicit knowledge, assuming that most of this knowledge is directly available. Graphic representation of the knowledge transfer stages, according to its types is shown in Figure 9.

Figure 9. Explicit and tacit knowledge in various phases of transfer

TYPES OF KNOWLEDGE	STAGES			
	Instant	Stabilization		Synergy and development
Explicit knowledge				
Tacit knowledge				

Legend:

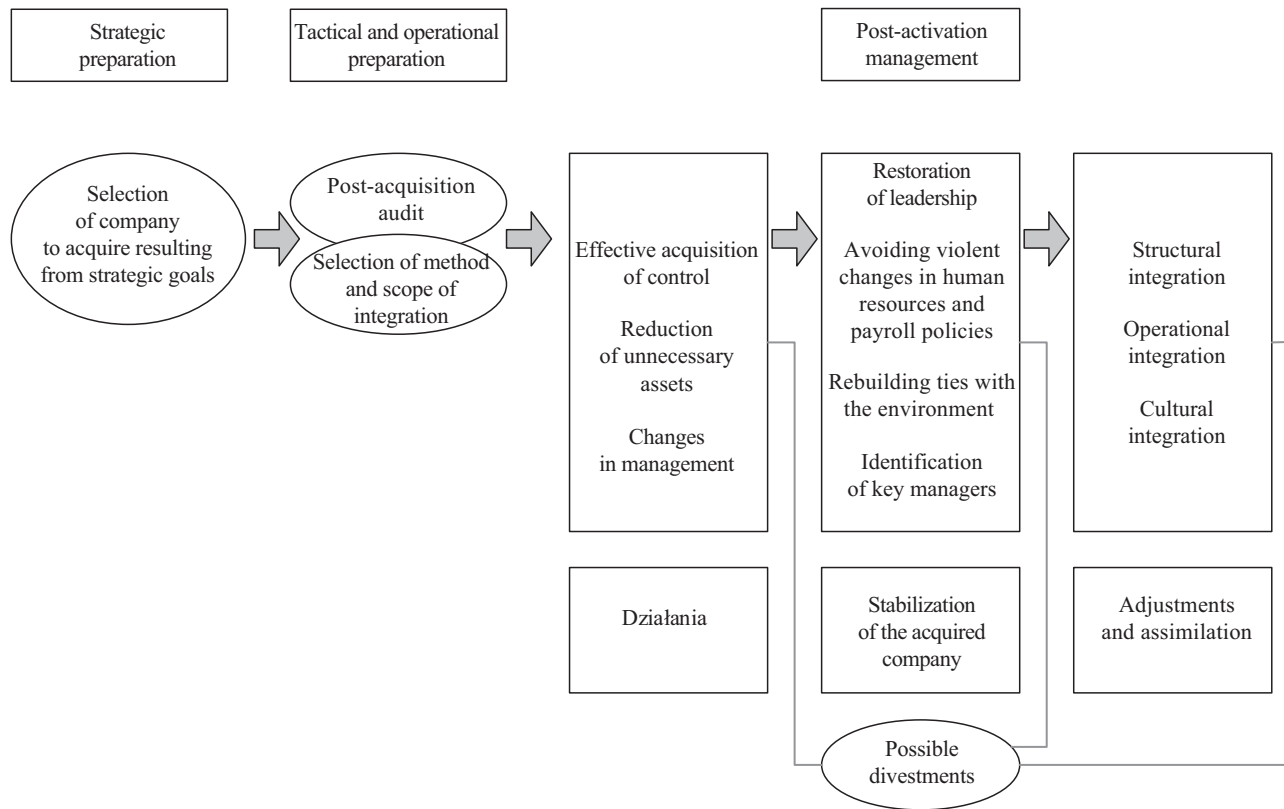
-  Explicit knowledge is transfer at the instant and stabilization stage
-  Explicit and tacit knowledge transferred at the stabilization stage
-  Tacit knowledge transferred at all stages
-  Tacit knowledge transferred at the stabilization stage
-  Tacit knowledge transferred at the synergy and development stage

Source: own study.

Figure 9 should be interpreted in the following manner. Basic explicit knowledge, expressed in clear and unambiguous form of documents, drawings, and easily accessible in databases, without the assistance of staff of the acquired company (which is not always favourable and helpful) can be obtained in the first stage (immediate). Some part of this knowledge is available only with qualified specialists from the acquired company, and this part of explicit knowledge will be practically available at the stabilization stage, when there are conditions for collaboration between the consolidated companies.

The situation with transmission of tacit knowledge is different. Due to its nature it cannot be included in the documentation. Often, the knowledge owner alone cannot articulate it. It is also less accessible because of its holder is not always

⁸³ K. Lahti, M. Ryan, M. Beyerlein, *Knowledge Transfer and Management Consulting. A Look at the Firm*, "Business Horizons" 2000, Vol. 43(1), p. 65–74.

Figure 8. Stages of enterprise integration

Source: own study on the basis: M. Lewandowski, Znaczenie integracji w procesach fuzji i przejęć przedsiębiorstw, in: W. Frąckowiak (ed.), Fuzje i przejęcia przedsiębiorstw, PWN, Warszawa 1998, s. 335 and Making Acquisition Work, p. 8.

interested in disclosing it due to personal interest. As long as the holder is in some manner a monopolist, it can count on the benefits that come from it. This knowledge is conveyed by observation and imitation, often by symbols and metaphors, and as I. Nonaka and H. Takeuchi write, „in strict sense, knowledge is created only individually. Organization cannot create knowledge without individualities”⁸⁴. Acquiring silent knowledge must last for almost the entire integration period. People need to persuade and encourage externalization of knowledge by appropriate motivation, and it requires time. Not only types of knowledge affect the stage in which it is ultimately transferred. Other categories, such as fields of knowledge, elements and types of knowledge, are also very important. An attempt of defining the fields of knowledge transferred at each stage of integration is presented in Figure 10.

Figure 10. Knowledge by fields passed at each stage

AREAS OF KNOWLEDGE	STAGE		
	Instant	Stabilization	Synergy and development
System and environment			
Threats			
Logistics			
Planning			
Finances			
Utility indications			
Expressive content			
Resources			
Preparation of production and products			
Processes			

Source: opracowanie własne na podstawie: A. Polak, *Nauczanie organizacji przedsiębiorstw za pomocą mapy wiedzy*, „Przegląd Organizacji”, nr 03/2012.

This figure shows how the knowledge transfer is placed at each stage of integration. It should be noted that in other sectors of the economy than metallurgical industry, the situation may be different, e.g. companies with so-called intensive knowledge creation are not typical of today functioning companies, especially in Poland. Analysis of the integration time shown in Figure 8 is not accurate because there is no exact data on the time of information transfer. However, a scale may be applied here, where there is a possibility of arranging individual fields of knowledge according to the number of necessary stages in descending order, which is shown in Figure 10 in Table 13.

⁸⁴ I. Nonaka, H. Takeuchi (eds.), *The Knowledge...*, op. cit., p. 59.

Table 13. Number of knowledge transfer stages taking into account type of knowledge

Fields of knowledge	Number of stages	The prevailing type of knowledge
Expressive content	3	<i>tacit</i>
Logistics	2¾	<i>tacit</i>
Processes	2½	<i>tacit</i>
System and environment	2	<i>explicit</i>
Utility indications	1¾	<i>tacit</i>
Planning	1½	<i>explicit</i>
Finances	1¼	<i>explicit</i>
Resources	1	<i>explicit</i>
Preparation of production and products	1	<i>explicit</i>
Threats	1	<i>explicit</i>

Source: own study.

The number of stages set in descending order show that the more tacit knowledge there is, the more stages the knowledge transfer has to pass. It should be reiterated, however, that these are estimates, both the estimation of the length of time needed and the estimation of the ratio of tacit and explicit knowledge in a given element of knowledge may be altered, which may be imprecise. The author's experience allows to judge that these deviations do not change the fundamental judgement in this respect.

3.2. Knowledge classification

Moving forward to detailed discussion of individual transferred knowledge elements, it should be borne in mind that due to the fact that explicit and tacit knowledge in pure state is rarely present, it was necessary to qualify it in one or the other type, as deepening the analysis by creating many further subtypes of knowledge would be very difficult, unrealistic and would require separate research. The first position in Table 13, however, does not raise any doubts (expressive content)⁸⁵. Under the term **expressive content** all kinds of innovations are understood. Information, often confused with knowledge, does not belong here. Innovation is the most desirable element of knowledge, although hidden they are the market or technological motive of company acquisition. According to estimation, based on the observation of historical reasons, full implementation of innovation may require use of the entire integration period. The reason for this state of things is usually that taking over and mastering innovation takes the longest and is most difficult not only as a technological and organizational fact, but also as skills and special competences,

⁸⁵ A. Polak, *Nauczanie...*, op. cit., p. 11.

being the domain of tacit knowledge, encoded in the human mind. Typically, the acquiring entity does not have own employees experienced in service, maintenance, and many other activities related to the acquired technology. It is forced to use the skills of the acquired crew, which is often in a monopoly position, and teaching new employees is difficult because it meets with resistance due to competition and threat to own position. Difficulties arise when due to improper conduct by acquisition of the company the current culture is not taken into account and there is an attempt to impose its manner of management by force. This can lead to employees with high competences potential leaving the company, as for them finding a new job is not difficult. The above difficulties make full takeover and maximum utilization of the acquired technology (or other innovation) prolongs not only through the period of immediate acquisition but also in two further stages.

Second place in the classification of knowledge was taken by logistics, which may be some surprise. However, the key issue is not to take the means of transport, storage and stock, but to ensure their smooth use. This is where contact with tacit knowledge takes place, especially in the metallurgy industry one has to deal not only with the large amount of needed raw materials, semi-finished products and articles, but also with a wide range of devices, electronics, spare parts, accessories and other components needed at all stages of the production process. Ensuring timely supply of good quality and at optimal cost requires a network of contacts, especially personal relations with suppliers and intermediaries. The latter, in the case of the enormous value of logistics, is essential in the industry for smooth operation of the entire consolidated enterprise. This is the knowledge that the staff employed in logistics is reluctant to share, as this knowledge often relies not only on business but also personal relations. It should be borne in mind that logistics should provide not only timely delivery, transport and efficient and safe storage, but also at an optimum cost. It follows from the fact that the knowledge of people employed in logistics is not only order in the orders, invoices, bills of lading or receipt records, but also the wide knowledge of the economic values: prices, tariffs, discounts and synchronization of these elements, as they are preconditions for success. Logistical experiences cannot be transferred immediately or stabilized in a short time. This takes place at the third stage of knowledge transfer. In fact, there are similar circumstances as in the transfer of innovations. Particular organizational changes, e.g. merging departments or organizational units in the field apart from benefits can bring problems related to the human factor. This case will be discussed more broadly within the framework of the transfer of knowledge related to integration of organizational structures. Another area of knowledge transfer time of which was estimated to half through the third stage is the processes. According to the nomenclature used in the cited paper, they consist of management, manufacturing and support processes. Of particular importance are

the first two. Management processes are primarily related to the specific competence of the management team. The transfer time depends to a large extent on its attitude and treatment. The situation deteriorates considerably when the managerial staff is exchanged in whole or in part. It is impossible to learn the entire knowledge of the company in a short space of time, especially since this knowledge is generated (usually) from personal experience, and therefore it is tacit knowledge. The period of gaining experience by new executives may also last in the third stage. This is a difficult process because there is no one to follow or imitate, and in this situation the methods of the acquiring company are often applied, which often do not correspond to the material circumstances and organizational culture of the acquired enterprise. The trial and error method is very expensive. Manufacturing process has a slightly different character, where in the vast majority to transfer the information explicit knowledge is sufficient. These are all sorts of instructions, procedural descriptions, record of the course of the machine and the time of operation of the apparatus, etc. This does not mean, however, that these sources are sufficient for mastering all the manufacturing processes. In the metallurgical industry these are often processes violation or interruption, especially discontinuity of which can be very costly and result in huge losses (not only because of lowering production and sales but also because of the often irreversible damage to fixed assets involved in production). In this situation, in addition to the explicit knowledge in publications or databases, much depends on personal experience and skills acquired by service personnel and direct supervision. Thus, despite the significant share of explicit knowledge, duration of the knowledge transfer is assessed on average in 2 stages, i.e. until the transition from the stabilization of the merged enterprise, i.e. initiation of development policy. Support processes do not play a greater role and fall within the overall assessment of the duration of transfer in the management area.

Particular attention should be paid to the field – system and environment, and within it the organizational structure.

Regarding the configuration of organizational structure, it should be noted that the knowledge transfer takes place as long as its adjustment to requirements of the acquiring entity. Such reconstruction is not easy, as it involves personnel policy. Example of changes in the organizational structure may be the use of merging units involved in logistics, particularly as mentioned above, procurement and transport departments. There is no justification for each of the consolidated companies to have a separate unit in these areas, especially since mergers are generally horizontal in nature and do not increase the range of products necessary to ensure the production process. Combining them significantly reduces costs through the ability to negotiate better delivery and shipping conditions, as well as reduced duplication of personnel and administrative costs. This, however, has the negative side of increase in social

tension as these activities do not take place without lay-offs and personnel shifts. These circumstances cause the knowledge transfer process to prolong and involve both explicit and tacit (mainly relations). Therefore, it is estimated that the transfer of knowledge that takes place during configuration changes can take an average entire two stages. The influence of changes in management centralization is opposite to the time required to complete the knowledge transfer in the field. It depends on system differences in the two consolidated companies. If differences in centralization of management between the two entities are significant, e.g. the acquiring entity has fairly extensive autonomy and the acquired company is heavily centralized or vice versa, it should be taken into account that adaptation processes will last long. Moving from a centralized system to autonomy seems to be as difficult as the reverse – from autonomy to centralized decision making. In both cases we are dealing with the transfer of knowledge contained in existing and usually deeply ingrained management practices. It is difficult and generally goes through all stages of knowledge transfer.

Specialization is a feature of the organizational structure, which contains the most essential elements of explicit and tacit knowledge. Hence, the time of the transfer process is very similar to the one that is being observed with innovations. Often, the goal of taking over a company is to obtain a highly specialized technology and experts who command it. Therefore, going through the immediate and stabilization phases seems to be necessary for the same reasons as when taking over innovation (unique technology and specialists).

In knowledge transfer, within the organizational structure, the most important due to its size and breadth, is knowledge that corresponds to the knowledge corresponding to the feature of formalization. It penetrates all areas of the enterprise operation and is unavoidable even in virtual teams. It is generally explicit knowledge, and the long transfer time results simply from its size and scattering, therefore it must last as long as the knowledge contained in other elements of the organizational structure (two stages).

The transfer of standards does not have to last very long, but it does not mean that it will happen immediately after the merger of companies. It is important to note that the standardization (as a rule) covers both parties to the merger, and therefore the transfer is of a two-way nature (except for standards equally applied in the two consolidated companies). In summary, all knowledge elements, transferred within merger, pass on average through the first two stages. After full integration in the third stage, integration efforts do not delay further development.

Usable indications are a specific subject of transfer that lasts quite a long time but does not cover the whole area of the stabilization stage. This is all knowledge derived from outside the enterprise. It is not always knowledge in the full sense of

the word, i.e. information combined with experience and interpretation. Sometimes this is simply information that has a special feature. They are objective because the knowledge coming from inside the company contains a lot of subjective elements and is somewhat contaminated with attitude of the stakeholders. Transmission of knowledge coming from the outside should not take too long because of its explicit character. Frequently, insufficient codification and scattering in various records of the company hinder its efficient transfer. This knowledge can be counted among transferred within the average time, which should end even before the stabilization process is over.

Planning knowledge should not be transferred long, if it were not for the human factor. An effective planner gathers vast knowledge and is irreplaceable, especially in long-term planning, i.a. relying on the rules of *foresight*⁸⁶. This knowledge cannot be easily transferred, especially in case of staff exchange, which is often the case for service competition in merging companies. In these cases, the transfer process can drag up to half of the next stage. However, it is worth point out that these data are of an approximate character and explain rather average situations.

Passing financial knowledge, especially knowledge of resources, is much simpler. It concerns explicit knowledge and well-documented knowledge. Only in case of financial knowledge a phenomenon of relational connections may occur, which should also be included in the organizational knowledge. Therefore, resources must be transferred immediately and close in the first stage. The transfer of strictly financial knowledge due to specific (sometimes) settlements and professional secrets, may take longer, overlapping the stabilization phase. This is true only for some companies that show complex financial ties, especially in terms of liabilities, loans and capital ties.

Transfers in other areas of organizational knowledge should not last long and exceed the limits of the first stage. The above-presented process of knowledge transfer by types and fields of knowledge does not exhaust all possibilities. For example, the views of H. Bresman, H. Briskinshaw and R. Nobel⁸⁷ are worth pointing out. as by examining Scandinavian companies, they have proposed to take adopt, for the purposes of study, division of knowledge transfer into two stages, which they referred to as phases. The first, the duration of which they defined for two to three years, was characterized by a diversified flow of knowledge between merging

⁸⁶ *Foresight* – understood as a systematic, participatory-based process of building medium- and long-term vision, addressing today's decisions and mobilizing joint actions. A study based on A. Gudanowska, *Mapowanie a foresight – wybrane aspekty metodologiczne jednego ze współczesnych nurtów badawczych w naukach o zarządzaniu*, "Współczesne Zarządzanie" 2012, No. 4, p. 103.

⁸⁷ H. Bresman, J. Briskinshaw, R. Nobel, *Knowledge...*, op. cit., p. 45.

companies, with the predominant flow from the acquired to the acquiring company. The second division of knowledge transfer was characterized by the balance of this flow in both directions. Such presentation of the case may, however, be regarded as too unilateral because in knowledge transfer not only flow direction is relevant but also its content, expressed in the types and domains of knowledge transfer, and the periodization presented by the authors omits these issues.

Chapter III.

SUCCESS FACTORS OF MERGING ENTERPRISES IN THE CONTEXT OF THE KNOWLEDGE TRANSFER

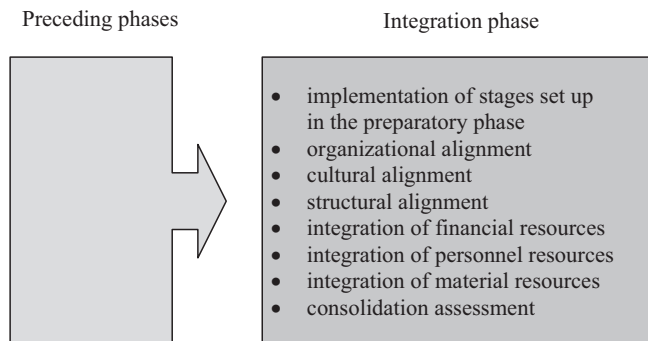
1. Success factors in the context of knowledge transfer

In the discussions so far the motives and objectives of performing mergers and acquisitions in terms of knowledge acquisition and the stages of integration of knowledge resources have been analysed. At this point, it seems reasonable to establish action in each of the integration phases in order to succeed in the form of successful merger and achievement of a specific goal. Therefore, it is important to distinguish the factors that make this success possible and condition it.

At this point it is worth stressing that it is easy to misunderstand here. It is not appropriate to identify the post-merger integration of companies with knowledge integration in consolidated enterprises, i.e. the flow of knowledge between them.

Integration of enterprises does not coincide with knowledge integration (transfer). The first term is much broader conceptually, encompassing all factors associated with the last phase of merger, such as organizational alignment, acquisition of management, assets, etc.

Figure 11. Factors determining success in the integration phase



Source: own study on the basis: A. Herdan (ed.), *Fuzje, przejęcia... Wybrane aspekty integracji*, Uniwersytet Jagielloński, Kraków 2008, p. 31.

Figure 11 illustrates further conditions that should be met within the integration phase. These are also factors that determine the success of the undertaken merger operations. Not all, however, and some, to a small extent, coincide with the conditions required in the knowledge transfer process. Some are only partially related to them. This mainly concerns integration of financial and material resources. On the other hand, the transfer of knowledge coincides with general conditions, more in organizational and structural alignment, and decisively in cultural adjustment and integration of personnel resources. It is understood that the last mentioned are the primary carrier of intellectual capital.

The analysis has covered those success factors that are the main subject of knowledge transfer and those that participate in the process in part.

Among the success factors in the scope of knowledge transfer, the characteristics covered:

- structural and systemic alignment,
- cultural alignment.

However, it seems important to define the time and importance of the activities undertaken, which are aimed at mutual alignment of the integrated enterprises organizations.

1.1. Structural and systemic factors of adjustment

Structural and systemic alignments are a precondition for success, which must be achieved immediately, in the first phase of the integration process.

With regard to systemic alignment, it is considered together with structural alignment, as appropriate organizational structure is constructed depending on the complexity of the management system. As organizational structure understood is „[...] posts occupied by people with assigned tasks (duties), rights and responsibilities, and interconnections present between them that lead to formation of organizational cells”⁸⁸. Out of many similar definitions, the above was chosen as it emphasizes the fact that the organizational structure is in fact the people who have the knowledge relevant to their contracted duties and the relational knowledge that allows them to maintain proper connections among them, especially horizontal and diagonal, as well as connections with the environment. Organizational structure corresponds to the management system adopted in the company, for example, in the hierarchical management a line-staff structure common today is generally created.

⁸⁸ J. Lichtarski, *Struktura organizacyjna przedsiębiorstwa i jej kształtowanie*, in: *Podstawy nauki o przedsiębiorstwie*, Wydawnictwo Akademii Ekonomicznej we Wrocławiu, Akademia Ekonomiczna we Wrocławiu, Wrocław 2001, p. 236.

On the other hand, with a decentralized and more autonomous management system, there are different structures that receive greater discretionary power at the lower decision-making levels, and the role of management, besides the necessary centralization of decisions, also take on features of coordination. In metallurgical enterprises the structure of integrated division dominates, which is a variation of the line-staff structure⁸⁹. This structure, as Strategor⁹⁰ states, is a result that companies with a dominant product, where 70-80% of sales are a single product or line of tightly integrated products, are essentially functional, but their divisions or branches are generally so autonomous that they can manage their diversified business. For functional units in this structure, the task is to ensure the synergy resulting from horizontal connections was foreseen. In this situation, the success factor of knowledge transfer, which is the structural matching, is to find the right direction of the flow of organization knowledge in a functional system, i.e. knowledge transferred from functional cells of one company to the corresponding cells of the other enterprise. This situation can be illustrated by the example of the incentive schemes in the merging companies. There may be variants of knowledge transfer, which indicate that there are three possible states (resources) of knowledge immediately after the merger. Two of them are vectors, and one is scalar. The vectors are the flow of knowledge from the acquired company to the purchaser, the flow from the purchaser to the acquired company, while the scalar is knowledge that is not transferred in any direction.

The example of the incentive system can take into account 3 basic variants. The incentive system of the acquiring enterprise is better, clearer and motivates better, the system of the acquired is better and both systems do not differ significantly or are identical in the essence of the rules. In the first variant, the acquiring enterprise imposes its system (or successfully convinces to adopt it), in the second uses system of the acquired, which shows the objectivity and control over the mood of its own employees, and in the third knowledge transfer variant success factor will be smooth performance of the transfer in the first stage of taking over the enterprise. It is possible here to encounter difficulties in the form of resistance of the former company employees in cases where new regulations, such as bonuses, threaten the level of remuneration and force them to increase labour productivity or tighten the rules of eligibility for bonuses.

Possible additional solution is retaining by the acquired company of its own system, slightly modified by the elements of the acquiring company's system (e.g. leaving the existing system of wage determination).

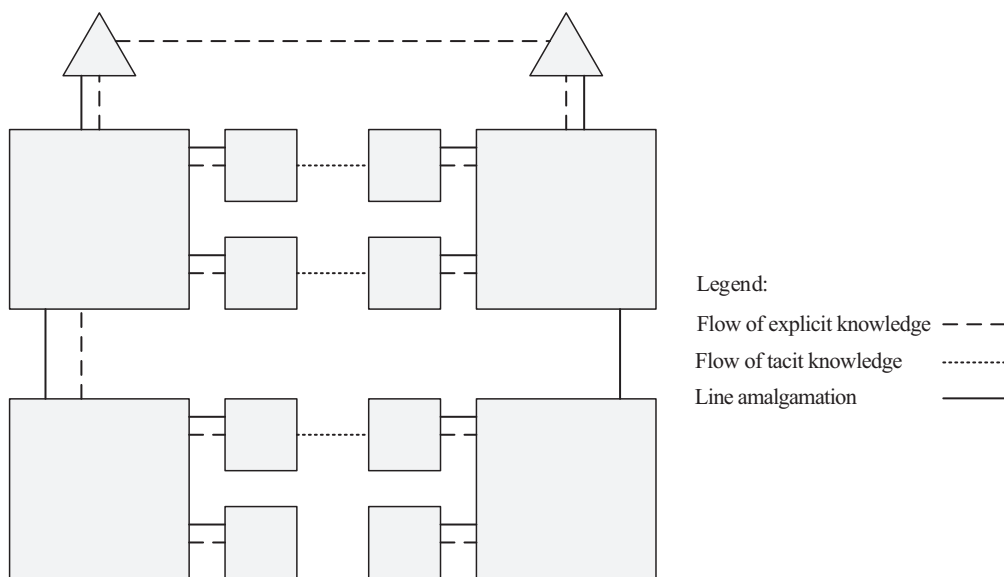
⁸⁹ Strategor, *Zarządzanie firmą*, PWE, Warszawa 2001, p. 325.

⁹⁰ Ibidem, p. 332.

The success factor which is structural adjustment can be briefly approximated by analysing the organizational chart. It is a graphic representation of the organizational structure and, together with regulations, service book and other documents, maps this structure at different levels of governance.

Knowledge transfer takes different routes. Open knowledge, contained in all kinds of documents, can be transferred by the management of the merged company down to the lower levels of management and to the staff units located at these levels. This may lead to the loss of important accompanying elements, which are not recorded but affect the use of the system in practice. These are, for example, very often used explanations and oral interpretations. Therefore, it is worthwhile to organize the meetings of the relevant staff of former independent companies, in order to provide knowledge that can be treated as tacit knowledge. The incentive system is no exception when it comes to transferring knowledge. At the time of unification and merging units, there is a similar flow of knowledge in many organizational units. Figure 12 illustrates the flow of knowledge in an example of a simplified organizational chart of two companies.

Figure 12. Flows of explicit and tacit knowledge within the merging organizational structures



Source: own study.

Another issue, related to adjustment processes, is establishment of transfer destinations for various knowledge areas. Using the previous knowledge classification, it is possible to determine where in the organizational structure (at

least in the analysed industry) the highest flow rate occurs, and which areas it most affects. The problem is not the flow of knowledge in general, as it is rightly noticed by B. Mierzejewska⁹¹ „explicit knowledge, articulated, easily undergoes the transfer processes [...]”, whereas „transfer of tacit knowledge is not an easy task, even within the organization. It is difficult to expect that in case of knowledge transfer between two so far different social groups, the transfer of knowledge could be simple.” Therefore, establishing critical sites for the transfer of tacit knowledge in the process of its flow may be of practical importance in undertaking integration efforts.

Figure 12 shows the streams of tacit knowledge in its previously formulated forms, directed to the organizational structure of the acquired enterprise. The streams reflected by the transfer vectors directed to the acquired company do not differ from those shown in Figure 12 and therefore need not be presented separately.

The presented in figure 13 locations (divisions, staff cells) of tacit knowledge flow indicate the special role of professional experience that is valuable to every management. Hence, it is concluded that, within restructuring, almost always taking place during mergers and acquisitions, this should be taken into account when redundancies are made.

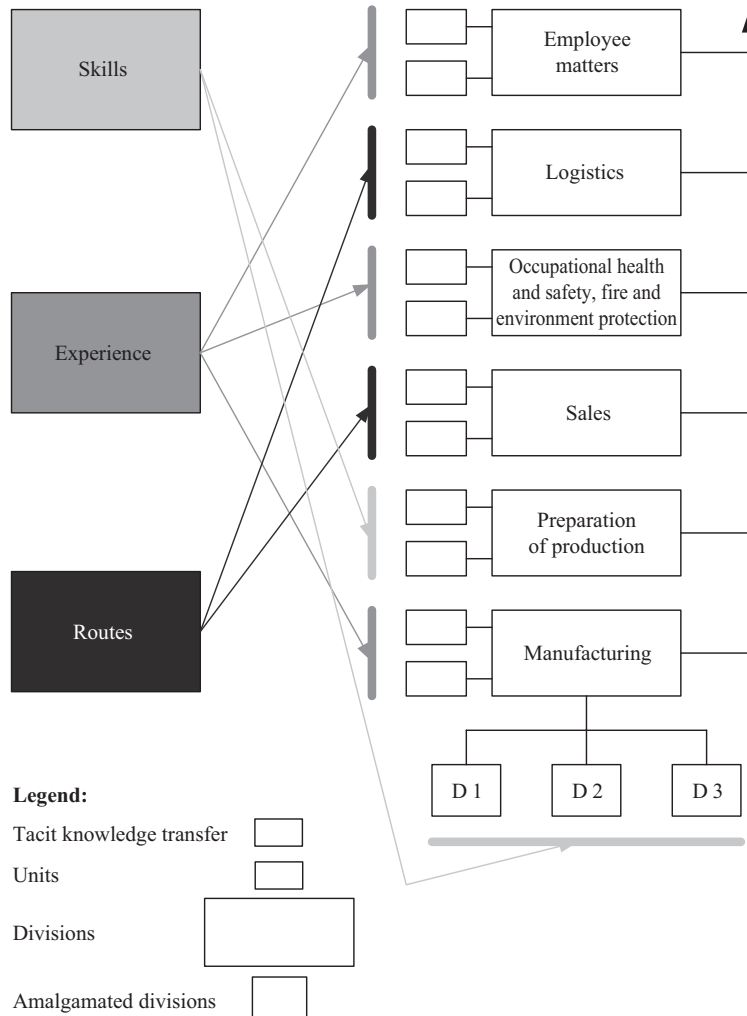
Skills, understood primarily as operational skills, are directed to the manufacturing sphere, and here are generally the least doubts. The new owner deprives of highly qualified staff only in extreme cases.

Relations, as a rule, personal, though seemingly invisible, are the basic attribute of logistics and sales personnel. In case of mergers of companies of horizontal character, these divisions are primarily „victims” of reductions. These works should not be duplicated, but the selection for lay-offs must necessarily take into account relations established by the employees. In the event employees with an extensive network of personal relations leave, there may be serious disruptions in supply and sales.

In addition, it should be noted that in the case of a different set of divisions, the situation will not change significantly. If, for example the list of divisions the R&D division is added (which happens rarely, as it is usually included in the division of General Manager or Production Planning), then certainly tacit knowledge would not be directed there. Work in R&D divisions is generally based on explicit knowledge, and only in very special and rare situations – tacit.

Considered should be the directions of the explicit knowledge, difficult to deal with from the point of view of the adjustment, which are the factor of success (Figure 14).

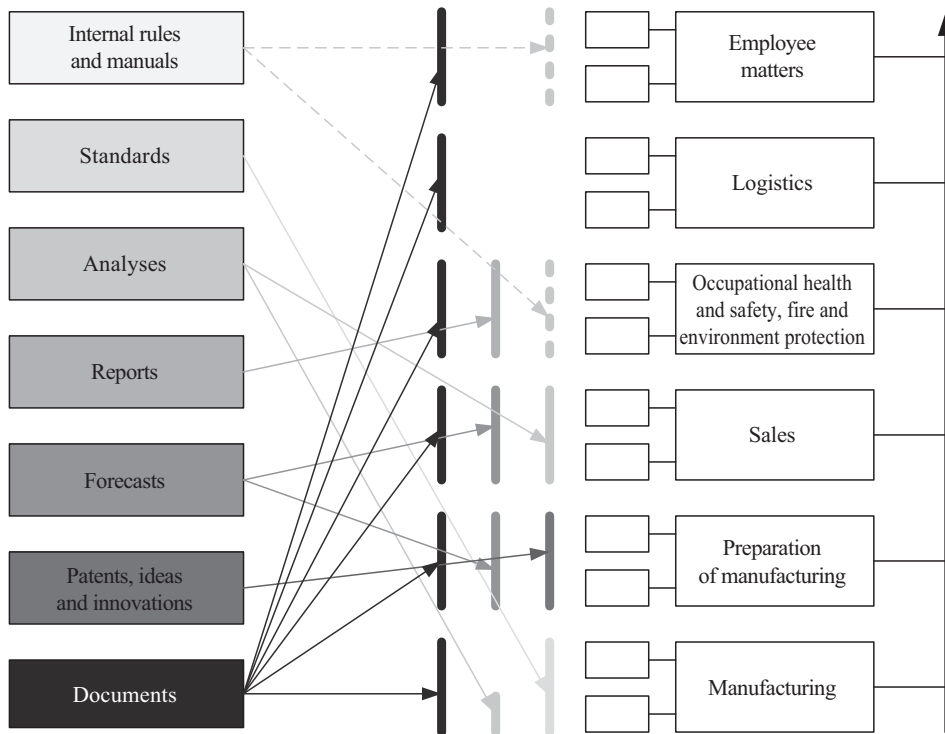
⁹¹ B. Mierzejewska, *Transfer wiedzy...*, op. cit., p. 23.

Figure 13. Simplified flow chart of tacit knowledge transfer

Source: own study.

Analysis of the scheme should begin with the statement that even to divisions and staff units, which any vectors do not lead to from certain types of explicit knowledge, it is transmitted in a certain limited amount. Figure 14 shows typical transfer directions. The most versatile is the transfer of knowledge contained in documents and concerns all divisions, which is understandable, as organizational knowledge of explicit nature usually takes the form of documents.

Therefore adaptation measures, which are a factor necessary for success in the area of knowledge transfer, need to focus on the rapid and correct implementation of joint knowledge documents in the consolidated enterprise. In case of absence of this knowledge, it is difficult to talk about success.

Figure 14. Simplified flow chart of explicit knowledge transfer

Source: own study.

Other types of the explicit knowledge media are of specialist nature and concern one or utmost two vertical divisions as the target of knowledge transfer. The second case concerns analyses, which most often relate to sales (sales and marketing) and manufacturing area (production). This does not mean that analyses are also prepared in other parts of the organizational structure, but they are less frequent.

1.2. Cultural factors of integration

Success factors that determine the success of the knowledge transfer process are the communities that make up the newly consolidated enterprise. The cultural factor of success is reduced to overcoming cultural differences that can undermine the actions taken to transfer knowledge. In particular, it is about breaking the inability to externalise the tacit knowledge and the possible mistrust of its transfer.

In the literature of the subject many definitions of organizational culture can be found. According to Strategor, the most appropriate definition was presented by E. Schein „[...] culture means all of the fundamental assumptions that a group has

invented, discovered and created, learning to solve problems of adaptation to the environment and internal integration [...]"⁹².

This is a very comprehensive definition, but it is not helpful in defining practical goals such as e.g. the role of culture in the merger process. The same author defines organizational culture as „an internal organizational subsystem that enables units to adapt to the environment”⁹³.

The definition of organizational culture was approached even more practically by A. Wojtowicz. According to her „organizational culture is a system of truly recognized and mutually interacting values and norms that determine behaviours, attitudes and decisions in an enterprise, and artificial creations of a given culture, the so-called artefacts”⁹⁴. For the purpose of this paper, we have adopted the definition of organizational culture by E. Morin⁹⁵ „Culture is a system that combines personal experiences of people and accumulated common knowledge, which is recorded and encoded and assimilated only by those who know this code and is also associated with the configuration allowing organisation and structuring of the existing relations, practices and images”. While previous explanations of what culture is were helpful in the strategic management process, the above are useful in the process of post-merger integration. The statement about knowledge acquisition by those who know this code seems particularly important. It follows that to successfully achieve knowledge transfer it is required to create a common code, i.e. a common culture. The further conclusion is that the sooner and deeper the development of a new, common culture or at least an inter-cultural agreement will take place, the easier it will be to transfer knowledge, mostly tacit one.

The second term that requires clarification is acculturation. The first to use this term were R. Redfield, R. Linton and M. Herskovitz⁹⁶, who defined acculturation as a change in the initial patterns of individuals or groups with different cultural background but remaining in constant and direct contact with themselves. According to T. Clark⁹⁷, acculturation is a function of cultural differences. In turn G. Hofstede⁹⁸

⁹² E. Schein, *Organizational culture and leadership*, Jostly Bass, San Francisco 1958, in: Strategor, *Zarządzanie firmą*, PWE, Warszawa 2001, s. 512.

⁹³ Ibidem, p. 432.

⁹⁴ A. Wojtowicz, *Diagnozowanie kultury organizacyjnej w procesie zarządzania strategicznego*, Uniwersytet Ekonomiczny w Krakowie, Kraków 2006, p. 3.

⁹⁵ E. Morin, *Socjologie*, Fayard, Paris 1984.

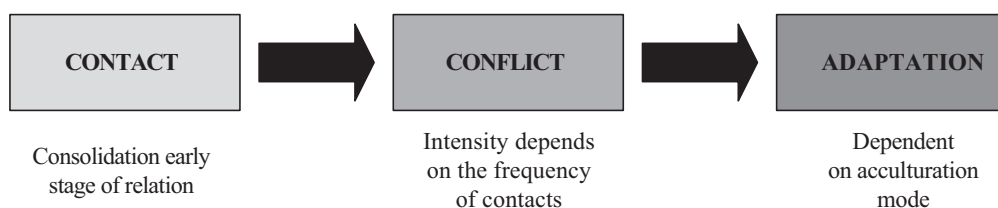
⁹⁶ R. Redfield, R. Linton, M. Herskovitz, *Memorandum on the Study of acculturation*, „American Anthropologist” 1936, No. 38, in: A. Herdan (ed.), *Mergers and acquisitions...*, op. cit., p. 92.

⁹⁷ T. Clark, *International human resource management. Perspectives, Problems, Polycentrism*, Woecester College, Oxford 1994, p. 99.

⁹⁸ G. Hofstede, *Kultury i organizacje. Zaprogramowanie umysłu*, PWE, Warszawa 2007, p. 38.

believes that these differences can be measured and the measurement tool is the scale their size can be evaluated by scoring or ranking. An attempt was also made to identify cultural differences occurring in the Polish and European metallurgical industry, which may be a symptom of a cultural collision referred to in the literature as *clash*. Clash occurs in various forms of contact between two companies, from loose forms of their cooperation up to their merger. In the latter case, cultural differences may be an important factor disrupting the integration process. Cultural clash depends on two factors – cultural distance between organizations, and the frequency of contacts between members of both organizations. This is illustrated by the scheme proposed by A. Nahavandi and A.R. Malehzadek⁹⁹ (Figure 15).

Figure 15. Acculturation in the case of mergers



Source: A. Herdan (ed.), *Fuzje, przejęcia... Wybrane aspekty integracji*, Uniwersytet Jagielloński, Kraków 2008, p. 97.

Within the thematic field of the paper, the following cultural differences were observed:

- local (regional),
- industry related (horizontal connection),
- system (management system).

In Polish metallurgy cultural differences appear to a very limited extent. Ethnic differences do not occur, although „the structure of each organization bears the characteristics of national culture and its participants”¹⁰⁰. Sometimes problems with regional differences in the culture steelworks in particular parts of the country are observed. An example may be the merging of steelworks in Silesia and Dąbrowa Basin, commonly called Zagłębie [*Basin*]. There are considerable differences due to the cultural formation of Silesia during the period of functioning in the German state and the Dąbrowa Basin, being in the Russian partition. In the first case there was a mixed worker environment, consisting of people of Polish or Silesian national consciousness and German nationals, generally related to the then German Empire state apparatus. This situation exerted an influence on relations in metallurgical companies, where the management and administration, which were generally German,

⁹⁹ A. Herdan (ed.), *Mergers and acquisitions...*, op. cit., p. 97.

¹⁰⁰ Strategor, *Zarządzanie firmą...*, op. cit., p. 511.

modelled internal relations in the spirit of German culture (language, discipline, customs, etc.). The organizational culture of the Zagłębie region was different. The environment was definitely Polish, and the partitioner rarely occupied key positions in the factories as they were owned by Western capital. On the other hand, the restrictive actions of the authorities in the field of the workers caused opposition and did not favour discipline in the internal relations of companies. Numerous strikes and demonstrations and low wages and poor working conditions and work safety were not conducive to discipline and regularity. Comparing some of the important features of these two regional cultures, one can observe the following antinomies:

- learned rigour (Silesia) – order based on strength and punishment (Zagłębie),
- cooperation (Silesia) – generally lack of it (Zagłębie),
- discipline (Silesia) – rebellion (Zagłębie),
- national indifference of the majority (Silesia) – strong national identity (Zagłębie).

These historically-shaped characteristics have over time been unified but periodically returned; unfortunately not always in the right direction. The discipline of work was strengthened in Zagłębie, which was influenced by closing plants and unemployment. In Silesia the traditional attitude towards work has gradually declined.

In this situation in the 1990s mergers took place of Companies from Silesia and Zagłębie. For example, when the Polish steelworks holding was established, two Silesian steelworks were merged „Florian” and „Kosciuszko” with the „Katowice Steelworks” located in Zagłębie. Through this consolidation the mentality of the now mixed crews was confronted. Theoretically, it may have been feared that regional differences could hinder the positive effects of the merger. In this case, however, this did not happen. It did not happen because Steelworks „Katowice” SA, which was the initiator of the merger, has already experienced the process of consolidation Silesian steelworks and steelworks from Zagłębie. Steelworks „Katowice” SA has emerged with the use of professional staff from both Silesian and Zagłębie steelworks. For twenty years, the existing cultural differences have been unified, which means that both communities have created a new culture that includes positives of the constituent cultures. In turn co-operation habits created a field for the conflict-free incorporation of „Florian” and „Kościuszko” steelworks. The favourable circumstance was that all three steelworks were territorially distant from each other, and although they were complementary in terms of production, the direct contacts of crews that favoured conflicts were not frequent. This example shows that the clash of cultures in companies where the crews are not ethnically diverse but, for example, only regionally, does not need to be destructive and does

not always require special integration programs, and therefore does not jeopardize the success of the merger.

It should be noted that some of the factors discussed above also include cultural elements.

Examples may be the behaviour of employees working in more hierarchical or more autonomous management systems. A typical metallurgical enterprise has a hierarchical structure, which is justified by the high accident risk associated related to the nature of production. The differences, however, exist and have some limited impact on integration. They become either a delaying factor or, when effectively neutralized, a factor of success.

In conclusion, it can be said that the factors that contribute to the success of knowledge transfer may have different significance. In metallurgical enterprises consolidated horizontally, with a similar organizational structure, varied in size, where cultural differences are small, integration efforts will need to be intensified.

This situation is shown in Table 14 and Figure 16. The magnitude of the impact has been evaluated, as before, by consultation with the subject matter experts. The following influence strength was determined.

Table 14. Contextual cultural factors of knowledge transfer

Factors	Units of influence
Horizontal consolidation	2
Differences in management systems	3
Regional differences	1

As a unit of influence on Figure 14 the length of the horizontal side expressed in centimetres was adopted.

Source: own study.

The data presented in Figure 16 may be helpful in assessing the cultural susceptibility of steelworks to their merger. This method, after possible inclusion of *due diligence* in the scope analysis, may be useful for assessing the impact of the discussed factors on the speed of the consolidated companies integration process. Referring to the values resulting from the chart, it must be stated that they have a de-stimulant character. This means that the larger the size is, the less possibilities of knowledge transfer are. An exception is a horizontal consolidation, which is a stimulant. It may therefore be assumed that the general, high degree of similarity of companies results in the fact that the more they identify themselves, the easier it is to consolidate them and transfer knowledge when it is justified.

The Figure 16 also shows that in the metallurgical industry the differences in management system are of the utmost importance and the regional factor is the least important. In the event that all factors occur simultaneously, there may be obstacles to the transfer of knowledge.

Figure 16. Share of cultural factors influencing the transfer of knowledge in specific situations

1. Steelworks consolidated horizontally, without influence from other factors



2. Steelworks consolidated horizontally, to a certain extent differing in management system (other constans)



3. Steelworks consolidated horizontally, to a certain extent differing in management system and showing cultural and regional differences



Key

Horizontal
consolidation

Differences
in management
systems

Regional
differences

Source: own study.

2. *Transition team* and its role in the integration process

The success of business mergers, including knowledge transfer, depends not only on the right choice of goals and the choice of candidate to combine material and human resources and to overcome the possible cultural distance, but mostly from the efficiency of organizational activities. P.J. Szczepankowski claims that “the success of a merger or acquisition is most often perceived in the strategic alignment of the merging entities or in the convergent cultures of their organization or management”¹⁰¹.

Implementation of the integration process requires much more attention than normal operating activity. For this purpose, it is necessary to create a separate organization, which following a well-prepared plan and having a high degree of autonomy in operation, would ensure that the consolidation of business takes place as seamless as possible. There are different concepts of such an organization. The simplest form of organization is separation, within the organizational structure of the purchaser, of a special unit dedicated to the conduct of merger or acquisition. S. Sudarsanam believes that it can be separated from the planning function and located at the level of the entire enterprise¹⁰².

¹⁰¹ P.J. Szczepankowski, *Fuzje...*, op. cit., p. 150.

¹⁰² S. Sudarsanam, *Fuzje i przejęcia...*, op. cit, p. 49.

Leaving the chief executive to make the final decision, all others would be within the power of the established organization.

In literature, there is generally no separate organization for knowledge transfer. On the other hand, specialized *knowledge creation* teams are often set up. Among the latter there is also a *transition teams*, whose task is to transfer knowledge. „Creating knowledge is not simply about processing objective information. Actually it is subjective and extremely personal activity”¹⁰³. Such activities carried out by a team of professionals from different fields and levels of management require appropriate organization and the responsible person (*project leader*).

Knowledge creation is a transfer, but special. The tacit silent knowledge transforms into an explicit one – it is an individual transfer. Knowledge is transferred to other people. Dissemination of knowledge is also a transfer, often accompanied by a combination of knowledge transferred with the already existing one. However, these activities do not require complicated organization but rather personal effort of interested individuals.

The need for organization occurs when it is working on large projects that require cooperation of many knowledgeable people. The situation is even more complex when knowledge related of large projects is transferred between different entities in the form of alliances or mergers. Then *transition team* is absolutely necessary. Examples here are works done as part of an alliance between „Caterpillar” and „Mitsubishi” by creation of a completely new type of hydraulic loader¹⁰⁴. Similar solutions are suitable by consolidation of businesses in the context of knowledge transfer. This shows that there are different manners and circumstances for solving organizational problems related to the transfer of knowledge between merging companies. Organization of works by merger of business is carried out by a *transition team* in traditional form. In literature of the subject descriptions of the performance of these teams and their context are seen quite often. For example, S. Sudarsanam¹⁰⁵ argues that in some larger companies such as ICI, the takeover management function at the level of the company as a whole is carried out by Mergers and Acquisitions Team (teams A), led by designated managers. It must be admitted, however, that these teams are mainly focused on the pre-implementation phase, therefore they do not fit the concept of supervising the course of knowledge transfer, which takes place in the integration phase. However, during the initiation phase, author of this paper, pointing to the strategic advantages that can be achieved at the acquisition

¹⁰³ R. Howard, *The Learning Imperative Managing People for Continuous Innovation*, in: I. Nonaka, H. Takeuchi (eds.), *The Knowledge Creating Company*, Oxford University Press, New York 1995, p. 229.

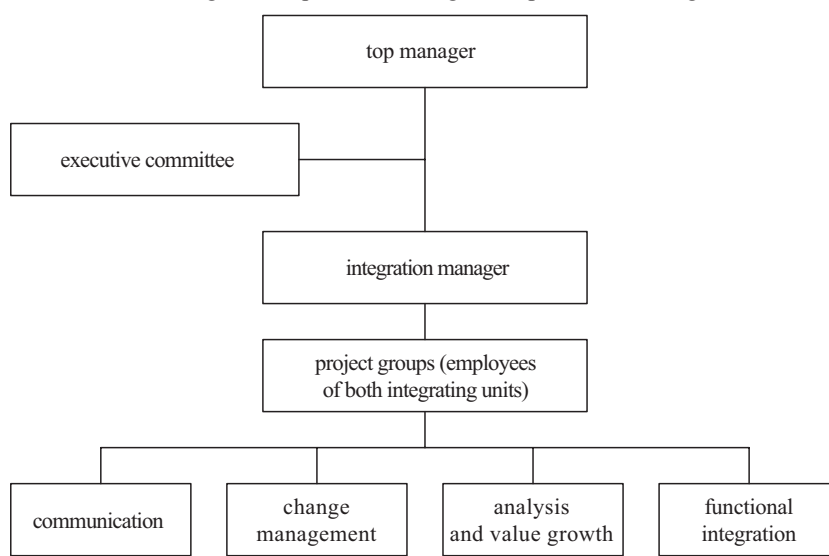
¹⁰⁴ I. Nonaka, H. Takeuchi (eds.), *The Knowledge...*, op. cit., p. 212.

¹⁰⁵ S. Sudarsanam, *Fuzje i przejęcia...*, op. cit., p. 49.

of an enterprise, emphasizes functional skills such as design, product development, production techniques, etc., i.e. elements of knowledge transfer. *Financial Times*¹⁰⁶, listing the benefits of possible consolidations, places functional skills, i.e. knowledge second in the list. Head of such a team, according to M.M. Stuss¹⁰⁷ should become the integration manager. The author points out the tasks of the team, which should focus on forcing speeding up and building success. The first task is to accelerate or monitor implementation. As part of the task which is building success, she draws attention to „managing the flow of best practices between companies”¹⁰⁸, which refers to the transfer of knowledge. According to J.F. de Ross¹⁰⁹ the organizational chart of such a team is shown in Figure 17. The management team is designed to supervise the consolidation stage referred to as *Post Merger Management (PMM)*, i.e. the stage of post-merger management. The tasks of the management team include:

- designation of a new set of objectives for consolidating unit,
- selection of the right integration strategy,
- construction of the target plan for the new organization.

Figure 17. Merger or acquisition management process – management team



Source: J.F. de Ross, *Increasing shareholder value through successful business integration and effective postmerger management*, „Management Review”, September 2003.

¹⁰⁶ „Financial Times”, 11.03.1992.

¹⁰⁷ M.M. Stuss, *Metody oceniania współczesnej kadry menedżerskiej*, Księgarnia Akademicka, Kraków 2003, p. 32.

¹⁰⁸ A. Herdan (ed.), *Mergers and acquisitions...*, op. cit., p. 53.

¹⁰⁹ J.F. de Ross, *Increasing shareholder value through successful business integration and effective postmerger management*, „Management Review” September 2003, p. 78.

In this type of team, it is difficult to isolate tasks related to knowledge transfer. In the event that among the targets there is a direct acquisition of a new technology, innovation or clearly defined object of knowledge, then all works on the action plan focus on the acquisition of the desired object of knowledge. On the other hand, where knowledge is a hidden or non-primary goal, the management team may not be sufficiently fit for the acquisition of tacit knowledge, typically in the functional units of the organization. This task could be directed to the project group. This would, however, require a clear and unambiguous indication of these tasks in the plan and scope of the responsibilities of the mentioned groups. The first task of the team is to implement the consolidation plan. According to H. Johnson¹¹⁰, this plan should be developed prior to the public announcement of the merger. The late construction and publication of the plan may cause delays in the merger process and „the loss of most of the strategic and economic benefits associated with the merger.” This plan foresees the establishment of a team of professionals, which corresponds to the project groups shown in Figure 13. The team consists of functional managers from both companies. The plan is divided into functional areas for which indicative integration dates are estimated. This team can not be too numerous, due to the need to maintain its effectiveness. The activity should be focused primarily on such matters as positions, salaries or managerial competence. An important part of the plan is the alignment or redevelopment of procedures. As you can see, the team referred to has the ability to handle knowledge transfer, but it is not clearly defined either in the structure or in the plan of its activities. The better solutions are teams organized primarily to take over knowledge, resembling organizations described above, known in the literature as a *knowledge-creating crew*¹¹¹. These *transition teams* can be formed in two possible ways. In the first case, the team members keep their current positions and at the same time work for the team designing knowledge transfer. This type of organization was applied in the „Rega” project the alliance for construction of a common, modern hydraulic loader. In the other one they leave for a definite, rather longer, period of time their permanent place in the organization and work exclusively on the creation and transfer of knowledge.

Figure 18 shows actions of the team mission of which is organisation of creation and transfer of knowledge based on the example of a partnership between American Caterpillar and the Japanese Mitsubishi Corporation.

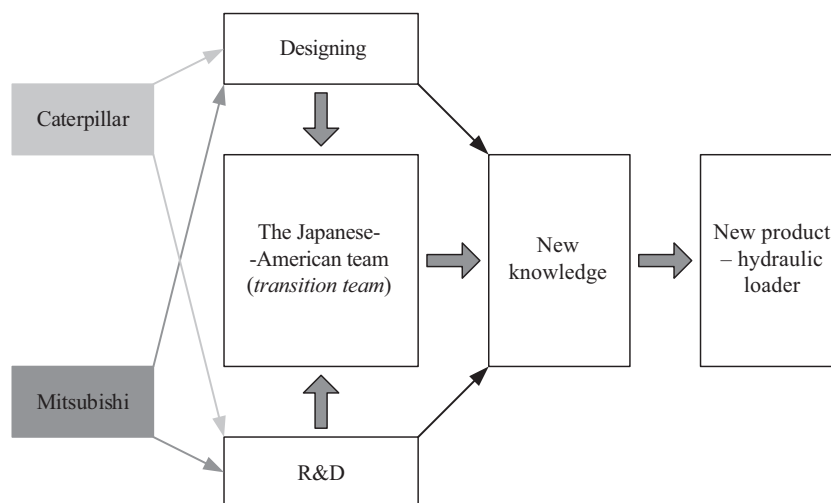
The organization of knowledge creation and transfer shown in Figure 18, demonstrates that the central element is an international unit established in accordance with uniform parity from workers of both companies. This team consists

¹¹⁰ H. Johnson, *Fuzje i przejęcia...*, op. cit., p. 30.

¹¹¹ I. Nonaka, H. Takeuchi (eds.), *The Knowledge...*, op. cit., p. 229.

of employees delegated permanently, with no guarantee of return to the previously occupied position, to design and manufacture a new type of hydraulic loader, defined as a global product, for the markets of Japan, USA and Europe.

Figure 18. Organization of knowledge creation and transfer by designing and developing modern hydraulic loader on the example of Caterpillar and Mitsubishi



Source: own study on the basis: I. Nonaka, H. Takeuchi (eds.), *Knowledge Creating Company*, Oxford University, New York 1995, p. 34.

This does not mean that employees who are seconded to perform this task after completion will lose jobs in their companies, especially in Japan. Quite contrary, in case of success, they may be promoted to higher posts.

It is important that their sole task is to realize the project. In addition to the full working time they have a practically unlimited budget at their disposal. The organization consists of employees with specific engineering specialities from the so-called first-line engineers working both in production and in research and development works. The confrontation of tacit knowledge of the first ones and the explicit knowledge of the latter ones enables a synthesis that facilitates creation of new knowledge, necessary for design and implementation of a new type of charger. The presence of other types of employees, such as marketers, economists, accountants, lawyers, organizers and, above all, R & D staff plays a vital role. It consists primarily of combination of explicit knowledge with the knowledge of production engineers, and also in adjusting the occasionally technically perfect ideas to cost requirements. Among the tasks assigned to a *transition team* or as in the Japanese circumstances the *Knowing Creating Crew*, there are also specific requirements. For example, the team set up by Matsushita to design and implement an automatic home baking machine, besides the basic task, was given cost, price,

aesthetics restrictions, product-related such as taste, smell and ease of use, joy from possession, etc. In case of the Mitsubishi-Caterpillar alliance, additional conditions were also set. Therefore, alongside first line engineers (practitioners) and R&D staff, the team included a group of specialists from other fields – economists, lawyers and marketing specialists. Their role consisted in constant monitoring of refined projects so that they do not exceed the set limits.

The tacit knowledge, discussed and confronted within the team, was subsequently externalized and socialized, so that the project executives possessed the newly created knowledge. This cycle in the team's work was repeated until the management of both companies recognized the process as complete. It should be emphasized that the scheme does not reflect the entire process designed by the *transition team*. This process is not a one off. Knowledge created in one cycle, through combination and reintegration is enriched and appears at the point of departure, but at a higher level, creating a loop. In this case designed charger or built prototype, after not being qualified for serial production and sales, are re-examined by the commission, the second time also confrontation takes place between the knowledge of production engineers and R&D and they then pass the test on a higher level of excellence. This cycle may run several times.

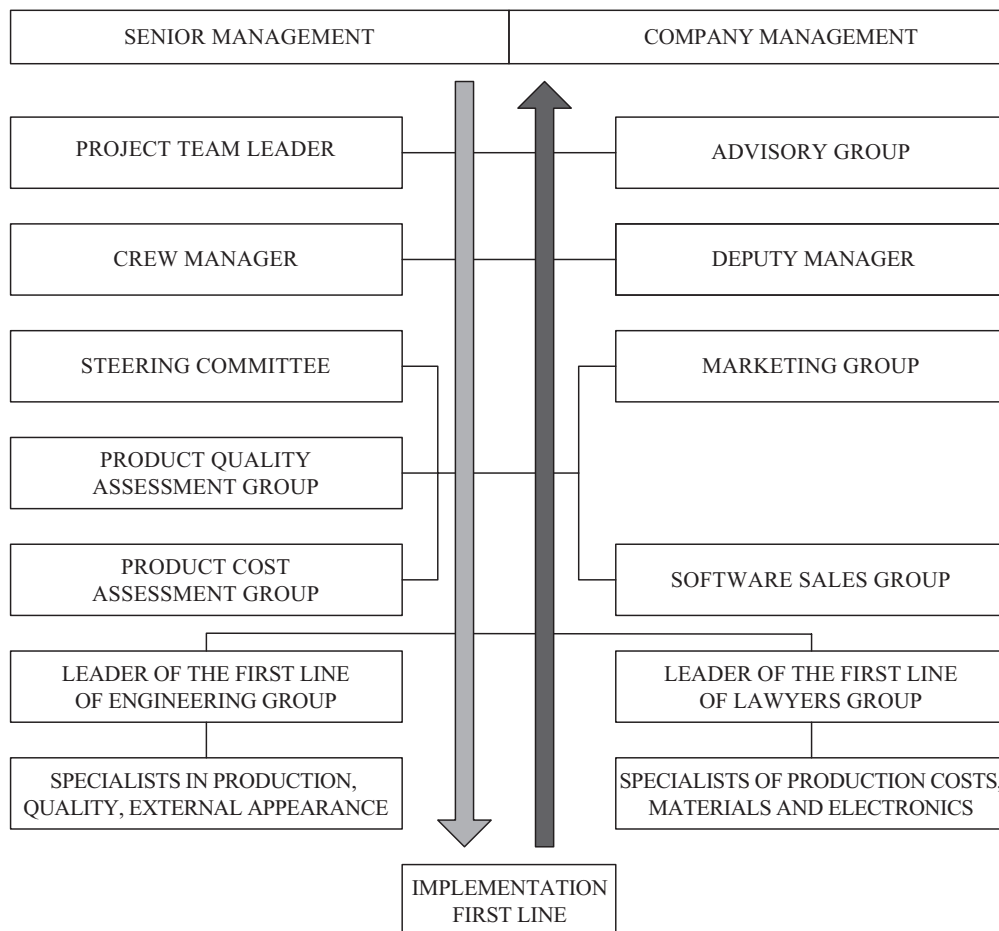
The second type of team is built otherwise. The example of knowledge creation by the company „Canon”, a well-known electronic manufacturer in the world will be considered. The team, which had the character of a task group, has received the task to design a mini copying machine that would meet three basic conditions. Firstly, it would have to make clean and stable copies on a continuous basis. Secondly, it would have to be the smallest and lightest on the world market, and thirdly, it should have sales price at the level of half of the smallest copier on the world market¹¹². The team called the copying machine task force was numerous – 130-200 members. Its characteristic was not only the inclusion of specialists from various areas, but also of different management levels: the corporation management, the middle engineering and research staff and the „first line” workers, i.e. production. This is a special feature for this type of teams due to the interaction of people from different levels of management referred to as *middle-up-down-management*. Figure 19 shows the organization of knowledge creation and transfer.

The basic distinguishing feature of the „Canon” task force from a similar Caterpillar-Mitsubishi group is that the knowledge flow through the various management levels of knowledge (*crossleveling of knowledge*) is taken into account. In this case, there are two directions – from top to bottom (from the company management down to the engineering and research team) and from the

¹¹² I. Nonaka, H. Takeuchi, *The Knowledge...*, op. cit., p. 140–150.

bottom up (from the „first line” workers, i.e. production to middle supervision). After confronting ideas and points of view as well as verifying them and correcting them on both sides, the middle ranks transfer them to the management area of the company. After acceptance or rejection, a reverse re-transfer takes place, reaching the sphere of production.

Figure 19. Organisation of knowledge creation and transfer at three levels of management in the Canon mini copying machine project



Source: own study on the basis: Organization of the task force of the Canon mini copying machine.

This type of product knowledge loop is justified by the need to include two assessment methods. The company's management creates ideas and sets the manner

for implementation, sets up a task force. The ideas of the management board do not always take into account the realities. These realities reach the middle level from below. The middle level confronts them with the ideas of management and transfers them down. This process is repeated until the final decision on production is made by the management and is carried out under specific organizational conditions.

The task force has a wide range of autonomy, including profit and loss. Unlike the previously discussed team, employees are not posted on a permanent basis, but they return to their previous position after completing the task. Due to the new skills acquired in the team, they usually advance quickly. The rule of thumb in the work of the team is to allow for very controversial discussions that foster externalization of knowledge. This does not, however, interfere with the appointment of a similar task force to transfer knowledge between companies, but at least two basic conditions should be met then. First of all, the commission should include specialists from both companies, and secondly, the main member of the system should be the leader of the company initiating consolidation. In the first case, due to the difference (in nature) of the merging businesses interests, the transfer of knowledge might fail, and in the second one the interests of the purchaser must be secured.

From the foregoing considerations it follows that the forms of *transition teams* may vary widely, depending on which companies are involved and what knowledge is to be transferred. Figure 20 shows the various forms of knowledge transfer organization within a business consolidation. It shows the situation in which the team appointed to oversee the merger is a newly formed organizational unit within the existing structure. This type of solution dominates in traditional branches of the economy, including in the metallurgical industry. An example of this may be the manner in which „Steelworks Batory” and „Steelworks Kosciuszko” were incorporated into „Steelworks Katowice”. This is generally sufficient when the main goal of a merger or acquisition is not to acquire any significant innovation but is limited to the transfer of organizational knowledge.

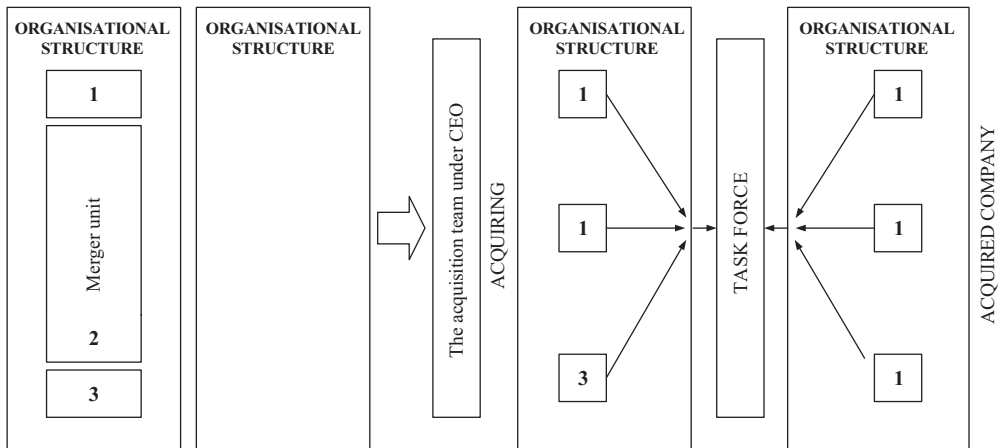
It presents the situation in which the organizational team is transferred outside the organizational structure, creating a separate organizational unit. It is a body set up for a specified period of time or to perform a specific task, but has no greater autonomy, and after completion of works is liquidated. This team is under the director of the acquiring company and all important decisions must be approved by that person. The difference in comparison to variant I is that it mainly consists of its (group) action over time and the lack of functional relations with these types of units in the parent organizational structure. The advantage of this solution is concentration on performing the consolidation unobstructed by other organizational units of the structure, not interested in the problem.

Figure 20. Simplified forms of *transition team* according to the different positions and autonomy in the organizational structure

1. Team within the structure of organisation of the acquiring entity

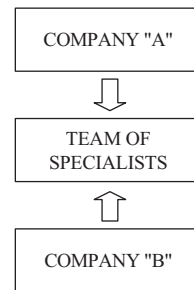
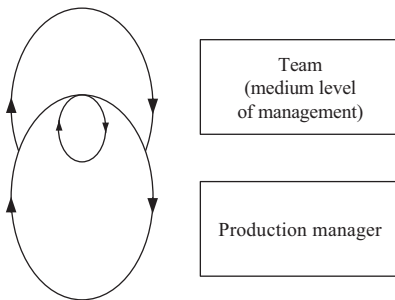
2. Team separated from the organizational structure

3. Team separated from the organizational structure



4. The task force from middle level in connection to CEO and production

5. International Task Force



Source: own study.

The above illustrates organization of a team more diversified in terms of composition and more emancipated from the organizational structure. The team consists of specialists from different functional units of the acquiring company and is a form of task force, and is therefore established only to perform the merger. The novelty is inclusion of the acquired company representatives, albeit often according to different parities. Since the task force is loosely linked to the structure

of the acquiring company, its autonomy is broader. At the end of the work, the group members return to their former positions. Such teams can be seen also in the metallurgical industry.

In the economic practice, you can meet organizations described in point 4 in Figure 20. This type of organization is the domain of Japan and the United States, but such companies are also established in Europe. It can be assumed that they are also used in industrial fields of a raw material and production of intermediate products, e.g. in metallurgy. The presented organization partly eliminates defects of the previously discussed types of mergers and acquisitions management in terms of knowledge transfer through existing structures. However, it can be used for transfers considered simultaneously as creation of new knowledge.

The essence of this type of team organization is, above all, to avoid a situation in which executives impose their ideas on the team or the situation in which they flow from the bottom, from of the so-called first line. The solution is to verify first and second ones at the middle management level, which consists in their flow in double loop through the structure of the verification team. An interdisciplinary team has broad autonomy and can create and transfer new knowledge. This is particularly important when knowledge of high marking importance is created and transferred. However, in the history of mergers and acquisitions in the metallurgical industry, such cases are very rare.

The team diagram shown in point 5 differs from the previous one (point 4) when the international consolidation is performed. The main difference lies in composition of the team, which includes professionals not only from different management levels but also from companies operating in different countries. This team, highly autonomous, can also function as described in point 4. The paper presents the example of alliance between Caterpillar and Mitsubishi. A similar team organization can also be applied for mergers and acquisitions.

In conclusion, it can be stated that the basic types of *transition teams* that perform works related to knowledge transfer between merging companies in the steel industry are generally applicable according to items 1-3.

The activity of these teams is in fact a continuation of the works undertaken at the preparatory stage. Continuing them at the integration phase should be a result of the performed analysis, especially *due diligence*.

3. Due-diligence method and its role in mergers and acquisitions

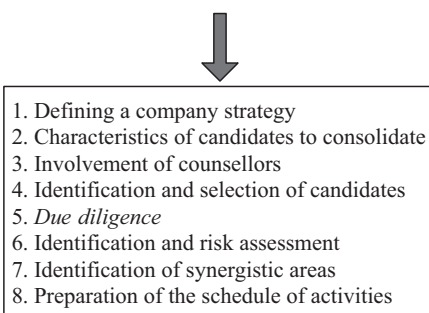
Examining the knowledge transfer process as an important determinant of integration leads to the problem of its location in the overall process of consolidation of enterprises within mergers and acquisitions. This should take place before the merger decision. M. Lewandowski claims that some of the *due diligence* studies are also performed after a formal acquisition¹¹³.

In literature of the subject matter the following phases of analysis are distinguished:

- pre-acquisition, also referred to as preparatory,
- negotiation,
- post-acquisition, also referred to as integration¹¹⁴.

The preparatory phase plays a key role as it allows you to diagnose potential difficulties that may arise after taking over the enterprise. The steps to be taken during the preparatory phase are shown in Figure 21.

Figure 21. Actions to be performed during preparatory phase



Source: A. Herdan (ed.), *Fuzje, przejęcia... Wybrane aspekty integracji*, Uniwersytet Jagielloński, Kraków 2008, p. 30.

The *due diligence* method is the last, extensive research step, followed by a rather narrow and specific research (risk, synergy) or technical (action plan).

Once the candidates have been identified, a preliminary analysis of the *preliminary due diligence* is performed, based on generally available data, generally on financial matters. If the analysed entities do not meet the established assumptions, they are eliminated from the list.

In this manner, the so-called short list is drawn. Candidate is selected as a result of strategic analysis, profitability, and management assessment. Under all these terms there is also an assessment of the knowledge base.

¹¹³ M. Lewandowski, N. Kulpa, *Integracja...*, op. cit., p. 174.

¹¹⁴ A. Herdan (ed.), *Fuzje, przejęcia...*, op. cit., p. 30.

As a result of a possible decision and establishing contact with the candidate company, the companies taking part in the merger or acquisition draw a letter of intent, which includes a *due diligence* analysis.

The *due-diligence* method typically includes the following items¹¹⁵:

- purpose of *due-diligence*,
- rules of conducting *due-diligence*,
- areas covered by *due-diligence*,
- description of the set of necessary documentation,
- list of people who will perform due diligence,
- description of the room in which the *due diligence* analysis will be done,
- schedule for conducting research and analysis,
- list of designated contact people,
- manners of reporting,
- list of people responsible for information,
- additional sources of information.

For the purposes of this paper it is assumed that the following are essential:

- purpose of *due-diligence*,
- areas covered by *due-diligence*,
- description of the set of necessary documentation,
- additional sources of information.

The purpose of the analysis is to reduce the risk. Although among the objectives set before the *due diligence* analysis, knowledge transfer issues are not listed *expressis verbis*, but this issue deserves attention and should be included in their set. Many authors, listing areas of interest in *due diligence* analysis, point to knowledge-related organizational issues. W. Frąckowiak mentions „an analysis of the organization and information system” at one of the top places¹¹⁶.

In particular, he draws attention to organizational structures, indicating the type and dimensions of the organizational structure (configuration, centralization, formalization, standardization). He divides *due-diligence* into three stages:

- analysis performed prior to a formal contract,
- after formalizing the contract,
- verification of research.

The first stage covers all the major areas of business of the company being taken over, and the data is mainly derived from secondary (external) sources. The second stage is characterized by performing work on site and in co-operation with the company. Here the data comes mainly from internal sources. Third stage studies are

¹¹⁵ A. Herdan (ed.), *Fuzje, przejęcia...*, op. cit., p. 34.

¹¹⁶ W. Frąckowiak, *Fuzje...*, op. cit., p. 177.

performed by competent people from outside the company. Their task is to confirm the results obtained so far.

The scope of *due-intelligence* is shown in Figure 22.

Figure 22. *Due-diligence* scope of candidate to acquire analysis

1. Company profile - candidate for acquisition	6. Analysis of markets, products, competition
2. Analysis of production, technology and procurement	7. Analysis of management and staff
3. Analysis of organization and information system	8. Analysis of planning and control
4. Analysis of the financial and tax situation and accounting systems	9. Analysis of research and development system
5. Ecological analysis	10. Legal analysis

Source: W. Frąckowiak (ed.), *Fuzje i przejęcia przedsiębiorstw*, PWN, Warszawa 1998, p. 175.

With the exception of topics 1 and 10, they all to a greater or lesser extent apply to the analysis of knowledge to be acquired. The intensity of the test depends on whether the topic is the main goal of the acquisition or whether it is an acquisition, containing incidental or tacit knowledge. In the metallurgical industry, the most frequent are analyses of production process, technology and logistics (section 2) and research and development system (section 9). The real value of the acquired technology, patents and innovations is being analysed first and foremost. Part two of the analysis concerns organizational knowledge (distributed in many partial analyses), is more complicated for the study. The main elements of the study are: analysis of specific skills and knowledge of staff (point 7), relational knowledge in market analysis and competition (point 6) and analysis of organization and information system (point 3). This does not mean that in other partial analyses, there is no such knowledge, but it is of subordinate importance. However, it should be particularly important to emphasize the importance of studying the organizational structure in all its analysed features, such as centralization, specialization, formalization and standardization, as they usually contain systemic knowledge in the acquired enterprise. However, one has to be aware that the author of the scheme enumerating the areas of interest in the *due diligence* analysis means the analysis of the entire activity of a company in a given field. In any of the aforementioned fields the author does not distinguish knowledge and its transfer as a separate research area. Therefore, an attempt was made to identify (omitted in the enumeration) the knowledge transfer which as a result of the merger should land in the company.

Analysis of the production, technology and supply (logistics) process can produce measurable results. This topic covers both the transfer of knowledge of major importance being the main motive for the merger, and organizational knowledge of a lesser but important significance. It should be emphasized that enterprises in metallurgical industry are particularly analysed in this respect. This group also includes such elements of knowledge as patents, innovations, technologies, etc., which can be an independent motive for merger. At the same time there may be relational connections, characteristic for logistics, which will not be considered as the main motive for the acquisition. Similar knowledge is needed in other topics of analysis. Analysis of the organization and the knowledge system provides valuable insights into the management system in the acquired company is a precondition for entry into day-to-day management without causing disruption. Data on the system is read from the organizational structure by the reflecting organization chart and other documents such as statutes, service books, wage and bonus regulations, etc. The data concerning the degree of centralization of management and specialization, the scope of formalization and standardization, the extent to which the company is centralized and what is the scope of centralization at each level of management.

The analysis provides an indication of the direction in which a unified policy should be pursued so that systemic and structural differences do not cause conflicts and, as a result, reduce or eliminate the effects of the merger. Organizational knowledge is mostly explicit and focused in the field of formalization of activities. In the metallurgical industry, system and structural differences are not great, but in the scope of formalization there can be serious divergences that affect correct functioning of the merged company. The analysis is designed to identify irregularities and its task is also to define differing standards in each of the consolidation companies. The analysis is designed to identify missing standards and those that can complement the standardization of the acquiring company. In systemic matters related to the organizational structure, the entity preparing the analysis must take into account the knowledge of the structure study itself, and state that in the context of a knowledge-based economy, „in the surveyed enterprises the hierarchy is between two and eight levels”¹¹⁷.

Systemic organizational knowledge also includes cooperation issues. „An essential coordination tool present in all categories of analysed enterprises is the organizational hierarchy, to a lesser extent plans and objectives, rules and procedures are used, but committees and meetings are much less organized”¹¹⁸. Examining this

¹¹⁷ P. Cabała, L. Koziół, C.Z. Mesjasz, H. Piekarz, K. Woźniak, *Wyniki analizy struktur organizacyjnych przedsiębiorstw w kontekście gospodarki opartej na wiedzy*, in: A. Stabryła (red.), *Doskonalenie struktur...*, op. cit., p. 296.

¹¹⁸ Ibidem, p. 302.

problem within a systematic analysis is of particular importance. Practice shows that different coordination methods used in components of a new entity can lead to organizational chaos, primarily to questioning decisions based on observation and different methods of coordination in the second part of a merged company.

System-related issues are connected with analysis of information flow. Reasons for interference may be differences in flow efficiency. Information deficiencies, delays and distortions can be identified, and the related lack of rapid contact. Consequently, this analysis concerns information support of business processes. This includes a substantive analysis of the information and presentation of the facts.

Another function that requires research is communication, understood as the systematisation of information resources and messages, and as modules and procedures in which information is conveyed¹¹⁹. All resources and activities that constitute the company's operational knowledge should fall within one of the detailed *due diligence* analyses.

Referring to the financial situation and accounting, the role of knowledge research is less relevant. It is worth noting, however, that the *due diligence* study is hampered in this area because the above-mentioned skills and relations are usually not documented anywhere.

The analysis of markets, products and competition in the scope of knowledge is in crucial aspects coincide with the analysis of production and technology and R&D. It is tacit knowledge concerning details of production and competition, contained in individual minds of employees, very difficult to investigate.

On the other hand, management and staff analysis takes into account both sides of the problem: explicit knowledge, contained in documentation, and knowledge of specific skills that can only be explored by the effects of the work of those who have these skills. Nevertheless, management skills analysis is important.

Equally important is the knowledge of specialized staff, both in administration and in executive posts. Linear level and functional units employees are subjected to partial evaluation in a variety of partial analyses, concerning individual areas within *due diligence*. Consequently, there is no need to mirror ratings. On the other hand, in relation to the highly qualified staff of various specialities it is worth emphasizing that the analysis should assess the opportunities and needs of keeping them in the company and transfer their knowledge.

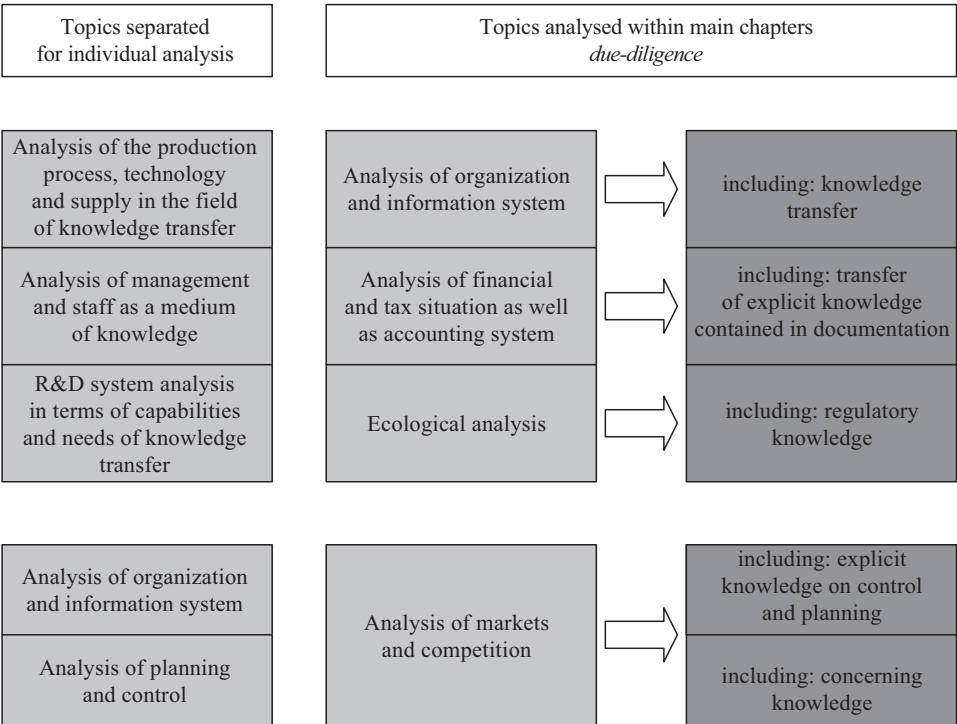
Analysis of planning and control in the scope of knowledge transfer does not entail any major difficulties, since organizational knowledge has (mostly) an explicit character and its transfer is relatively straightforward.

¹¹⁹ T. Małkus, A. Stabryła, S. Wawak, K. Woźniak, *Organizacja systemów zarządzania wiedzą w przedsiębiorstwie*, in: A. Stabryła (ed.), *Doskonalenie struktur...*, op. cit., p. 426–427.

Analysis of the research and development system may contain elements of knowledge important from the point of view of transfer. While at the beginning of the discussion, the great importance of knowledge in the scope of the ready and functioning manufacturing processes, patents, technologies, etc., in the acquired enterprise has been indicated, in the topic of the research and development system, the analysis is more about the degree of advancement and the predicted efficiency of works on development of the company. Their results may seriously affect the company's assessment in terms of the cost-effectiveness of its purchase.

In summary of the above review of the *due diligence* analysis, it should be emphasized that the issues of the production process and production technology, human resources, organization and information system and the state of research – in the scope of company development – should be distinguished from other parts of analysis. Other areas should be considered by investigation of various side features. It is worth to emphasize that *due diligence* is the last analysis prior to purchase of the company and its excessive dragging can lead to a situation where the seller will find another offer.

Figure 23. Scope and areas for completing of the *due diligence* analysis with knowledge transfer issues within the framework of mergers and acquisitions



Source: own study.

The scope and areas complementing *due diligence* with knowledge transfer issues in mergers and acquisitions are shown in Figure 23.

The proposed arrangement is flexible and, if additional research is necessary it may be extended or in case of finding lack of knowledge relevant in certain field, be abandoned. This does not change the fact that the inclusion knowledge transfer issues to the *due diligence* analysis can prevent its loss and can be a potential source of competitive advantage. In view of the above, it can be assumed that the extension of the *due diligence* analysis in mergers will likely produce tangible benefits.

4. Examples of mergers and acquisitions of metallurgical enterprises in the world economy

Selected mergers include mergers and acquisitions between entities within the European Union, as well as cases where one of the parties does not belong to it (e.g. Norway, Russia, Switzerland or Turkey). Single cases have also been taken into account, when the merger or acquisition of non-European companies have taken place, however, taking into account the close links between at least one of the parties to the European Union.

The surveyed population includes merger cases observed from 1998 to 2012 inclusive. 80 cases were taken into account, i.e. 160 metallurgical companies in total, including acquiring and acquired entities. Table 15 lists the official company names and data on registered office, understood as a country. In addition to this information, some data not included in Table 15, referring to moment (year) of consolidation and other important information used in the remainder of this chapter, were used, and due to incompleteness they were not included in the main list. At this point, however, it should be emphasized that the research sample discussed in the next part of the paper contains only complete data, as it was selected from the consolidations, which exhaustive information was available for.

Table 15. Mergers and acquisitions of the metallurgical industry since 1998

No.	Acquiring companies	Countries	Acquired companies	Countries
1.	British Steel	Great Britain	Europipe (AG der Dillinger Huttenwerke and Mannesmannröhren-Werke AG)	Germany
2.	Usinor S.A.	France	Finarvedi	Italy
3.	Usinor SA	France	Cockerill Sambre SA	Belgium
4.	Lucchini SpA	Italy	Ascometal	France
5.	British Steel	Great Britain	Corus JV	Great Britain
6.	Thyssen Stahl	Germany	Thyssen Krupp AG	Germany
7.	Salzgitter AG	Germany	Mannesmannröhren-Werke AG	Germany
8.	Outokumpu Steel	Finland	AvestaPolarit Oyj Abp	Sweden

No.	Acquiring companies	Countries	Acquired companies	Countries
9.	Arbed S.A.	Luxembourg	Arcelor	Luxembourg
10.	Mannesmannröhren-Werke AG	Germany	DMV Stainless B.V.	Netherlands
11.	Vöest-Alpine Stahl AG	Austria	Polynorm N.V.	Netherlands
12.	Sidenor SA	Greece	Stomana Industry SA	Bulgaria
13.	IHC Holland N.V.	Netherlands	Metalix JV	Netherlands
14.	Outokumpu Oyj	Finland	AvestaPolarit Oyj Abp	Sweden
15.	LNM Holdings N.V.	Netherlands	DanSteel	Denmark
16.	Arcelor S.A.	Luxembourg	Duology JV	Luxembourg
17.	CMC Commercial Metals Company	USA	Zawiercie Steelworks (currently CMC Zawiercie S.A.)	Poland
18.	LNM Holdings N.V.	Netherlands	Polskie Huty Stali	Poland
19.	Celsa Group	Spain	Plant in Cardiff (Celsa UK)	Great Britain
20.	Celsa Group	Spain	Huta Ostrowiec SA	Poland
21.	Mannesmannröhren-Werke AG	Germany	Röhrenwerk Gebr. Fuchs GmbH	Germany
22.	LNM Holdings N.V.	Netherlands	Mittal Steel Company N.V.	Netherlands
23.	ISD Corporation	Ukraine	DUNAFERR Company Group	Hungary
24.	SIDENOR S.A.	Greece	Corinth Pipeworks S.A.	Greece
25.	INTEK S.p.A	Italy	Generale Industrie Metallurgiche S.p.A	Italy
26.	ZAO Severstal Group	Russia	Lucchini SpA	Italy
27.	Rautaruukki Oyj	Finland	Ovako JV	Sweden
28.	Mittal Steel Company N.V.	Netherlands	Huta Częstochowa S.A.	Poland
29.	CVC Capital Partner Group Sarl	Luxembourg	Beheermaatschappij Wavin B.V.	Netherlands
30.	Metinvest B.V.	Ukraine	Leman Commodities S.A.	Nigeria
31.	Evráz	Great Britain	Vitkovice Steel	Czech Republic
32.	Evráz	Great Britain	Palini e Bertoli	Italy
33.	ISD Corporation	Ukraine	Huta Częstochowa S.A.	Poland
34.	Mittal Steel Company N.V.	Netherlands	ArcelorMittal	Luxembourg
35.	Schmolz + Bickenbach KG	Switzerland	Ugitech S.A.	France
36.	Celsa Group	Spain	Fundia Reinforcing AS	Norway
37.	Arcelor Steel Service Centres SAS / Mitsui & Co	Luxembourg	AMSA Steel Service Centre	RSA
38.	Arcelor S.A.	Luxembourg	OAO Severstal / Lucchini SpA	Italy
39.	Piombino	Italy	Sungrebe Investmens Limited	Virgin Islands
40.	Voestalpine Profilform GmbH	Austria	Société Automatique de Profilage	France
41.	Arcelor Flat Carbon Steel Europe	Luxembourg	Bamesa Otel, S.A.	Romania
42.	TPG Advisors IV, Inc.	USA	Aleris International, Inc.	USA
43.	Hombérgh Holdings B.V.	Netherlands	Oy Ovako AB	Sweden
44.	Tata Steel Ltd	India	Corus Group Plc	Great Britain
45.	OJSC Novolipetsk Steel (NMLK)	Russia	Steel Invest & Finance S.A.	Luxembourg
46.	Celsa Group	Spain	Zakłady w Mo i Rana (Celsa Nordic)	Norway
47.	Holding Gonvarri S.L.	Spain	Arcelor SSC Slovakia s.r.o	Slovakia

No.	Acquiring companies	Countries	Acquired companies	Countries
48.	Companhia Siderurgica Nacional	BRASIL	Corus Group Plc	Great Britain
49.	Salzgitter AG	Germany	Vallourec Précision Etirage S.A.S	Germany
50.	Pampus Stahlbeteiligungs GmbH	Germany	Ovako Holding B.V.	Sweden
51.	Arcelor Luxembourg S.A.	Luxembourg	Saar Ferngas AG	Germany
52.	KOKS Group	Russia	SIJ – Slovenian Steel Group	Slovenia
53.	Arcelor Netherlands BV	Netherlands	OFZ, a.s.	Slovakia
54.	Celsa Group	Spain	Zakłady w Laracha (A Coruña) (Celsa Atlantic)	Spain
55.	Celsa Group	Spain	Aciérie de l'Atlantique (Celsa France)	France
56.	Metinvest BV	Ukraine	Trametal SpA	Italy
57.	ArcelorMittal Steel Service Centres SAS	Luxembourg	JV	Sweden
58.	NLMK International BV	Russia	Novexco Limited	Cyprus
59.	ArcelorMittal	Luxembourg	Gonvarri Brasil Produtos Siderúrgicos SA	Brazil
60.	ArcelorMittal S.A.	Luxembourg	JV	Turkey
61.	Eramet SA	France	Tinfos A/S	Norway
62.	Outokumpu Oyj	Finland	So.Ge.Par Group	Italy
63.	System Capital Management Limited	Ukraine	Metinvest BV	Ukraine
64.	Mitsui & Co. Europe	Great Britain	Bami Celik Service Sanayi ve Ticaret AS	Turkey
65.	ArcelorMittal	Luxembourg	Noble European Holdings B.V.	Netherlands
66.	JSC Severstal	Russia	Holding Gonvarri Russia S.L.	Spain
67.	ArcelorMittal Netherlands B.V.	Netherlands	Uttam Galva Steels Limited	India
68.	Companhia Siderúrgica Nacional	Brazil	CIMPOR – Cimentos de Portugal, SGPS, S.A	Portugal
69.	Triton Managers III Limited	Great Britain	Non-Wire Business Entities of Ovako Holdings AB	Sweden
70.	Metinvest BV	Ukraine	CJSC Ilyich Steel	Ukraine
71.	ArcelorMittal Bremen GmbH	Germany	Kokerei Prosper	Germany
72.	OJSC Novolipetsk Steel (NLMK)	Russia	Steel Invest & Finance S.A.	Luxembourg
73.	CSN Steel S.L.	Spain	AG Cementos Balboa, SA	Spain
74.	AIF VII Euro Holdings, L.P.	USA	Ascometal S.A	France
75.	Outokumpu Oyj	Finland	Inoxum GmbH	Germany
76.	NV Bekaert S.A.	Belgium	Bekaert Southern Wire Pte Ltd. JV	Singapore
77.	Trinecke Zelezarny a.s.	Czech Republic	ZDB Dratovna a.s.	Czech Republic
78.	Ruukki Engineering (Ruukki))	Finland	Fortaco	Finland
79.	Tri-Langley Acquisition ApS	USA	LRA III ApS	Denmark

Source: own study.

The information presented in Table 15 allows to make comparisons with data from the entire population, which contains more entities than the aggregation of consolidating enterprises.

Under the analysis the following questions also raise:

- Are the consolidations equally or evenly distributed across all European countries?
- Do the EU countries show more or less instances of consolidations than non-EU countries?
- Are the acquiring enterprises distributed fairly evenly across EU and non-EU countries?
- What is the concentration of mergers and acquisitions in each country?

Table 16 shows the countries in which mergers and acquisitions were performed and their number in each country.

Table 16. Location of metallurgical enterprises consolidations in European countries

No.	Country	No. of consolidations	Structure %
1.	Great Britain	10	6,25
2.	France	8	5
3.	Italy	9	5,625
4.	Germany	15	9,375
5.	Netherlands	16	10
6.	Finland	7	4,375
7.	Luxembourg	18	11,25
8.	Austria	2	1,25
9.	Greece	3	1,875
10.	USA*	5	3,125
11.	Spain	11	6,875
12.	Ukraine	8	5
13.	Russia	6	3,75
14.	Switzerland	1	0,625
15.	India*	2	1,25
16.	Brazil*	3	1,875
17.	Belgium	2	1,25
18.	Czech Republic	3	1,875
19.	Sweden	7	4,375
20.	Bulgaria	1	0,625
21.	Denmark	2	1,25
22.	Poland	5	3,125
23.	Hungary	1	0,625
24.	Nigeria*	1	0,625
25.	Norway	3	1,875
26.	RSA*	1	0,625
27.	Romania	1	0,625
28.	Slovakia	2	1,25

No.	Country	No. of consolidations	Structure %
29.	Slovenia	1	0,625
30.	Cyprus	1	0,625
31.	Turkey	2	1,25
32.	Portugal	1	0,625
33.	Singapore*	1	0,625
34.	Virgin Islands*	1	0,625

* A non-European company but closely linked to the EU in economic terms (e.g. tax havens)

Source: own study.

By analysing the data in Table 16, it can be observed that mergers and acquisitions are very scattered, covering as many as 34 states. In individual cases they occur outside Europe, but they are always associated with European capital. Nevertheless, it can be said that several countries are characterized by a higher number and percentage share of metallurgical companies' consolidations. These are countries whose share fluctuates around 10% of the total. These include Luxembourg 11.25%, Netherlands 10% and Germany 9.375%. Luxembourg's disproportionately high share is related mainly to tax issues, albeit independently the country has its own, strongly developed steel industry. In general it can be said that more consolidations are shown by economically developed countries with high GDP. More information on this topic is provided in Table 17, which is organized by the growing number of consolidated companies.

Table 17. The group of consolidation is ordered ascending by list of consolidations

No.	No. of consolidations	Country
1.	1	Switzerland
2.	1	Bulgaria
3.	1	Hungary
4.	1	Nigeria
5.	1	RSA
6.	1	Romania
7.	1	Slovenia
8.	1	Cyprus
9.	1	Portugal
10.	1	Singapore
11.	1	Virgin Islands
12.	2	Austria
13.	2	India
14.	2	Belgium
15.	2	Denmark
16.	2	Slovakia
17.	2	Turkey
18.	3	Greece

No.	No. of consolidations	Country
19.	3	Brazil
20.	3	Czech Republic
21.	3	Norway
22.	5	USA
23.	5	Poland
24.	6	Russia
25.	7	Finland
26.	7	Sweden
27.	8	France
28.	8	Ukraine
29.	9	Italy
30.	10	Great Britain
31.	11	Spain
32.	15	Germany
33.	16	Netherlands
34.	18	Luxembourg
	160	

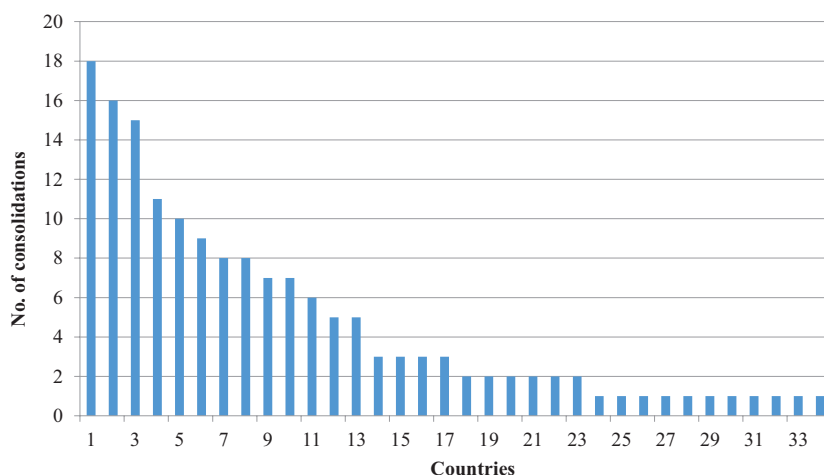
Source: own study.

The presented data show that the arithmetic mean of the number of consolidations per country is 2.42, while the median is 2.5. The slight difference between the two values indicates, however, the existence of a certain asymmetry in the distribution. These are mostly small states, such as Switzerland, Bulgaria, Hungary, etc., and non-European states episodically involved in consolidations, having strong links to European capital. In the group with high numbers of consolidations there are only two non-European countries – South Africa and Brazil. This, however, does not change the overall picture of metallurgical consolidations in Europe. Figure 24 shows distribution of the group.

The analysis of the bar chart leads to the conclusion that the distribution of the examined group of states is not bell-shaped, but is right-angled and represents a positive asymmetry of „J” type¹²⁰. This means the domination of individual or two consolidations in each country. Very high numbers of consolidations concern the most industrially and economically developed countries or countries where consolidations are very numerous but in the form of entities taken over by industrial organizations from highly developed countries. Of course, the most common are mergers of one pair of enterprises, which is in turn reflected by a modal with the value of 1.

Analysis of consolidations by their location due to membership in the European Union or non-EU countries is presented in Table 18.

¹²⁰ J.E. Freund, *Podstawy nowoczesnej statystyki*, PWE, Warszawa 1968, p. 78.

Figure 24. Number of metallurgical enterprises' mergers per state

Source: own study.

Table 18. Number of consolidations by member states of the European Union or non-EU countries

No.	EU member states	No. of consolidations	No.	Non-EU states	No. of consolidations
1.	Bulgaria	1	1.	Switzerland	1
2.	Hungary	1	2.	Nigeria	1
3.	Romania	1	3.	RSA	1
4.	Cyprus	1	4.	Singapore	1
5.	Portugal	1	5.	Slovenia*	1
6.	Virgin Islands	1	6.	India	2
7.	Austria	2	7.	Turkey	2
8.	Belgium	2	8.	Brazil	3
9.	Denmark	2	9.	USA	5
10.	Slovakia	2	10.	Russia	6
11.	Greece	3	11.	Ukraine	8
12.	Czech Republic	3			
13.	Norway**	3			
14.	Poland	5			
15.	Finland	7			
16.	Sweden	7			
17.	France	8			
18.	Italy	9			
19.	Great Britain	10			
20.	Spain	11			
21.	Germany	15			
22.	Netherlands	16			
23.	Luxembourg	18			
	Total	129			31
	Total			160	

* Data on the period before Slovenia's accession to the EU.

** Norway is not part of the EU, but it has strong economic ties and many legal regulations, very close to the EU.

Source: own study.

The presented data show that intra-EU consolidations are more than four times more numerous than in non-EU countries. However, within the Union, the number of consolidations varies widely. The arithmetic average for this group is 5.61 consolidations per country, and the median is 3. This shows a strong asymmetry of distribution.

Among the 11 countries surveyed, there are as many as six countries relatively recently admitted to the Union, and the remaining, being members of the community for a long time, are states economically weaker than the remaining ones. In this group one to maximally three connections were shown. In the second half, with a high number of consolidations, there are highly developed countries, with the exception of Poland. In the group of non-EU countries, the difference – M , i.e. the arithmetic mean and median is also significant (given the much smaller group size) and is $2.82 - 2 = 0.82$ consolidations, which is translated by fairly simply by greater economic potential of countries with greater number of consolidations. As a result, a different division was made, namely the entities that were the acquiring and acquired organizations, also according to the countries in which they took place.

The following list, shown in Table 19, indicates the division of the companies involved in consolidations divided into the acquiring and the acquired.

Table 19. The group of the merged metallurgical enterprises with division into the acquiring and the acquired

No.	Acquiring countries	No. of enterprises	No.	Acquired countries	No. of enterprises
1.	Great Britain	6	1.	Germany	8
2.	France	3	2.	Italy	8
3.	Italy	2	3.	Belgium	1
4.	Germany	7	4.	France	5
5.	Finland	6	5.	Great Britain	4
6.	Luxembourg	11	6.	Sweden	7
7.	Austria	2	7.	Luxembourg	6
8.	Greece	2	8.	Netherlands	6
9.	Netherlands	9	9.	Bulgaria	1
10.	USA	4	10.	Denmark	2
11.	Spain	8	11.	Poland	5
12.	Ukraine	6	12.	Hungary	1
13.	Russia	7	13.	Greece	1
14.	Switzerland	1	14.	Nigeria	1
15.	Virgin Islands	1	15.	Czech Republic	2
16.	Brazil	2	16.	Norway	3
17.	Czech Republic	1	17.	RSA	1
18.	India	1	18.	Romania	1
19.	Belgium	1	19.	USA	1
			20.	Slovakia	1

No.	Acquiring countries	No. of enterprises	No.	Acquired countries	No. of enterprises
			21.	Slovenia	2
			22.	Spain	3
			23.	Cyprus	1
			24.	Brazil	1
			25.	Turkey	2
			26.	Ukraine	2
			27.	India	1
			28.	Portugal	1
			29.	Finland	1
			30.	Singapore	1
Total		80		SUMA	80

Source: own study.

The analyses of the data contained in table 19 leads to the conclusion that acquiring companies (19) are significantly less numerous, comparing to the acquired ones (30). It is worth noting that many highly developed countries also constitute part of the group of acquired companies. A partial explanation of this issue is contained in Table 20.

Table 20. Intra-state consolidations

No.	Intra-state consolidation	No. of consolidations	No.	Intra-state consolidations ordered in decreasing order	No. of consolidations
1.	Germany	6	1.	Germany	6
2.	Luxembourg	2	2.	Luxembourg	2
3.	Netherlands	2	3.	Netherlands	2
4.	Greece	1	4.	Spain	2
5.	Italy	1	5.	Ukraine	2
6.	USA	1	6.	Greece	1
7.	Spain	2	7.	Italy	1
8.	Ukraine	2	8.	USA	1
9.	Czech Republic	1	9.	Czech Republic	1
10.	Finland	1	10.	Finland	1

Source: own study.

Germany shows the absolute highest number of consolidations (6) between German companies. This results from the strive to a clearly visible in the metallurgical industry concentration on acquisition of new technologies and other types of knowledge needed by enterprises to meet the competition.

Other countries, characterised by two consolidations are also those with a strong metallurgy, but the reasons for internal consolidations may be different. The remaining, one-off consolidations have rather incidental character. In the group of acquired companies, the presence of companies from countries, which underwent

systemic transformation is significantly visible. Among them are: Poland (5), Hungary (1), Bulgaria (1), Czech Republic (1), Slovakia (1). After deduction of intra-state transformations in developed countries, it turns out that generally acquired are metallurgical enterprises in the states with lower-tier economies.

However, by analysing the group of metallurgical consolidation it is worth to note their geographical distribution, but also distribution over time, as presented in Table 21.

Table 21. Number of consolidations in each year of the examined period

No.	Year of consolidation	No. of consolidations	Structure %
1.	1999	4	7,02
2.	2000	1	1,75
3.	2001	4	7,02
4.	2002	2	3,51
5.	2003	4	7,02
6.	2004	5	8,77
7.	2005	6	10,53
8.	2006	4	7,02
9.	2007	8	14,04
10.	2008	7	12,26
11.	2009	2	3,51
12.	2010	2	3,51
13.	2011	2	3,51
14.	2012	6	10,53
Total		57	100,00

Source: own study.

Since 2000, which was characterized by almost total lack of consolidations, a not steady increase was observed, which reached its apogee in 2008. Then one can see quite sharp decline until 2011. In 2012 again an increase began, which this study does not cover. The initial strong growth, followed by the equally strong decline in the number of consolidations should be linked to the level of economic activity on the steel market. Mergers and acquisitions also involved (in certain cases) the transfer of knowledge when it was the main reason for the transaction. Therefore, an analysis has been performed of countries in which growths and declines have been recorded, in relation to their economic potential.

Table 22 lists the number of consolidations in each of the years of the period under study.

Table 22. Number of consolidations in each year of the examined period

Year of consolidation	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	X
France	2								1	1				1	5
Italy	1						2		2	2					7
Great Britain	2				1		2		1			1			7
Germany	2	2			1	2			4				1	1	13
Finland			2				1			1				3	7
Belgium	1													1	2
Sweden			2				1	1	1	1		1			7
Luxembourg				2			1	1	1	2	1		1		9
Netherlands			1	1	1	3	1	2			1				10
Austria			1												1
Greece			1			2									3
Bulgaria			1												1
Denmark				1											1
USA					1									1	2
Poland					2	1	1								4
Spain					2			2	3		1			2	10
Ukraine						1	1			3		2			7
Hungary						1			1						2
Russia							1			1	1		1		4
Czech Republic							1							2	3
Norway								2		1					3
India									1						1
Slovenia									1						1
Cyprus										1					1
Brazil										1					1
Singapore													1	1	2
Σ	8	2	8	4	8	10	12	8	16	14	4	4	4	12	114
max.	-	2	-	2	-	3	-	-	4	3	-	2	-	3	
range	1	0	1	1	1	2	1	1	3	2	0	1	0	2	
modal	2	2	1	2	1	1	1	2	1	1	1	1	1	1	

Source: own study.

When analysing the data from Table 22, the following conclusions were drawn, regarding the number of consolidations in each year:

- in most cases, the distribution between countries in a given year is flat, as evidenced by the modal, in most of the years equal to 1 and a very small range, which in one case only reaches 3 units;
- the exception is the years 2004-2008 of the peak economic recovery in which the structure of the group, according to the countries involved in the merger and acquisition process, exhibited certain characteristics. Accepting

all consolidations, e.g. in 2007 as 100% – Germany participated in 25% of them and Spain in 19%;

- the maximum number of consolidations concern companies from Germany (4), Spain (3) and Ukraine (3). In the case of Ukraine this is due to the special character of the metallurgical industry in this country, characterized by the desire for an internal oligopoly.

The analysis performed in this chapter covers the total number of consolidations in structural cross-sections, by: acquiring and acquired companies, number of countries in which they occurred, time of performing mergers and acquisitions, and distribution in years by country. On the basis of the data obtained from the data analysis, the selection of subjects for the test was made.

Chapter IV.

ISSUES AND ORGANISATION OF OWN RESEARCH

1. Model of knowledge transfer in the processes of mergers and acquisitions

The ambiguity of the notion of model derives from the fact that this notion occurs in various scientific disciplines.

By „model” generally a simplified representation of a complex object is understood¹²¹. Construction of a model may strive to know the existing, complex state of things, i.e. structure, functioning and development. For modelling results to be scientifically valid, it must be verified by simulation¹²².

The notion of a model can be understood as a copy of a complex system that we intend to study¹²³. Among the reasons justifying the need to create models are¹²⁴:

- focusing on important features of the system, omitting the less relevant ones,
- introducing changes and corrections that are adequate to requirements of the user (low cost and minimal risk),
- verifying that the user environment is understood and documented in a manner allowing the designers and programmers to build the system.

We distinguish many different types of systems. It can be assumed that everything we encounter in everyday life is the system or its component. According to *Webster's New Collegiate Dictionary* it is:

- a group of interacting, interrelated, or interdependent elements forming a complex whole,

¹²¹ A. Groble, *Metodologia nauk*, Areus, Znak, Kraków 2006, p. 175.

¹²² S. Sudół, *Badania naukowe w zakresie zarządzania*, in: *Dynamika zarządzania organizacjami. Paradygmaty – Metody – Zastosowania. Księga pamiątkowa wydana z okazji 50-lecia pracy naukowej prof. zw. dr. hab. J. Rokity*, Prace Naukowe Akademii Ekonomicznej im. Karola Adamieckiego w Katowicach, Katowice 2007, p. 373–374.

¹²³ L.J. Krzyżanowski, *O podstawach kierowania organizacjami inaczej. Paradygmaty, metafory, modele. Filozofia, metodologia. Dylematy, trendy*, PWN, Warszawa 1999, p. 28–45.

¹²⁴ E. Yourdan, *Współczesna analiza strukturalna*, WNT, Warszawa 1996, p. 120.

- an organized set of doctrines, ideas or rules designed to explain the construction or operation of a certain systematic whole,
- harmonious interaction or order,
- organized society or social situation treated as sustainable organization¹²⁵.

Increase in complexity of the designed systems results in increased demands for the designed systems. New design techniques are being sought to shorten the design cycle and achieve the highest quality design solutions. One of the key capabilities in this area is the extensive use of modelling technique. The essence of modelling is to present the original in a simplified manner.

The original is understood as a slice of reality in terms of existing or future real physical objects or processes. Model is an abstract design, representation of the original, obtained by omitting its insignificant properties that are not of interest in this dissertation. The model, i.e. a substitutionary form of the original, is less complex than the presented reality, and therefore easier to use for research or design purposes. The model is a quantitative, qualitative or quantitative-qualitative representation of the original that allows mapping, understanding and exploring the essential features and relations between the factors that were considered. It is a compromise between the desire to faithfully represent the studied part of reality (in the scope of including the largest possible number of factors) and the possibility of its reflection (the more factors the model considers, the more difficult it is to build the model and its study and inference). It can be observed that the simpler the model is, the more abstraction it contains.

The closer a model comes to reality, the more impact factors will occur, and the more difficult it will be to master such a model. Therefore, to create a model it is necessary to adopt simplistic assumptions and constraints that will always be the reason for provoking discussions about relations between the model and the reality.

The sense of modelling consists in the fact that the model is more convenient for research than the original, without incurring excessive costs. For modelling, two issues are of crucial meaning:

- purpose for which the model is created,
- mutual correlations between model features and original features.

By building a model we overlook certain features, leaving others. The aim of abstraction, as the most important element of modelling, is to separate the non-essential features (due to the model's purpose) from the relevant ones, i.e. the ones that are the subject of interest and subject to research. The degree of simplification of the original features for needs of the model is influenced by the correlation between individual properties of the original. One cannot allow here to reject the feature

¹²⁵ G. & C. Meriam, *Webster's New Collegiate Dictionary*, Mass Company, Springfield 1977.

strongly correlated with the attributes of great importance (in this paper), as this would lead to an incorrect model.

Modelling is fundamentally based on the principle of isomorphism, i.e. mutual equality of physically diverse phenomena. This allows to reproduce or express real phenomena and objects, using isomorphic models, which differ from their original in physical characteristics. The isomorphic model is more suited to testing than the original. In constructing the model, apart from the isomorphism principle the principle of analogy is applied¹²⁶. Analogy is a kind of similarity of phenomena. It is used in all areas of human activity, including design. When analysing a complex design problem for component problems, the similarity between them and problems already solved or analogies to other problem classes is often observed.

Models are characterized by some characteristic traits that embody their essence:

- **hypothetical nature** – the model is a „supposition” that the original shown in simplified manner represents it well;
- **subjectivism** – the model is a reproduction of the original in a degree determined by the needs;
- **relative simplicity** – the model is a simplification that seeks to limit the number of values occurring in it and correlate them, or to limit the form of the dependencies;
- **diversity** – different models of the same original for different purposes coexist; this is even necessary as it allows the original to be reproduced from different points of view.

Based on the study of literature of the subject matter, the basic characteristics of knowledge transfer between the merging companies have been identified. Very often, models are used to analyse various phenomena. In the modelling process we also use the language of mathematics and logic¹²⁷. The characteristics of the model do not coincide, however, with characteristics of the described phenomenon, in this case transfer of knowledge. The model contains less of them than in the process described by them. This is a necessary simplification, since the possible inclusion of the model to the *due-diligence* analysis should not lead to its excessive complication. Obtaining data to use a very advanced model would be impossible in practice. Besides, incorporating the principle of the universe of phenomena in the model prevents it from being built. By constructing a model, we leave out all variables in it, limiting ourselves to the most important ones¹²⁸.

¹²⁶ L.J. Krzyżanowski, *O podstawach kierowania...*, op. cit., p. 37.

¹²⁷ T. Trzaskalik, *Modelowanie optymalizacyjne*, Absolwent, Łódź 2001, p. 5.

¹²⁸ S. Bartosiewicz, *Modele ekonometryczne – kwalifikacja zmiennych występujących w modelu*, in: Z. Hellwig (ed.), *Zarys ekonometrii*, PWE, Warszawa 1970, p. 13.

Contemporary social sciences, such as knowledge management, use mathematics, and usually form the norms in society in the following manner: the value of the phenomenon X is a function of the values of the phenomena $V, W, Y, Z \dots$ ¹²⁹. This results in the need for granting an analytical character, which is primarily comes down to construction of the model and estimation of its parameters.

The main purpose of developing a research model is to calculate the total time of knowledge transfer in the planned process of businesses' consolidation as part of their merger or acquisition.

Firstly, function of the target or function-criterion is set. The purpose of knowledge transfer is to gain knowledge from the acquired company. The advantage may also include the transfer of own knowledge to improve the condition of the new, merged company and increase its market value. Delay in the transfer of knowledge, as part of enterprise integration, results in loss of benefit. Patents, innovations, management and crew skills as well as organizational knowledge transferred too late often result in loss of benefit, for example from the planned synergy.

Therefore, the measure of the transfer success is time. In each unit of time, the company that acquired the other company gains a certain substantial advantage. The delay in transfer also causes a countable loss. Therefore, as a measurable variable, constituting a function-criterion, the total time of knowledge transfer should be assumed. The shorter the time, the greater the benefit from application of the acquired knowledge will be. If we denote this time as Y_n , then we should strive for this to be as small as possible, i.e. $Y \rightarrow \text{minimum}$. The next step in the analysis is selection of variables that shape the value Y_n . These variables are the amount of knowledge transferred. It can be expressed by averaged times, necessary to convey it.

The knowledge transfer should not, of course, be understood mechanically as covering a certain distance from one business to another. Transfer is understood as mastering (learning) knowledge, understood as skills, relations, powers or experience. Such transfer is not possible immediately and it must take a certain time, especially with regard to tacit knowledge. This period, measured in months or seldom in years, can be a measure of the knowledge transfer effectiveness.

The fact that the model explains several variables mentioned above, and what the variables are requires explanation. While striving to convey knowledge as a whole, however, (as already mentioned) there are different kinds of knowledge with different degrees of perception. This causes – depending on whether it is *tacit* or *explicit* knowledge, whether it is more or less complicated, whether it is provided easily or difficult, willingly or reluctantly, etc., the transfer times to differ significantly.

¹²⁹ Ibidem, p. 56.

Therefore, in the first equation of the model four variables x_n (x_1 x_2 x_3 x_4) are provided. Each of them represents another type of knowledge, interpreted as the time necessary to master it, counted in the months of transfer. These times may take different values due to circumstances, such as resignation from the transfer of certain kind of knowledge or vice versa – because of finding additional sources of knowledge. They can also be used for experimental calculations, namely to answer the question of how long it will take to wait, for example, for a particular technology to be acquired if the company is planning to acquire a particular technology.

When forming knowledge into larger groups, introduction of the following variables is proposed¹³⁰:

- x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies, etc.);
- x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. specific managerial competencies, unique contractor skills, etc.);
- x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.);
- x_4 – organisational knowledge characteristic of certain enterprises (pay system, regulations, protocols, important legal documents, etc.).

The variables described above were grouped on the basis of conclusions drawn from the previous chapters, discussing the division of knowledge transferred into types and categories.

Variables x_n define the „mass” of knowledge to transfer, but do not indicate its meaning, which varies according to the type of knowledge. It is necessary to have coefficients with constant character, which can differentiate knowledge transferred on account of its significance.

These coefficients will be identified by the symbols A, B, C, D.

Expert qualifications¹³¹ have allowed to propose to companies operating in the metallurgical industry the coefficients assigned to particular types of knowledge.

The method of expert consultation aimed at gathering opinions that served to formulate a position concerning the importance of knowledge significance due to the motives behind its transfer.

Expert consultations took place through meetings with scientists from the AGH University of Science and Technology in Kraków and an institute specializing in

¹³⁰ The procedure for identifying and dividing the knowledge factors, related to the set research goal was based on a critical analysis of the subject matter literature, the author's experience and suggestions of the people directly related to the researched subject.

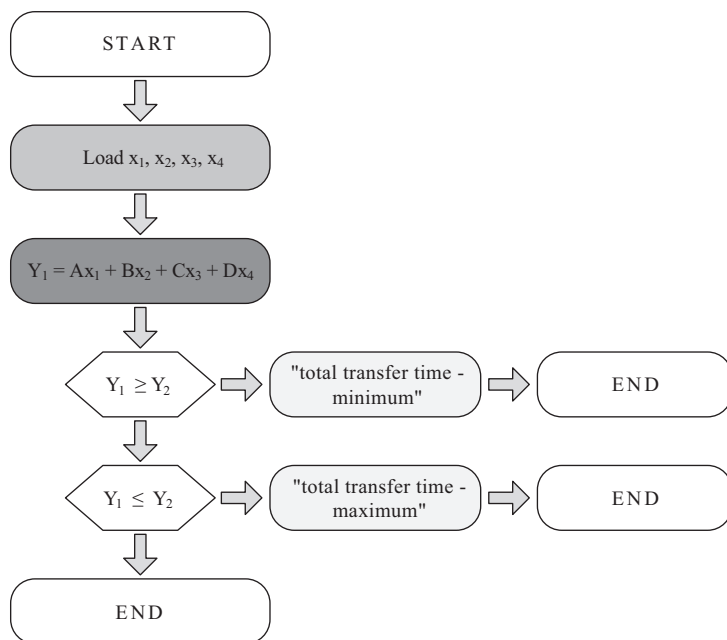
¹³¹ Z. Fend, *Expert Consultation – Comprehensive Analysis Method on the 2-mode Network of Expert Consultation*, Dept. of Autom., Tsinghua University, Beijing, China, BCGIN, Shanghai, October 2012.

analyses of the iron and steel market. Through expert and consultation workshops in the form of directional recommendations and suggestions, a recommendation was formulated in the form of A, B, C and D coefficients.

They assume the following values: $A = 4.0$, $B = 3.0$, $C = 1.5$, $D = 1$.

Taking into account the above-mentioned coefficients (and their values: $A = 4.0$, $B = 3.0$, $C = 1.5$, $D = 1.0$) the diagram illustrating the impact of particular types of knowledge, taking into account their importance for knowledge transfer, is as follows.

Figure 25. Type of knowledge and its importance for transfer



Source: own study.

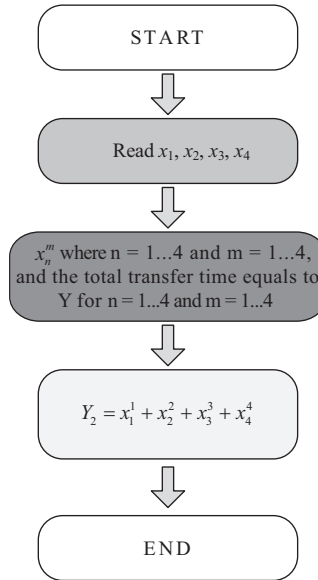
The best situation would be when the Y value, that is, the total transfer time, would be the smallest, i.e. when $Y \rightarrow \text{minimum}$.

The transfer operations described above are not sufficient, as they do not cover a different situation where the acquiring enterprise not only collects the knowledge from the acquired company, but also gives it in order to increase the goodwill and gain additional benefits.

This is a transfer of knowledge in direction contrary to the previous one, as referred to in the second chapter. In this case, flow vectors of opposite directions will not neutralize each other, but they add. This is due to the fact that it is certainly not the same knowledge.

As a result of identification of the knowledge flow variables from the acquiring enterprise to the acquired company by x_n^m , where $n = 1 \dots 4$ and $m = 1 \dots 4$, and the total transfer time is Y , for $n = 1 \dots 4$ and $m = 1 \dots 4$, the equation shown in Figure 26 is obtained.

Figure 26. Knowledge transfer time



Source: own study.

Superscript $m = 1$ means knowledge transfer from the acquiring entity to the acquired company, and after the coefficients are given it takes the form:

$$Y_2 = 4x_1^1 + 3x_2^2 + 1.5x_3^3 + x_4^4. \quad (1)$$

It is only the total time of knowledge transfer in both directions, that is, from the acquired to the acquiring and vice versa, that determines the final transfer time and transfer of knowledge. This is expressed by the sum of both equations.

$$Y_1 + Y_2 = 4(x_1 + x_1^1) + 3(x_2 + x_2^2) + 1.5(x_3 + x_3^3) + (x_4 + x_4^4). \quad (2)$$

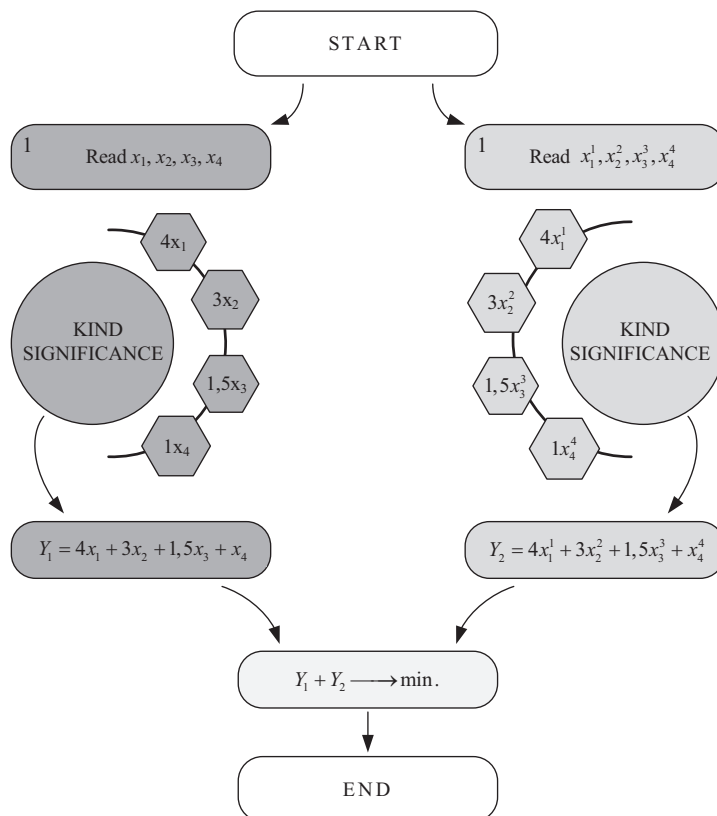
Equations that constitute model being the basis for further reflection (Figure 27).

As with any other model, the following equation is limited by defined boundary and organizational conditions. The description of the variables shows that they must satisfy the weak inequality $x_n \geq 0$ and $x_n^m \geq 0$.

In practice, knowledge cannot have a negative value; at most, it may not be useful, meaning zero.

Organizational conditions have other characters. Transfer taking too long, i.e. mastering the knowledge of the other company, must be limited in time. 5 years is the maximum time during which knowledge transfer takes place. This limitation was adopted for variables: $x_n \leq 60$ months and $x_n^m \leq 60$ months.

Figure 27. Model of knowledge transfer in the processes of mergers and acquisitions



Source: own study.

Verification of model operation was performed on fictitious data:

$$x_1 = 6 \text{ months}, x_2 = 5 \text{ months}, x_3 = 2 \text{ months}, x_4 = 1 \text{ month},$$

$$x_1^1 = 0 \text{ months}, x_2^2 = 3 \text{ months}, x_3^3 = 2 \text{ months}, x_4^4 = 1 \text{ month}.$$

After placing these values in the formulas, the following were obtained:

$$Y_1 = 24 + 15 + 3 + 1 = 43 \text{ months},$$

$$Y_2 = 0 + 9 + 3 + 1 = 13 \text{ months},$$

where:

Y_1 – total transfer time for the acquiring enterprise

Y_2 – total transfer time for the acquired enterprise.

This means that in the example given, the transfer of knowledge will take a total of 56 months. Vector of knowledge transfer is 13 months.

Each transfer requires action and application of appropriate measures: human, material and financial, which are limited. Assuming, however, that an enterprise is particularly keen on the accelerated transfer of certain type of knowledge, such as important technology, it can shift engineers and staff involved in organizing the transfer of other knowledge to work on mastering the new technology. This allows, for example, to shorten the time at transfer x_1 by 1 month, at the expense of increasing the transfer time of knowledge passed x_2^1 by this value. Then the new variables will take the following values:

$$x_1' = 5 \text{ months}, x_2' = 5 \text{ months}, x_3' = 2 \text{ months}, x_4' = 1 \text{ month},$$

$$x_1^1 = 0 \text{ months}, x_2^2 = 4 \text{ months}, x_3^3 = 2 \text{ months}, x_4^4 = 1 \text{ month}.$$

After placing new values of variable x_1' and x_2' the equations will take the following form:

$$Y_1 = 4 \times 5 + 3 \times 5 + 1.5 \times 2 + 1 = 39 \text{ months},$$

$$Y_2^1 = 4 \times 0 + 3 \times 4 + 1.5 \times 2 + 1 \times 1 = 16 \text{ months},$$

$$Y_2^1 + Y_1 = 39 + 16 = 45 \text{ months},$$

whereas

$$Y_1 + Y_2 = 43 + 13 = 56 \text{ months},$$

therefore

$$(Y_1 + Y_2) - (Y_1^1 + Y_2^1) = 56 - 55 = 1 \text{ month}.$$

In this manner, the time for learning knowledge has been reduced by 1 month. It brings benefits of transferring new knowledge in time shorter by 1 month. This is purely theoretical deliberation, but shows the benefits (or losses) resulting from shifts and concentration on the transfer of a particular type of knowledge.

When considering the opportunity to acquire valuable knowledge from two different consolidations, the speed of transfer and the benefits of choosing each one can be compared. The problem is obtaining relevant information, but if it can be achieved, for example, within in-depth *due diligence* analysis, it would make selection of a candidate for merger easier. This is the case where the purpose of the merger or acquisition is the transfer of knowledge, otherwise the results of the analysis through the presented model would only be of an auxiliary nature.

2. Characteristics of selected research methods

In order to obtain credible test results, verification of research thesis and give a full answer to the research questions, a multi-stage research sequence was applied, based on triangulation¹³² understood as multiplying:

- research methods and techniques (*methodological triangulation*¹³³, which consist in the use of multiple research methods),
- data (*data triangulation*¹³⁴ – use of data from different sources).

Triangulation is a methodological method consisting in „illuminating” the subject of research from as many various sides as possible, and considering different approaches for mutual verification, complementation, relativization, and clarification¹³⁵.

For the final result application of several test methods simultaneously is very beneficial. Then more comprehensive illumination of the research problem is obtained and the danger of unilateralism or even obtaining a result not quite in line with economic and social reality is avoided. In view of the above, in order to comprehensively investigate research problems and increase the cognitive value of the overall research results, both qualitative and quantitative methods (*methodological triangulation*) have been applied¹³⁶.

This approach allows to diagnose various aspects of a research subject, and also to harness the strengths of each research method and technique, with mutual neutralization of their weaknesses.

For the purpose of this paper, the research methodology presented in Figure 28 is proposed in the analysis of knowledge transfer.

The main sources of knowledge gained from research are questionnaires addressed to managers in pilot studies and questionnaires using a group expert assessment. Data triangulation was also used, surveying people from different backgrounds, and analysing data about the researched phenomenon included in European Commission publications¹³⁷.

¹³² M. Jasiński, M. Kowalski, *Falszywa sprzeczność: metodologia jakościowa czy ilościowa?*, in: A. Haber (ed.), *Ewaluacja ex post. Teoria i praktyka badawcza*, PARP, Warszawa 2007, p. 101.

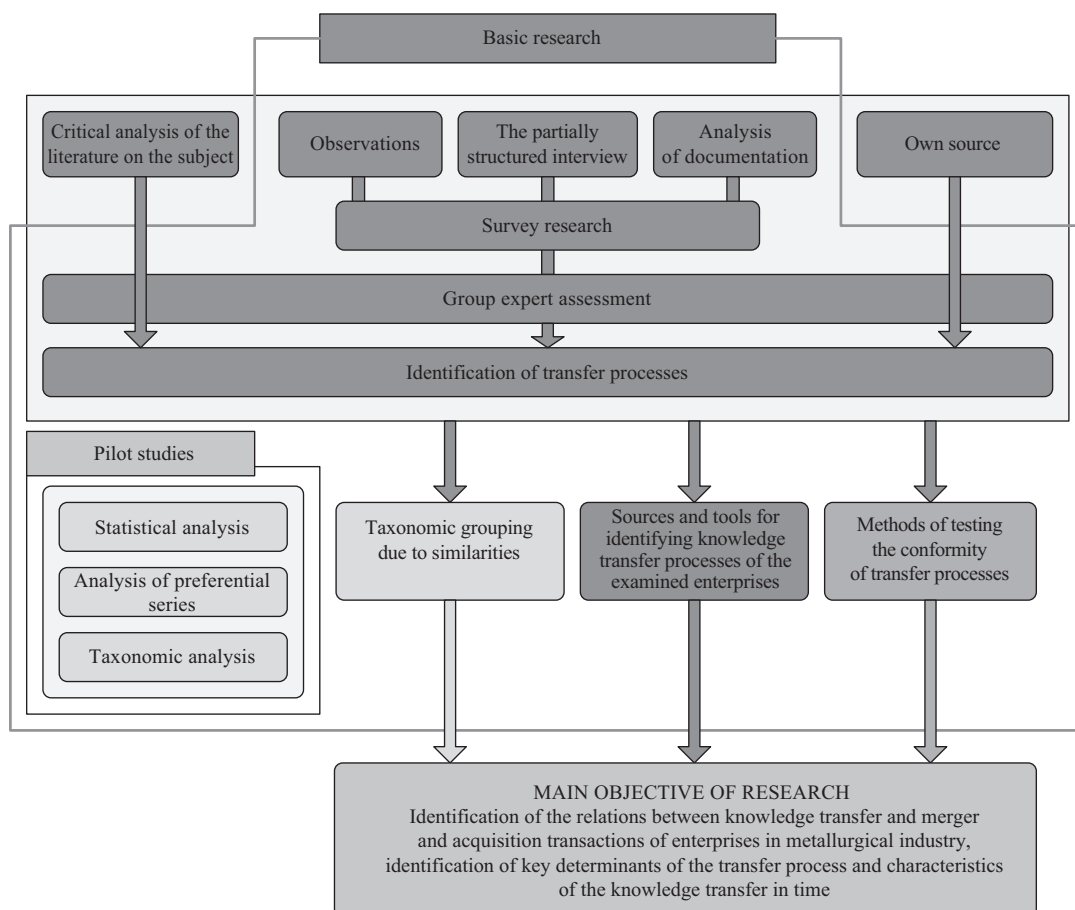
¹³³ N. Denzin, *Sociological Methods: A Sourcebook*, Aldine Transaction, New York 2006.

¹³⁴ K. Konecki, *Studia z metodologii badań jakościowych. Teoria ugruntowana*, PWN, Warsaw 2000, p. 86.

¹³⁵ L. Korporowicz, *Słownik ważniejszych pojęć*, in: L. Korporowicz (red.), *Ewaluacja w edukacji*, Oficyna Naukowa, Warsaw 1997, p. 278.

¹³⁶ M. Kostera, *Antropologia organizacji. Metodologia badań terenowych*, PWN, Warszawa 2005, p. 18.

¹³⁷ European Commission, DG Competition, Unit E4: Basic Industries, Manufacturing and Agriculture (mergers), <http://ec.europa.eu/competition>.

Figure 28. Research methodology

Source: own study.

The research methodology shown in Figure 25 consists of three parts. The sources and tools of analysis, leading to the identification of knowledge transfer processes, are discussed in the first one. The main sources of identification are data from the companies that are subject to mergers or acquisitions.

Critical analysis of the literature

The own research performed i.a. on *critical analysis of the literature* on management sciences contributed to development of the research method.

The analysis of quoted definitions and formulations of various authors on knowledge transfer, performed in this monograph, allowed to distinguish some typical elements, i.e. those which the authors attribute to particular importance and which most frequently repeat in the cited definitions.

Based on the conducted studies of the literature on the subject, it is assumed that the transfer of knowledge from the transferor to its beneficiary is the process of knowledge transfer, leading to obtaining at least the same effects from its use.

The review of literature on the subject covered the market context of mergers and acquisitions, in which analysed were their motifs, multifacetedness and knowledge as a separate motive for acquisition.

Regarding the issues of knowledge transfer, the following were assessed:

- transfer of knowledge in creating a new organization value,
- knowledge in an organization and forms of its manifestation,
- success factors in the context of knowledge transfer,
- *transition team* and its role in the integration process,
- stages of knowledge transfer in mergers and acquisitions,
- *due-diligence* method and its role in mergers and acquisitions,
- examples of mergers and acquisitions of metallurgical enterprises in the world economy.

Observation

The second method that has been applied in the research was *observation*. It was conducted in the two enterprises, covered by pilot study.

A. Kamiński defines the notion of observation in the following manner „This is a one-sided act that engages only the investigator, who aspires to the intentional, planned, systematic and critical perception of certain behaviours, objects, etc.”¹³⁸.

T. Pilch¹³⁹ writes on the other hand that observation is a research operation involving accumulation of data through noticing.

A researcher who interacts with the surveyed community may assume four different roles: a total participant, an external observer, an observer as a participant and participant as an observer¹⁴⁰.

In the case of the investigated enterprises, the role of participant as an observer was assumed, i.e. the researcher obtained „consent to the group to participate in its life and observe it in its natural environment”¹⁴¹. However no organizational role was assumed¹⁴². In such case the researcher had to set themselves in a manner avoiding interpretation of what is observed, actions of people and their behaviours.

¹³⁸ A. Kamiński, *Metoda, technika, procedura badawcza w pedagogice empirycznej*, in: R. Wroczyński, T. Pilch (ed.), *Metodologia pedagogiki społecznej*, Ossolineum, Wrocław 1974, p. 56.

¹³⁹ T. Pilch, *Zasady badań pedagogicznych*, Żak, Warszawa 1977, p. 128.

¹⁴⁰ K. Konecki, *Studia z metodologii...*, op. cit., p. 146.

¹⁴¹ Ibidem.

¹⁴² M. Kostera, *Antropologia organizacji...*, op. cit., p. 89.

Unfortunately, it is very difficult as „the natural process of perception consists in automatic classification of the world around us”¹⁴³.

The **participant observation** consists in observer seeking to „enter” the surveyed community in order to observe it from the „inside”¹⁴⁴. This involves a deliberate registration of the authentic behaviour of employees in natural conditions.

The participant observation is performed by accompanying the respondents during the exercise of routine, daily tasks. The observer has not limited themselves only to passive registration. Questions were asked, resulting from a current situation in order to understand the course of process and the motives of the investigated people.

The purpose of observation was to determine the importance (role) of knowledge in the organization, therefore the researcher (observer) made direct contact with the people subjected to the researched, took direct, active participation in the observed situations, and even with their own behaviour provoked the observed to specific reactions and actions. However, the researcher did not directly influence the behaviour of the observed persons; only one of the roles typical for the observed events was assumed, often without revealing actual intentions to the examined people.

Important elements of observation are also the diagnosis of the degree of knowledge utilization in the organization and the availability of knowledge. The duration of the knowledge process acquiring in the organization and the internal exchange of knowledge between members of the organization were also monitored.

In observation analysed were also attempt to determine the level of knowledge demand and assess its importance.

The above implied the construction of the determinants and motives of the takeover due to the type of knowledge, which i.a. allowed to sort the knowledge into groups of knowledge factors marked by the following variables:

- x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies, etc.);
- x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. specific managerial competencies, unique contractor skills, etc.);
- x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.);
- x_4 – organisational knowledge characteristic of certain enterprises (pay system, regulations, protocols, important legal documents, etc.).

¹⁴³ Ibidem.

¹⁴⁴ J. Altkorn (ed.), *Podstawy marketingu*. Wydawnictwo oo. Franciszkanów, Kraków 1998, p. 380.

Analysis of documentation

A supportive method in enterprises is analysis of documents (*desk research*). An analysis of the data found was performed – documents directly related to management of enterprises. In order to correctly perform the research the following documents, listed below, were read:

- organizational regulations of companies,
- statute of the company,
- organizational diagrams,
- charter of competence,
- circulation of documents,
- report from external audit of the enterprise.

The above research leads to partial identification of resources in the organization, including the forms of knowledge manifestation. Treating the organizational knowledge as a resource of the organisation is a common form of its definition. One of the basic divisions of knowledge, first introduced by M. Polanyi and G. Probst, and later developed by J. Nonaka and H. Takeuchi, is the distinction between *tacit knowledge* and *explicit knowledge*, together with different manners of their conversion.

Analysis of documentation also aimed at recognising places and forms of storing the explicit knowledge in the form of e.g. regulations, procedures, process descriptions or patents and other forms of intellectual property.

The partially structured interview

Knowledge transfer process, due to its complexity, requires deeper analyses of the researched notion. To this end, the research method of **qualitative interview** was applied.

Combination of interviews with observations „brings several benefits – for example data obtained in this manner may facilitate understanding of other facts”¹⁴⁵.

Qualitative interview is the interaction between the conducting person and the respondent. The conducting person has in it a general plan of the examination it, but it is not a specific set of questions, which should be asked using specific words and in defined order. It is important that the person conducting qualitative interview, just as the pollster conducting a survey, was perfectly acquainted with the questions to be asked. Thanks to this, the interview will run quickly and naturally¹⁴⁶.

¹⁴⁵ M. Hammersley, P. Atkinson, *Metody badań terenowych*, Zysk i S-ka, Poznań 2000, p. 138.

¹⁴⁶ E. Babbie, *Badania społeczne w praktyce*, PWN, Warszawa 2007, p. 327.

Qualitative interview is a directed and controlled conversation, during which the conducting person puts special emphasis on certain topics addressed by the respondent and sets the overall direction of the interview.

There is a wide variety of interviews in sociological literature.

Individual¹⁴⁷ semi-structured interviews (*SSI*) were used in the studies.

Semi-structured interviews are characterized by asking a series of questions that are predetermined but the researcher can change their form and order. This allows for a deeper investigation of certain answers¹⁴⁸.

The semi-structured interview is a technique of data acquisition, combining the advantages of quantitative and qualitative methods. Due to small population, which the test sample is selected from, and its specificity, it is possible to use a qualitative approach and collect unique data. However, the details of the information sought results in the fact that during the study the partially structured test scenario is applied, which contains questions-instructions, equally asked to all respondents. These questions may be closed or open.

In some studies, it is appropriate to choose a sample based on own knowledge of the studied population and the purpose of the study. This type of selection is referred to as deliberate or arbitrary attempt¹⁴⁹.

Selective targeting is applied when the population is well known and the most typical units of the sample can be easily determined. The researcher selects units for the targeted sample in a subjective manner so that they are most useful or representative.

The purposeful and strictly targeted selection of questioned people should be preferred, to avoid the participation of colourless and incompetent individuals who do not have much to say¹⁵⁰.

Interviews were conducted with 12 experts selected on the basis of the competence coefficient (Annexe 1), which constitute an important source of knowledge in the subject matter of the study.

Free-form interviews are of a general nature, which means that they give the researcher a place to ask other questions than those that are prepared and which result from the course of conversation. It is also possible to omit those that do not fit in the

¹⁴⁷ In the individual interview the researcher asks only one question to one person at a time.

¹⁴⁸ J. Moorhouse, *Podstawy marketingu 1*, Pret SA, Warszawa 2000, p. 22.

¹⁴⁹ E. Babbie, *Podstawy badań społecznych*, PWN, Warszawa 2009, p. 212.

¹⁵⁰ H. Bieniok and team, *Metody sprawnego zarządzania. Planowanie, organizowanie, motywowanie, kontrola*, Placet, Warsaw 1999, p. 154.

context of the conversation. Thus, the rule of adapting the language of the researcher and the content of the questions to be asked to each situation is preserved¹⁵¹.

The individual interview technique was carried out on the basis of a partially structured scenario¹⁵², whereby the respondent could introduce new topics to the conversation, important for the purposes of the study. This allowed to obtain varied and in-depth information on a given subject. Interviews were recorded on the recorder and then transcribed.

Analysis using the semi-structured interview method is the **second stage** of the base study.

Survey research

For the purpose of this study, it is assumed that the survey is the best way to obtain reliable data to address the research problem set. The application of surveys was also dictated by the possibility to rapidly collect systematic, substantive analysis of the analysed problem and to subject them to a unified manner of assessment by individual managers and experts.

The survey has been applied in pilot studies and main studies of **stages I and III**.

In social sciences it is very important that the research material was collected in a manner not violating personal rights of the respondents. By performing the study, the following conditions should be observed¹⁵³:

- obtaining consent from the respondent (decision of a competent, mature person, taking voluntary participation, fully informed),
- privacy (relevance of the information received, environment in which the research is conducted, provision of information),
- anonymity (anonymity, confidentiality),
- subject of study,
- information about the institution conducting the study,
- explanation of the study purpose,
- instructions for completing the survey,
- open and closed questions,
- basic information.

The applied survey methodology was developed according to the principles of constructing surveys¹⁵⁴. In the survey, which took the form of a questionnaire, the

¹⁵¹ On the basis of: E. Babbie, *Badania społeczne w praktyce*, PWN, Warszawa 2004; K. Konecki, *Studia...*, op. cit., p. 327.a

¹⁵² Full text of the scenario is contained in annexe 2.

¹⁵³ Ch. Frankfurt-Nachmias, D. Nachmias, *Metody badawcze w naukach społecznych*, Zysk i S-ka, Poznań 2001, p. 79.

¹⁵⁴ E. Babbie, *Podstawy badań...*, op. cit., p. 275–293; H. Bieniok and team, *Metody sprawnego zarządzania...*, op. cit., p. 158.

enclosed questions were in a closed form due to the ambiguity of the studied subject matter, in order to limit the number of possible answers.

It has been proposed that the manner of evaluating individual issues contained in **stages I.A** and **I.B** was formulated on the basis of a five-level Likert scale¹⁵⁵. In the social research methodology, the five-level scale is used in the survey questionnaires. Using the Likert scale allows to obtain answers on the degree of acceptance of the phenomenon, view, etc.; it is also often used to measure attitudes towards specific problems or opinions.

In study of the research thesis correctness, set for a group or unit, from a particular gallery of categorised answers a **predilection** (special preference, high inclination to someone or something) is established¹⁵⁶. This allows, using the above-mentioned scale, to define the paradigm (the most general model) of the set or unit.

This scale consists of multiple-choice answers, with five possibilities arranged in order from total acceptance to total rejection. The respondent's task is determine to what extent they agree with the given assertion.

Variants described on the scale:

- I strongly agree,
- I rather agree,
- I have no opinion,
- I rather disagree,
- I strongly disagree.

An odd number of choices to answer have been accepted, so that the middle statement is as neutral as possible.

Heuristic methods – expert group assessment method

Heuristic methods have a long and rich tradition and solid scientific foundations. They use the opinions and assessment of different people (experts, professors and non-professionals) involved in solving a given problem, i.e. finding facts and relations between them, and formulating their own unhindered judgements and proposals of solutions. These methods use the achievements of heuristics, i.e. the discipline of researching creative thinking processes and formulating recommendations, application of which allows for more effective problem solving. The heuristic approach to the problem implies stimulation of fantasy, imagination and intuition and a focus on the creative elements of the solved problem¹⁵⁷.

¹⁵⁵ R. Likert, *A Technique for the Measurement of Attitudes*, „Archives of Psychology” 1932, No. 140, p. 140, 55.

¹⁵⁶ <http://sjp.pwn.pl/>.

¹⁵⁷ J. Orzeł, *Rola metod heurystycznych, w tym grupowej oceny ekspertów oraz prawdopodobieństwa subiektywnego w zarządzaniu ryzykiem operacyjnym*, „Bank i Kredyt” 2005, No. 5, p. 4.

Persons whom the survey was addressed to and who sent the completed questionnaire are referred to as *respondents*. Respondents who, according to the assessment methodology presented below, show an appropriate level of competence within the scope of the study and whose opinions will be used in further research are referred to as **experts**.

Experts were not selected randomly, but deliberately, considering their knowledge and experience in the subject area.

The selection of experts may be facilitated by indicators, such as: seniority, theoretical or practical knowledge, cooperation with other entities, number and scale of implemented projects, etc.

Many years of experience indicate that the self-evaluation of the selected respondent, allowing to determine their competence, is a picture of their authentic fluency in the field and can be used in the process of selecting reliable experts¹⁵⁸.

The indicator of the expert competence level contained in the paper of A. Kopiński can be applied to investigate competence of experts¹⁵⁹.

The coefficient denoted as K_k is calculated in the following manner¹⁶⁰:

$$K_k = \frac{K_z + K_a}{2}, \quad (3)$$

where:

K_k – coefficient of expert expertise,

K_z – coefficient of expert acquaintance with a given problem,

K_a – coefficient of argumentation.

Elements of the K_z and K_a pattern are obtained through experts' self-assessment. It consists in finding specific competences and arguments, their sources, which prove the existence of indicated theoretical and practical skills. The coefficient variation region is in the closed range $<0, 1>$.

Following A. Kopiński¹⁶¹, the following score scale was adopted:

0 – expert does not know the problem;

¹⁵⁸ A. Męczyńska, *Wspomaganie procesów zarządzania w przedsiębiorstwie metodami heurystycznymi*, doctoral dissertation, Silesian University of Technology, Faculty of Organization and Management, Gliwice 2001.

¹⁵⁹ A. Kopiński, *Metody oceny kondycji ekonomicznej przedsiębiorstw*, Scientific Papers of Wrocław Academy of Economics No. 590, Publishing House of Wrocław Academy of Economics, Wrocław Academy of Economics, Wrocław 1991, p. 1 and 2.

¹⁶⁰ J. Grabowska, *Grupowe oceny ekspertów*, Zeszyty Naukowe, series: Organizacja i Zarządzanie, vol. 78, Silesian University of Technology, Gliwice 2013, p. 1; A. Męczyńska, *Metoda heurystyczna – grupowa ocena ekspertów w zastosowaniu do analizy procesów, produktów*, in: R. Konsala (ed.), *Komputerowe zintegrowane zarządzanie*, Conference papers, WNT, Warszawa 1999, p. 32.

¹⁶¹ A. Kopiński, *Metody oceny...*, op. cit., p. 1 and 2.

- 1, 2, 3 – expert knows little about the problem, but falls into the sphere of their interests;
 4, 5, 6 – expert knows the problem satisfactorily, but does not participate in its practical solution;
 7, 8, 9 – expert knows the problem well, participates in its practical solution;
 10 – the problem belongs to a narrow specialization of the expert.

To maintain scores in the set interval, the sum of points for each expert is multiplied by 0.1.

In addition, the impact of the argumentation on the expert's assessment had to be reported. Also the case the ready evaluation scheme contained in Table 23 was applied.

Table 23. Degree of argumentation influence on expert's opinion

Source of arguments	Argumentation		
	high	average	low
Theoretical analysis performed by the expert	0,3	0,2	0,1
Expert's practical experience	0,5	0,35	0,2
Generalization of expert's home jobs	0,05	0,05	0,05
Generalization of expert's foreign jobs	0,05	0,05	0,05
Expert's intuition	0,1	0,1	0,1

Source: J. Grabowska, *Grupowe oceny ekspertów...*, op. cit.; A. Męczyńska, *Wspomaganie procesów...*, op. cit., p. 32.

By adding coefficient of problem acquaintance K_z and coefficient of argumentation K_a and averaging them we obtain competency coefficient K_k^n of each respondent and a comparison to a set threshold of 0.5.

In the process of final selection of the expert group the following assumptions have been considered:

- value of the coefficients k_z and k_a came from the range $\langle 0,1 \rangle$, coefficient K_k also assumes a value in the range of $\langle 0,1 \rangle$;
- the k_a coefficient decreases with the transition from practical experience to the theoretical analysis;
- threshold value of the competence coefficient $\rho = 0,5$. If the value of the respondent's competency coefficient is greater than or equal to the threshold value ρ , i.e. $K_k \geq \rho$, the respondent is appointed to the team of experts and the data obtained is further analysed (annexe 1).

Group expert assessment method was used in **stages II and III** of the core study, for the purpose of examining the conditions of knowledge transfer in mergers and acquisitions.

The gathering of information leading to identification of factors that are of particular relevance to a particular research objective is possible through research among selected experts, i.e. management practitioners, who are at the same time research workers.

Quantitative methods

Quantitative methods have been applied, inter alia, to study the preference series, reflecting the transfer time and its significance in relation to the various types of knowledge.

These methods allow to determine the group of the studied companies in terms of their central values (average, median, modal), dispersion (standard deviation, mean, etc.), and other features characterizing the group of selected companies.

Table 24 presents example taxonomical methods for ordering objects.

Table 24. Selected taxonomic methods of ordering objects

Method name	Characteristic features of the procedure	Usefulness for the implemented project
Nearest Neighbour Method Johnson's Method	The method has a connecting nature. It consists in finding items for which the distance is minimum.	The method exhibits simplicity. Applied in larger collections. Disadvantage of the method is consideration of only the smallest and the biggest differences.
Outermost Neighbourhood Method Johnston's Method	The connection method (hierarchical). The farthest elements are sought.	Characteristics of the suitability and disadvantages of the method as above.
Czekanowski Method	Diagrams of different colours or shades. Around the main diagonal fields representing the short distances are concentrated.	The method does not provide the ability to determine a particular position of the item between the first and the last one. In research on similarity of structures, this can be a significant obstacle. Non-formalized method.
On-line Method	It is based on the principles of the Czekanowski method. Unlike the prototype, not the classes are analysed, but the actual distances of the units (items).	Due to the use of real elements rather than classes more useful for research purposes of this paper.
Wroclaw Taxonomy Method, the so-called Shortest Dendrite Method	Dendrites are constructed by combining each object with an object similar to it, considering the condition that the sum of the distances be the smallest. The division of dendrites is performed successively, rejecting its shortest stretches, as a result, the most similar classes or elements are obtained.	It is one of the most commonly used methods of hierarchical grouping. Inclusion of hypothetical or real patterns is practised. As a result of classification, the pattern can be found in a uniform group, which facilitates interpretation. This corresponds to the aims of the paper.

Method name	Characteristic features of the procedure	Usefulness for the implemented project
Berry Method	It differs from other methods through replacing a pair of nearest points by the midpoint for which the distance from other points is calculated.	This leads to reduction in size of the collection. Under conditions where the starting collection of steelworks and holdings is small at the entrance – this method is not appropriate.
Gravity Centres Method	It consists in grouping together into one group such two groups for which the distance between their centres of gravity is the smallest. The centre of gravity is understood as fictitious object described by the relevant variables.	It is doubtful whether there is a ready-made computer program for this kind of calculations. Apart from that, it is necessary to consider the inadequacy of the method to a small examined group.
Median Method	It consists in finding the smallest distance between two groups, measured as the median, and combining them into one group.	This concerns more groups than individual elements. In addition, in the conditions of significant differences between business structures, it may produce incorrect results.
Group Average Method	It consists of joining together two groups' average value of which is the smallest.	Similar reservations as above. The average may produce even more distorted results than the median in a small group of metallurgical enterprises.

Source: own study on the basis: R. Decker, H.J. Lenz, *Advances in Data Analysis*, Springer, Berlin–Heidelberg–New York 2007; K. Florek, J. Łukaszewicz, J. Perkal, H. Steinhaus, S. Zubrzycki, *Taksonomia Wroclawska*, „Przegląd Antropologiczny”, 1951, vol. XVIII; Z. Hellwig, *Taksonometria ekonomiczna, jej osiągnięcia, zadania i cele*, in: J. Pocięcha (ed.), *Taksonomia – teoria i jej zastosowania*, Akademia Ekonomiczna w Krakowie, Kraków 1990.

It is possible to use additional criteria, such as the scope of computerisation, which facilitates the flow of knowledge. From this point of view, taxonomic methods applied for sorting and classifying empirical material undoubtedly the best to research susceptibility of metallurgical enterprises to consolidation¹⁶². Classified entities are test objects, even if they are not material entities, e.g. knowledge and its types. Classification is understood as division of heterogeneous set of objects into classes or groups of similar objects. Solution to this problem requires basic findings that concern:

- selection of the similarity measure between the objects studied,
- selection of division criterion,
- selection of division algorithm¹⁶³.

¹⁶² F.A. Szczotka, *Podstawy taksonomii numerycznej*, PAN, Warszawa 1996, p. 6.

¹⁶³ Ibidem, p. 11.

Classification and organization of multidimensional objects require a quantitative determination of the similarity measurement method. The distance metric is most commonly applied to achieve this¹⁶⁴.

Due to the occurrence in the study of quantum variables (time, value, etc.), the most commonly used Euclidean distance (formula 4) was applied as a measure of similarity¹⁶⁵.

$$c_{kl} = \left[\frac{1}{n} \sum_{j=1}^n (z_{kj} - z_{lj})^2 \right]^{\frac{1}{2}}, \quad (4)$$

where:

c_{kj} – taxonomic distance between k-th and l-th objects,

z_{kj} – normalized j-th variable value for the k-th object,

z_{lj} – normalized j-th variable value for the l-th object.

The Ward method¹⁶⁶, was applied for calculation as it intends to minimize the sum of squares of deviations within the clusters. At each stage of all pairs of clusters that can be merged the one is selected which, as a result of joining, gives a cluster of minimal variation. The variance analysis approach is used to estimate the distance between clusters. It is considered to be very effective, although it tends to create clusters of small size and provides control over the number of groups¹⁶⁷.

In the analysed case, the formed groups separate companies more or less susceptible to consolidation. In this method success is determined by correct selection of diagnostic features.

The need to perform a taxonomic analysis of knowledge transfer between the merging companies results directly from one of the specific objectives of the paper, namely to „develop a tool for assessing vulnerability to knowledge transfer in the integration process”¹⁶⁸. This involves construction of a tool measuring the susceptibility of knowledge transfer as part of the merging pairs of companies. This indicator should define the degree of susceptibility to mergers or acquisitions.

The indicator is built on the basis of multi-criteria analysis. Among the criteria are not only the size and importance of the transferred knowledge, but also the variables of general nature. The result of multi-criteria analysis is ordering the enterprises participating in mergers and acquisitions by degree of closeness, understood as

¹⁶⁴ L. Pawłowicz, *Wybrane metody taksonomii numerycznej i ich zastosowanie w badaniach ekonomicznych*, Uniwersytet Gdański, Gdańsk 1998, p. 23.

¹⁶⁵ www.statsoft.pl, Electronic Statistics Textbook Inc., 1984–2011.

¹⁶⁶ K. Woźniak (ed.), *Narzędzia ekonomiczne w naukach ekonomicznych*, Mfiles.pl, Kraków 2015, p. 159.

¹⁶⁷ <http://www.statsoft.pl/text.book/stathome.html>

¹⁶⁸ Ibidem, p. 10.

being suitable for knowledge transfer within the merger. It may occur that due to the complementarity of knowledge, entities(enterprises) most similar to each other, but complementary, will be particularly suitable for merger or acquisition. This approach is referred to as **aggregate analysis**.

„Aggregate analysis is a synthetic estimation of an object value, which involves combining single evaluation criteria in one entirety”¹⁶⁹. Consequently, multi-criterion qualification provides a wider and deeper picture of the state of affairs, in this case knowledge transfer, between enterprises undergoing merger or acquisition. Limiting, for example, to the assessment of the knowledge transfer (one criterion) within a consolidation would not give a complete picture of the situation. It would not explain what kind of knowledge was transferred, how long it took to master it and whether it was tacit or explicit. It would also lack the background of the transfer, understood as the economic and social situation of the enterprises involved in the merger process.

These types of studies use simplified methods, such as ranking and scoring, or complex but more effective research methods, such as arranging and taxonomy grouping. The latter allows to choose a rational project if this term is understood to mean a choice of acquisition or merger from a number of variants available, including enterprises that qualify for consolidation, due to knowledge or exhibit demand for knowledge on the part of the tenderer.

The tool of reaching the multi-criterion analysis is the study of preferences. In this activity individual objects (in this case metallurgical enterprises) are qualified on a defined scale that expresses significance of the objects.

In the research conducted on transfer of knowledge in mergers, there are measurable qualities, such as assets or employment, i.e. the absolute or relative number, which is share in the group. The latter refers, for example, to the share of explicit and tacit knowledge of the entire enterprise’s knowledge base. However, in many cases it was not possible to use absolute or relative numbers. This applies to indicators such as financial situation (which itself is assessed by a set of indicators) or cultural differences.

In such situations it was necessary to use the ranking method. „The ranking method involves determination of the validity of a particular object in a given set due to the pre-determined preferential aspects”¹⁷⁰. This gives the opportunity to rank research subjects, according to their importance. Preferential aspects are quite subjective, as they are points of view used to estimate the significance of objects. An example may be determination of the knowledge importance by granting it specific

¹⁶⁹ A. Stabryła, *Zarządzanie projektami...*, op. cit., p. 172.

¹⁷⁰ Ibidem, p. 174

coefficients. Thus, for example, the knowledge transferred (learned) in four months can be estimated higher than the one transferred in eight months if it is preferred with three times higher coefficient. This means that although in the first case large knowledge resources are higher, in the latter case they are more important. Ranking the importance of knowledge is a criterion for creating preferential series.

In the paper such variables as the financial situation of the company, the average level of the staff qualifications, type of organizational structure and cultural differences have been ordered. Data on variables prepared in this manner was used as the starting material for taxonomic calculations aimed at identification of two groups (clusters) from the enterprises in the sample.

The first of them are enterprises little interested, for various reasons, in knowledge transfer, the other are enterprises looking for the knowledge they need, or acquiring it in a merger or acquisition. Criteria for division into groups are just the variables mentioned previously. The commonly used Ward method was used for calculations¹⁷¹.

The Ward method „is one of the agglomerative clustering methods, distinguished from the others by the use of the variance analysis approach to estimate the distance between clusters. It aims to minimize the sum of the squares of the deviations of any two clusters that can be formed at each stage”¹⁷². In Ward’s method, the order of steps is almost the same as in other methods¹⁷³. In the first place, the distance matrix between pairs of object is determined¹⁷⁴. Then pairs of elements are searched, followed by clusters with smallest distances (formula 5)¹⁷⁵.

$$D_{pr} = a_1 \times d_{pr} + a_2 \times d_{gr} + b \times d_{pq} \quad (5)$$

„r” is the number of clusters different from „p” and „q”,

where:

D_{pr} – distance of the new cluster from the cluster with the „r” number,

d_{pr} – distance of the original cluster „p” from the cluster „r”,

d_{gr} – distance of the original cluster „q” from the cluster „r”,

d_{pq} – mutual distance of the original clusters „p” and „q”,

a_1, a_2, b – parameters which in the Ward method have the formulas:

$$a_1 = \frac{n_p + n_r}{n_p + n_q + n_r} ; a_2 = \frac{nq + n_r}{n_p + n_q + n_r} ; b = \frac{-n_r}{n_p + n_q + n_r} .$$

¹⁷¹ www.statsoft.pl, Electronic Statistics Textbook Inc., 1984–2011.

¹⁷² U. Biegańska, *Cluster Analysis*, [http://endrju.ovh.org/SPSS/files\(cluster.ppt\)](http://endrju.ovh.org/SPSS/files(cluster.ppt)).

¹⁷³ Statistica.pl, <http://www.statistica.pl/textbook/stelnan.html>.

¹⁷⁴ In the case under investigation an algorithm developed by J.A. Hartigan and M.A. Wong was applied, details of which will be discussed at a later stage of the paper.

¹⁷⁵ www.statsoft.pl, Electronic Statistics Textbook Inc., 1984–2011.

In patterns „n” = the number of individual objects in clusters.

In the studied case, the procedure is stopped on two focus groups, as the paper concerns division into two clusters – one focusing on enterprises that are susceptible to consolidations due to knowledge and the other that are not susceptible. The Ward method does not determine how the taxonomic distance between the clusters is set.

In the investigated problem a centroid (k-med) algorithm was applied, developed by the aforementioned J.A. Hartigan and M.A. Wong. The goal of the k-med algorithm is to divide M points in N dimensions so that the intra-cluster squared sums of squares are the minimum¹⁷⁶.

It should be emphasized that this method is commonly used in group division problems in connection with determining the distance between elements, individual elements and groups (clusters) and between clusters.

The study culminates in grouping the studied metallurgical enterprises according to their susceptibility to consolidations. This means that similarity (in terms of consolidation susceptibility) is determined not according to one criterion (e.g. type of knowledge labelled as x_n) but according to many criteria (e.g. variables accepted for taxonomic calculations). These criteria can be all types of transferred knowledge, its flow time, and importance (value for the acquiring or acquired enterprise).

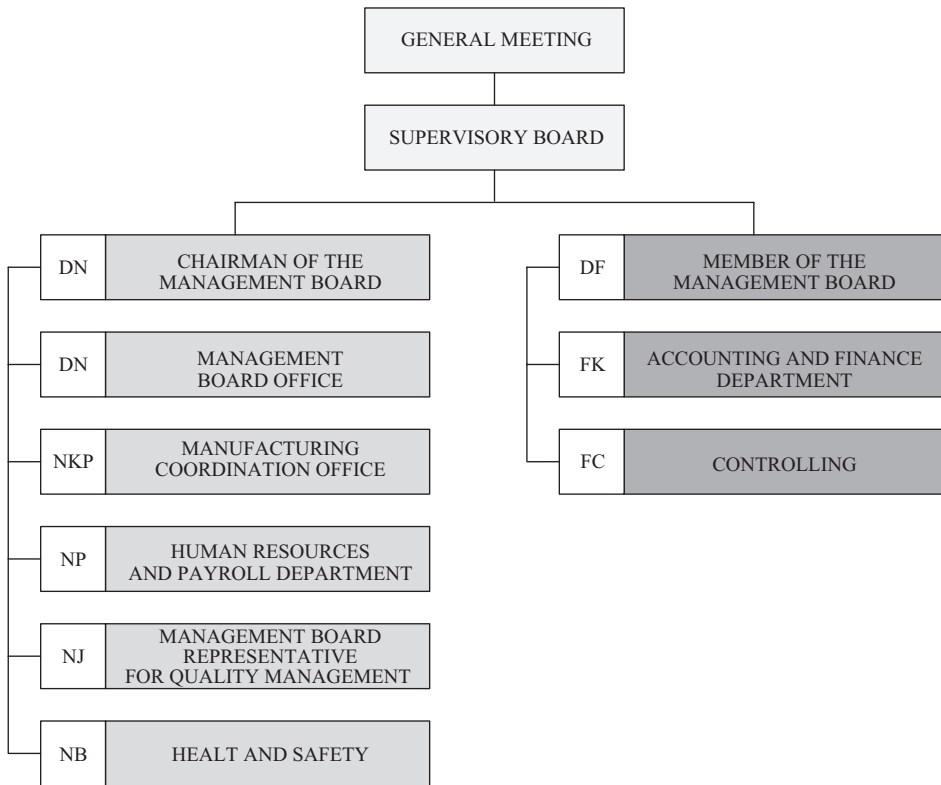
The proposed research methods allow an attempt to quantify knowledge in the model form. They also allow to group the enterprises according to their consolidation capacity, which may be complementary to the *due diligence* method.

3. Description of research sample and characteristics of the surveyed enterprises

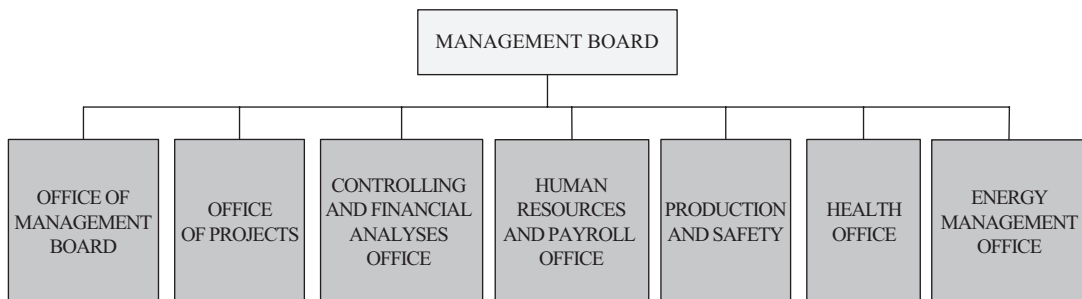
Pilot studies

For the purposes of this research process, a pilot study was performed in the same group where the baseline study was conducted. Pilot studies were directed to the management board of two companies. These are companies producing ferrous alloys. In the further course of the analysis the following names were accepted: Company 1 (acquiring company) and Company 2 (acquired company). Both companies operate in Poland, and their registered offices are also located there. Organisational diagrams for both companies are shown in Figures 29 and 30.

¹⁷⁶ J.A. Hartigan, M.A. Wong, *Algorithm AS 136. A k-means Clustering Algorithm*, „Journal of the Royal Statistical Society”, Series C (Applied Statistics), Vol. 28, No. 1, p. 78.

Figure 29. Organisational diagram of Company 1

Source: own study based on documents of Company 1.

Figure 30. Organisational diagram of Company 2

Source: own study based on documents of Company 2.

Preliminary analysis of both diagrams shows that Companies 1 and 2 differ significantly both in production and functional terms. Company 1's organizational structure is very extensive to meet the organization's needs of the enterprise.

Both companies produce ferrous alloys, specializing in ferrosilicons. Both melting and the subsequent processing are covered by the manufacturing activity. Ferrosilicon, produced in ferrous alloy furnaces, is after congeal transported to a crusher where it is subjected to mechanical processing, i.e. crushing and spreading to customer-required granulometric fractions. In this form it is stored in warehouses and sold. Sophisticated processing of melting requires experience from the involved employees, an experience they gain in the long period of working.

Stage I – survey of managers

In the **first stage** of the study, 150 questionnaires were sent to 80 enterprises from metallurgical industry, in order to obtain the necessary sample size. Surveys have been targeted at senior and middle managers in companies.

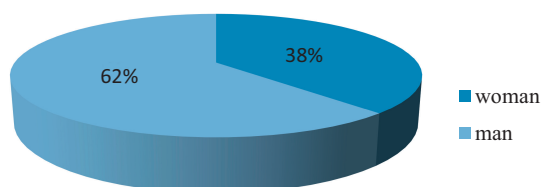
Assuming that the population of managers is equal to 400 (as at the day of conducting studies), the representative sample should be 80, which means that the sample should cover randomly selected 80 managers. The procedure for determining the necessary sample size is outlined in annexe 3.

For the **first stage** study, 86 randomly selected managers were qualified. Due to the nature of the conducted study (survey that did not require direct and personal supervision of the researcher), not all surveys could be used for further stages of the research process. A certain number of surveys were not returned, however 116 questionnaires were received (77%), from which 30 incomplete or wrongly filled-in or rejected.

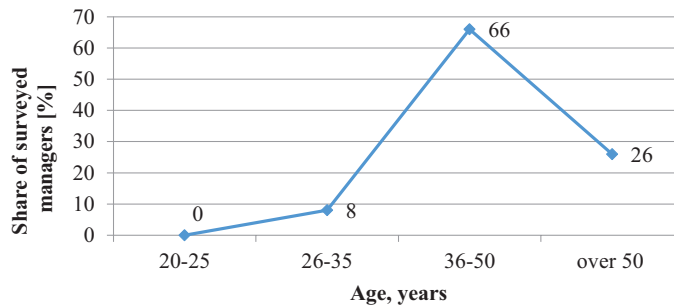
The personal data of the surveyed managers is contained in Annexe 4. Further characteristics of managers, i.e. gender, age, education, level of management, length of service and number of employees are shown in the graphs (Figures 31-36).

In the sample the largest share was male managers (62%), aged 36-50 (66%), with higher education (92%). The surveyed managers are mostly middle management (71%). Approximately 39% of the surveyed managers, i.e. 33 managers, are managers who indicated in the survey that their length of service is between 11 and 15 years.

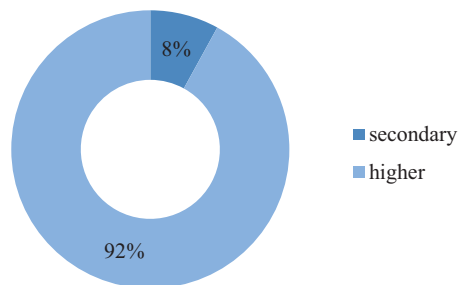
Figure 31. Gender of the surveyed managers



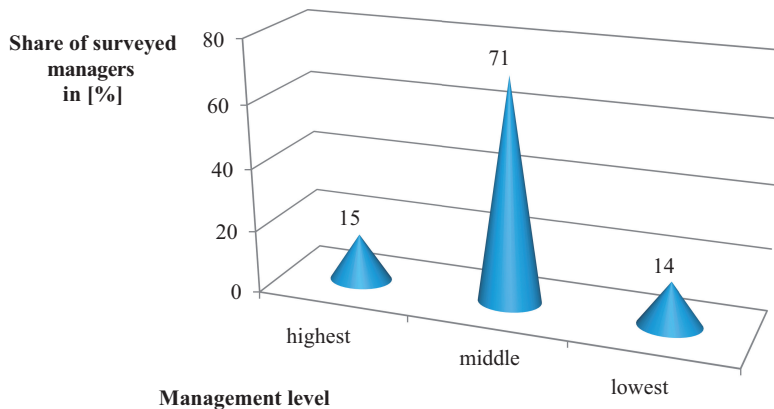
Source: own study.

Figure 32. Age of the surveyed managers

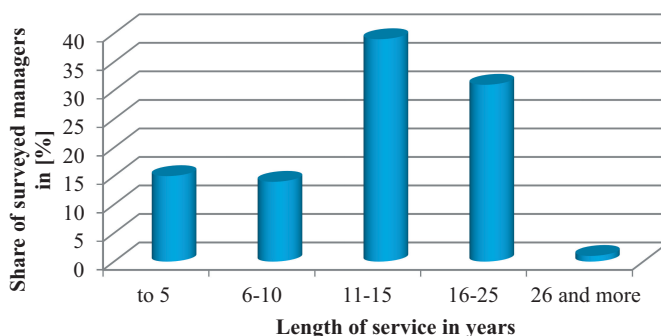
Source: own study.

Figure 33. Education of the surveyed managers

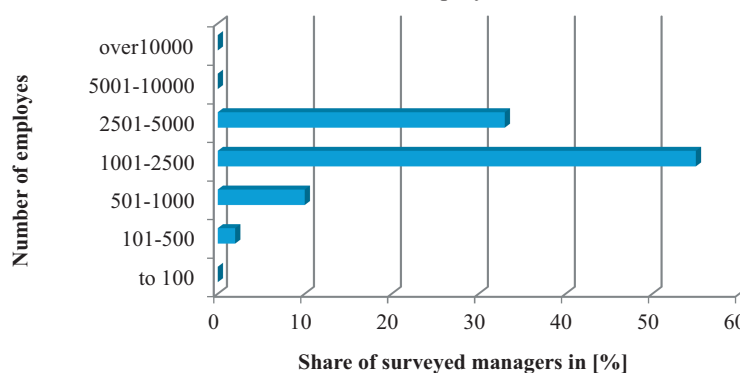
Source: own study.

Figure 34. Management level of surveyed managers

Source: own study.

Figure 35. Length of service of surveyed managers

Source: own study.

Figure 36. Number of employed workers

Source: own study.

Managers represent companies differentiated in terms of employment size. 55% of the managers surveyed work in companies employing from 1001 to 2500 people 33% work in those employing from 2501 to 5000 employees. The share of managers from companies employing between 501 and 1000 and 101 to 500 employees is 10% and 2%, respectively.

Stages II and III – partially structured interviews and surveys using group expert assessments

In order to obtain credible research a result, a research sample¹⁷⁷ of 22 metallurgical companies in Europe was selected that consolidated through mergers or acquisitions. It is important to note that it is difficult to gain access to source information by experts selected through the study. First of all, in most cases, such records are not kept outside of, for example, manuals, contracts with equipment suppliers, etc. These

¹⁷⁷ The procedure for selecting a study sample is shown in Annexe 19.

data do not, however, speak much about the size and importance of knowledge for both parties, i.e., for the acquiring and the acquired. This kind of knowledge should be estimated on the basis of expert's own information and experience. For that, however, one needs access to the studied entity and experience in critical evaluation of the messages received.

In view of the above limitations, the study was carried out in $\frac{1}{4}$ of the group of described cases of metallurgical companies' consolidations.

The group of companies that are ultimately the subject of basic research consists of 22 units and 11 consolidations (mergers and acquisitions). A list of subjects in the test sample is included in Annexe 5.

In the study of **stages II and III**, using group expert assessment, among 23 respondents, 12 experts were selected.

The people who were interviewed and to whom the questionnaire was sent were management practitioners – managers in top-level of enterprises¹⁷⁸, who were also researchers¹⁷⁹.

The characteristics of the examined experts are presented in Table 25.

Table 25. Characteristics of the experts examined in stages II and III

Feature	Percentage share of experts	
Gender	women	38%
	men	62%
Age	20 – 25 years	0%
	26 – 35 years	8%
	36 – 50 years	66%
	over 50 year	26%
Education	vocational	0%
	secondary	0%
	higher	100%

Source: own study.

In the sample, the largest share was in men (62%), women accounted for 38% of the sample. Experts aged 26 to 35 make up 8%, 66% are people in the age 36 to 50, and over 50 account for 26%. All experts have higher education.

¹⁷⁸ Top managers included the presidents, vice presidents and directors of the surveyed companies.

¹⁷⁹ Interviews and questionnaires were addressed to the research staff of the following institutes: Stanislaw Staszic Institute for Ferrous Metallurgy in Gliwice, EUROFER (*The European Steel Association*), Hutnicza Izba Przemysłowo-Handlowa (Polish Steel Association) in Katowice.

4. Course of research process

The research process consists of a number of elements that should be carefully planned based on continuous choices made for the sake of reliability and credibility of the research findings¹⁸⁰.

According to M. Kostera, the research process becomes a coherent sequence of choices that allow for credibility and reliability of the research¹⁸¹.

The utilitarian layer should be accompanied by a theoretical layer, constituting a basis for solutions and recommendations for practice, and which is the basis and inspiration to seek new and better solutions.

The subject of this study covers variables determining knowledge transfer in mergers and acquisitions of metallurgical companies. The scope of the study includes the determinants of knowledge transfer and the time it takes to master it in the merger and acquisition process.

Basic research consists of three stages: **stage I**, **stage II** and **stage III**, preceded by pilot analyses (Figure 37).

The **first stage** study uses the survey methodology – **stage I.A** and **stage I.B**.

Stage I.A aims at identifying the important determinants of knowledge transfer in mergers and acquisitions, while **stage I.B** aims at determining the validity of factors that influence the success of mergers and acquisitions in relation to knowledge transfer.

In the **second stage** of the study, semi-structured interviews were applied, using a group experts' assessment.

Firstly, criteria for selecting experts (criteria of respondent's knowledge on the issue, argumentation and competence) were established, and finally a group of experts was selected.

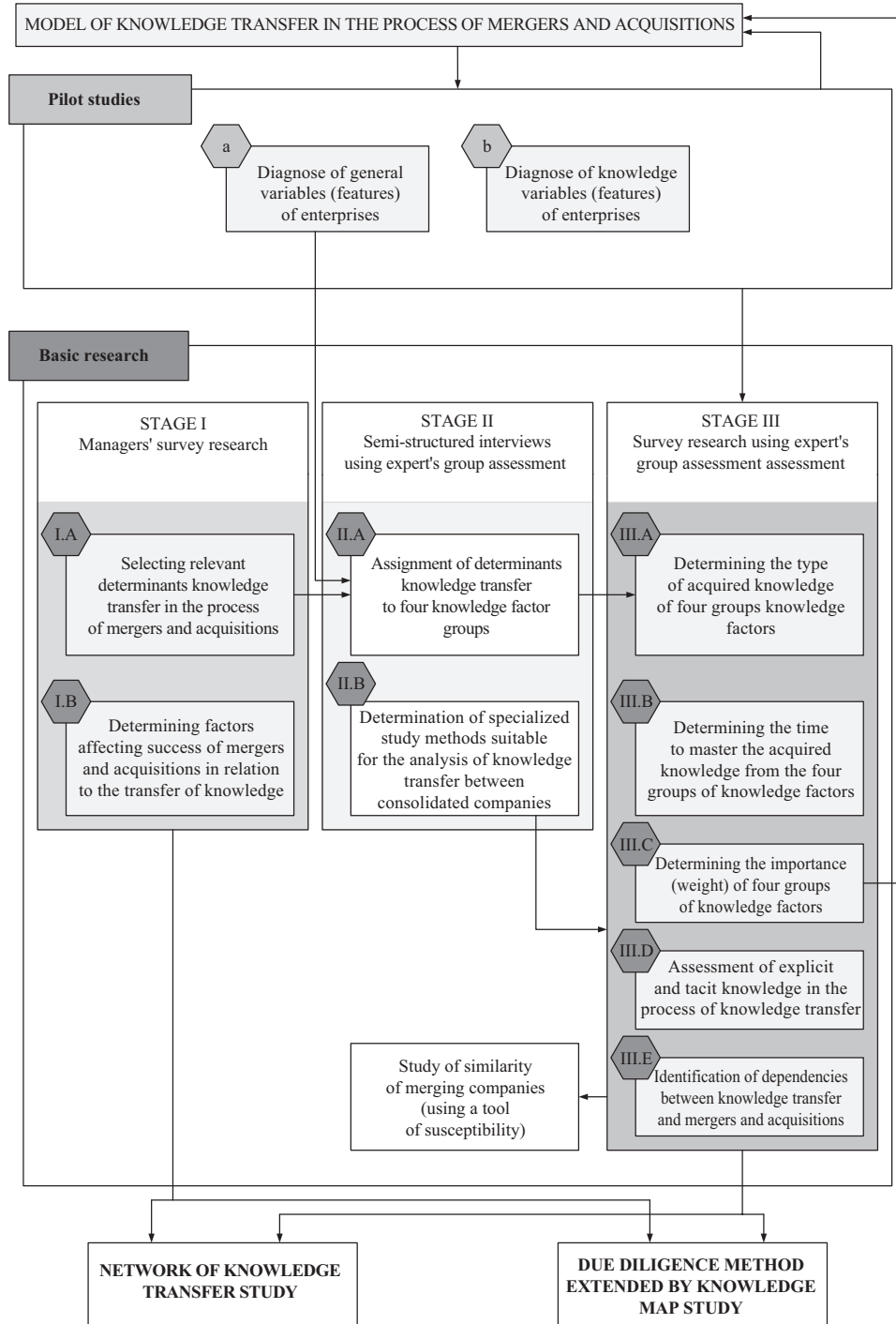
Stage II was divided into 2 parts. The aim of **stage II.A** is experts' ordering important determinants of knowledge transfer to the four groups of knowledge factors. In turn, **stage II.B** aims at establishing specialized research methods suitable for analysis of knowledge transfer between the consolidated enterprises.

In the **third stage** of the research, a group expert's assessment is also applied, using the survey methodology. For **stage III** of the research experts' opinion from the **second stage** was used.

Stage III was divided into 5 parts (**stage III.A**, **stage III.B**, **stage III.C**, **stage III.D**, and **stage III.E**).

¹⁸⁰ E. Babbie, *Badania społeczne w praktyce*, PWN, Warszawa 2005, p. 127.

¹⁸¹ M. Kostera, *Antropologia organizacji...*, op. cit., p. 18.

Figure 37. Course of research process

Source: own study.

The aim of **stage III.A** survey is to determine the type of knowledge acquired among the four groups of knowledge factors. The second objective of the survey (**stage III.B**) consists in indicating the time of learning the acquired knowledge from the four groups of knowledge factors. **Stage III.C** consists of determining the importance (weight) of four groups of knowledge factors. The goal of **stage III.D** group experts' assessment is to assess the explicit and tacit knowledge in the knowledge transfer process. The final phase of the group experts' assessment aims to identify the relations between knowledge transfer and mergers and acquisitions.

Pilot studies

The pilot study directs the research process, giving the field to use the research methods provided for the core research.

Pilot studies programme disqualifies certain statistical methods, such as correlation and regression, therefore statistical studies cover only structure indicators, average, and deviations from them in the analysed group. In addition to statistical analysis, is anticipated that the set knowledge transfer model will be confronted with the possibility of using several variants of knowledge transfer. The last step is to verify elements involved in the taxonomic grouping of the examined group of metallurgical enterprises. Within pilot study, it is possible to make a limited assessment of the similarity of the enterprises. The list of variables necessary for multi-criteria grouping of objects has been established.

Firstly, four groups of knowledge factors (x_1 , x_2 , x_3 and x_4) were separated.

The procedure for identifying and dividing knowledge factors related to the set aim of research has been based on critical analysis of the literature on the subject, the author's experience and suggestions of people directly related to the researched subject.

The analysis within pilot study covered 2 companies: the acquiring one – Company 1 (F1) and the acquired one – Company 2 (F2) with 31 variables (features) characterising the studied enterprises.

Pilot studies consist of two stages (**stages a and b**)¹⁸².

The aim of **stage a** is to characterize the 15 general variables (characteristics) of the studied enterprises (Table 26).

¹⁸² Full text of the pilot studies survey is contained in annexe 6.

Table 26. General variables (characteristics) of the studied enterprises – pilot studies stage a

No.	General variables (features)	Company 1 (acquiring)	Company 2 (acquired)
1.	Company assets	..... (million EUR)	..... (million EUR)
2.	Average pay	..... (PLN)	..... (PLN)
3.	Total number of employees		
4.	Percentage of employees with higher education (%)		
5.	Departments (production, electromechanical, technical-implementation)		
6.	Revenues from sale	.....(PLN million)	.....(PLN million)
7.	General assessment of company financial condition (1 – the lowest grade, 4 – the highest grade)	1	1
		2	2
		3	3
		4	4
8.	Whether <i>transition team</i> was established in the company?	YES	YES
		NO	NO
9.	Whether representatives of the acquired company take part in works of the team?	YES	YES
		NO	NO
10.	Average staff qualification level	low	low
		average	average
		high	high
		very high	very high
11.	Type of organizational structure	centralised	centralised
		rather centralised	rather centralised
		rather decentralised	rather decentralised
		other	other
12.	Applied wage system	piecework	piecework
		incentive wage system	incentive wage system
		daily pay	daily pay
		daily-task	daily-task
		other	other
13.	Cultural differences in relation to consolidated company (0 – lack, 2 – small, 3 – average, 4 – highest)	0	0
		1	1
		2	2
		3	3
14.	Number of employees having access to a computer compared to the total number of employees (in %)%%
15.	Number of employees having access to data base compared to the total number of employees (in %)%%

Source: own study.

Stage b is aimed at characteristics of 16 variables (features) of knowledge of the studied enterprises, considering:

- determination of the type of knowledge acquired from the four groups of knowledge factors,
- indication of the time to master the acquired knowledge from the four groups of knowledge factors,
- determination of the importance factors of the four groups of knowledge factors,
- assessment of the explicit knowledge share within the four groups of knowledge factors in the knowledge transfer process.

The variables (features) from **stage b** of the pilot studies are shown in Table 27.

Table 27. Knowledge variables (characteristics) of the studied enterprises – pilot studies stage b

No.	Type of knowledge taken over	Acquiring company		Acquired company	
1.	x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	YES	NO	YES	NO
2.	x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management staff, unique skills of contractors, etc.)	YES	NO	YES	NO
3.	x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.)	YES	NO	YES	NO
4.	x_4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	YES	NO	YES	NO
Type of knowledge taken over		Knowledge learning time			
		Acquiring company		Acquired company	
5.	x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	..... (months)		..... (months)	
6.	x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management staff, unique skills of contractors, etc.)	..... (months)		..... (months)	
7.	x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.)	..... (months)		..... (months)	
8.	x_4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	..... (months)		..... (months)	

Type of knowledge taken over		Significance (weight) of knowledge	
		Acquiring company	Acquired company
9.	x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	..... (scale 4–6)	..... (scale 4–6)
10.	x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management staff, unique skills of contractors, etc.)	..... (scale 2–4)	..... (scale 2–4)
11.	x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.)	..... (scale 1–2)	..... (scale 1–2)
12.	x_4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	..... (scale 0,5–1)	..... (scale
Type of knowledge taken over		Knowledge of bigger importance	
		Acquiring company	Acquired company
13.	x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)%%
14.	x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management staff, unique skills of contractors, etc.)%%
15.	x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.)%%
16.	x_4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)%%

Source: own study.

Stage I studies (survey of managers)

The survey method for managers consists of two stages (**stage I.A** and **I.B**) and was applied for the purpose of examining the knowledge transfer determinants in the processes of mergers and acquisitions.

Stage I.A

In **stage I.A**, a set of 57 factors¹⁸³ that determine the transfer of knowledge in merger and acquisition processes has been identified. Such a considerable number induces an attempt to reduce them and aggregate them to a smaller number of factors' groups.

¹⁸³ A collection of 57 knowledge factors was developed on the basis of study on the subject matter literature.

To this end, it is necessary to classify each factor on the basis of their relevance to allow the experts to group them at a later stage. This entails the need to leverage the knowledge and experience of managers, employed as senior and middle managers in enterprises directly involved in the consolidation processes that have performed mergers and acquisitions.

Respondents were asked to evaluate in terms of relevance, on a 5-point scale (1 – the lowest rating, 5 – the highest rating), each of the knowledge factors.

These factors included:

- complaints analysis,
- analyses, calculations and synthesis,
- current R&D works within the company,
- intangible goods protection period of which has expired,
- personal experience in occupational safety and health, fire, sanitary and epidemiological fields,
- planning experience,
- product documentation,
- documentation and unofficial information on quality,
- operating records of machinery and equipment,
- record of inspections, periodic and capital repairs,
- information and analysis of competition quality,
- customer information on quality, features and prices of the products,
- emergency procedures,
- information and analysis of product characteristics,
- configuration of organizational units,
- materials for analysis, calculation and cost synthesis,
- standards and regulations,
- standards for emissions of gases, land contamination and water pollution,
- technical descriptions and operating instructions,
- portfolio of orders and skills of its shaping,
- forecasts of research cells,
- R&D works on enterprise development,
- ideas, patents, innovations,
- employees with valuable skills and competencies,
- computer programs, utility models, trademarks,
- practical experience of employees in the sphere of sales,
- health and safety regulations, inspection and accident reports,
- fire protection regulations,
- sanitary and epidemiological reports,

- external and internal regulations on the protection of the air, land and water,
- projects,
- practical experience of supervisory staff,
- relations with debtors and creditors,
- relations with customers and sales representatives,
- personal relations with suppliers and buyers
- product, technology and organizational standards,
- specialization of divisions and organizational units
- production technology,
- ability to regulate financial flows,
- skills and competences in cooperation with the environment,
- ability to optimize inventory,
- explicit knowledge of competitors and markets,
- knowledge of R&D by the competition (inventions, innovations, quality, patents),
- marketing knowledge of customers,
- knowledge in the scope of *foresight*,
- personal knowledge of specialized employees,
- knowledge of costing,
- knowledge of production possibilities and delivery dates,
- knowledge of optimum stock shaping,
- tacit knowledge of financial employees,
- knowledge of quality regulations,
- tacit knowledge of executive employees,
- principles and organization of autonomous units,
- knowledge of laws and regulations and internal instructions,
- knowledge of production technology,
- knowledge of statistical and econometric tools,
- knowledge of suppliers' market.

The procedure for identifying and evaluating the knowledge factors has been developed for their identification and systematization.

Stage I.B

The purpose of **stage I.B** study is having managers to evaluate the factors that influence the success of mergers and acquisitions, in terms of knowledge transfer, on a five-point scale (1 – the lowest rating, 5 – the highest rating).

These factors included¹⁸⁴:

- precisely designed integration program,
- clearly defined goals of the acquisition,
- cultural similarity of the enterprise organization (including the organization learning culture),
- properly built and managed *transition team*¹⁸⁵,
- preparation or recognition of an existing knowledge map,
- degree of knowledge verbalisation,
- level of knowledge articulation,
- knowledge distance (understood as the difference in knowledge level between transferor and receiver).

The full text of the **first stage** survey is contained in Annexe 7.

Stage II studies (semi-structured interviews using expert's group assessment)

Stage II.A

In **stage II.A** 32 factors that determine the transfer of knowledge in the merger and acquisition processes that were identified by managers as significant in **stage I.A** were presented.

Important factors determining the knowledge transfer in the merger and acquisition process include:

- current R&D works within the company,
- documentation and unofficial information on quality,
- information and analysis of competition quality,
- customer information on quality, features and prices of the products,
- information and analysis of product characteristics,
- technical descriptions and operating instructions,
- portfolio of orders and skills of its shaping,
- forecasts of research cells,
- R&D works on enterprise development,
- ideas, patents, innovations,
- employees with valuable skills and competencies,
- computer programs, utility models, trademarks,
- practical experience of employees in the sphere of sales,

¹⁸⁴ Selection of factors was developed on the basis of study on the subject matter literature.

¹⁸⁵ As the *transition team* in the study any type of team established within or outside the organization to transfer knowledge should be understood.

- projects,
- practical experience of supervisory staff,
- personal relations with suppliers and buyers,
- product, technology and organizational standards
- production technology,
- ability to regulate financial flows,
- skills and competences in cooperation with the environment,
- ability to optimize inventory,
- explicit knowledge of competitors and markets,
- knowledge of R&D by the competition (inventions, innovations, quality, patents),
- marketing knowledge of customers,
- knowledge in the scope of *foresight*,
- personal knowledge of specialized employees,
- knowledge of costing,
- knowledge of optimum stock shaping,
- tacit knowledge of financial employees,
- tacit knowledge of executive employees,
- knowledge of production technology,
- knowledge of suppliers' market.

The task of experts is to assign factors that determine the knowledge transfer to one of the four groups of knowledge factors (x_1, x_2, x_3, x_4).

Stage II.B

The aim of **stage II.B** of the group expert's assessment is to select specialised research methods appropriate for the analysis of knowledge transfer between the consolidated companies.

Below the research methods¹⁸⁶ are placed in the form presented to the experts (Table 28).

¹⁸⁶ Research methods were developed on the basis of: R. Decker, H.J. Lenz, *Advances in Data Analysis*, Springer, Berlin–Heidelberg–New York 2007; K. Florek, J. Łukaszewicz, J. Perkal, H. Steinhaus, S. Zubrzycki, *Taksonomia Wrocławska*, „Przegląd Antropologiczny” 1951, v. XVIII; Z. Hellwig, *Taksonometria ekonomiczna, jej osiągnięcia, zadania i cele*, in: J. Pocięcha (ed.), *Taksonomia – teoria i jej zastosowania*, Akademia Ekonomiczna w Krakowie, Kraków 1990.

Table 28. Research methods for knowledge transfer analysis

No.	Research methods for knowledge transfer analysis	YES/NO
1.	Nearest neighbour method (Johnson's method)	
2.	Outermost neighbourhood method (Johnston's method)	
3.	Czekanowski Method	
4.	<i>On-line</i> Method	
5.	Wrocław taxonomy method (shortest dendrite method)	
6.	Berry Method	
7.	Gravity centre method	
8.	Median method	
9.	Group average method	
10.	Spearman's rank correlation coefficients: Kendal coefficient	
11.	Scattering measures: entropy and Taylor's development as a Gini coefficient	
12.	Proximity measures – Kullback-Leiber distance	
13.	Dependency measures – Goodman-Kruskal coefficient	
14.	other (what?)	

Source: own study.

A full scenario of semi-structured interviews of **stage II** is included in Annexe 2.

Stage III studies (surveys using expert's group assessment)

In the **third stage** studies, using group expert assessment, a survey questionnaire was applied, consisting of five main components: **stage III.A**, **III.B**, **III.C**, **III.D** and **III.E** (Annexe 8).

The questionnaire was addressed to the same group of experts, who were covered by semi-structured interviews in **stage II**, based on an indicator of competence level (K_k coefficient).

The task of experts is to diagnose variables that determine the transfer of knowledge in 22 metallurgical enterprises that consolidated in the merger and acquisition processes, forming 11 pairs.

In **stages III.A**, **III.B** and **III.C**, four groups of knowledge factors were subjected to the study, after assigning by experts in **stage II** the individual knowledge factors to four groups (x_1 , x_2 , x_3 , x_4).

Stage III.A

The task of experts is to identify factors of knowledge acquired in the merger or acquisition process.

Table 29 contains data in the form in which they were presented to the examined experts.

Table 29. Type of knowledge acquired as a result of a merger or acquisition

Type of knowledge taken over	Acquiring company		Acquired company	
	YES	NO	YES	NO
x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	YES	NO	YES	NO
x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)	YES	NO	YES	NO
x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.)	YES	NO	YES	NO
x_4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	YES	NO	YES	NO

Source: own study.

Stage III.B

Stage III.B objective is to indicate the time of learning the acquired knowledge from the four groups of knowledge factors.

Experts have the task of giving time (in months) that was needed to master the acquired knowledge.

Table 30 shows the types of knowledge, along with periods, in the form presented to the experts.

Table 30. Type of acquired knowledge in a time unit

Type of knowledge taken over	Knowledge learning time	
	Acquiring company	Acquired company
x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	..... (months)	..... (months)
x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)	..... (months)	..... (months)
x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.)	..... (months)	..... (months)
x_4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	..... (months)	..... (months)

Source: own study.

Stage III.C

The aim of **stage III.C** is to determine the importance (weight) of the four knowledge factor groups in the merger and acquisition processes.

It is the task of the experts to allocate a sufficient number of points on a four-point scale, where the importance of the transferred knowledge means respectively:

1 – trace, small,

- 2 – limited,
- 3 – significant,
- 4 – important, decisive.

Experts have the task of addressing each of the listed groups of knowledge factors (Table 31).

Table 31. Significance (weight) of knowledge

Type of knowledge taken over	Significance (weight) of knowledge on the scale 1-4	
	Acquiring company	Acquired company
x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)		
x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)		
x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.)		
x_4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)		

Source: own study.

Stage III.D

Stage III.D aims at assessing tacit and explicit knowledge in the knowledge transfer process.

The investigated experts were asked to indicate which type of knowledge (explicit or tacit) is more important in the context of its transfer in the merger or acquisition process (Table 32).

Experts were asked to comment on each of the listed four groups (x_1 , x_2 , x_3 , x_4).

Table 32. Explicit and tacit knowledge transfer process

Type of knowledge taken over	Knowledge of bigger importance			
	Acquiring company		Acquired company	
x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	explicit	tacit	explicit	tacit
x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)	explicit	tacit	explicit	tacit
x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.)	explicit	tacit	explicit	tacit
x_4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	explicit	tacit	explicit	tacit

Source: own study.

Stage III.E

The aim of **stage III.E** is to identify the relations between knowledge transfer and mergers and acquisitions. Experts were asked to comment on 11 general indicators concerning knowledge transfer (Table 33).

Table 33. General indicators concerning knowledge transfer

No.	Indicators	Company 1 (acquiring)	Company 2 (acquired)
1.	Company assets	..... (million EUR)	..... (million EUR)
2.	Average pay	..... (EUR)	..... (EUR)
3.	Total number of employees		
4.	Revenues from sale	..... (million EUR)	..... (million EUR)
5.	General assessment of company financial condition (1 – the lowest grade, 4 – the highest grade)	1	1
		2	2
		3	3
		4	4
6.	Whether <i>transition team</i> was established in the company?	YES	YES
		NO	NO
7.	Whether representatives of the acquired company take part in works of the team?	YES	YES
		NO	NO
8.	Average level of employees' qualifications (1 – lowest grade , 4 – highest grade)	1	1
		2	2
		3	3
		4	4
9.	Type of organizational structure	centralised	centralised
		rather centralised	rather centralised
		rather decentralised	rather decentralised
		other	other
10.	Applied wage system	piecework	piecework
		incentive wage system	incentive wage system
		daily pay	daily pay
		daily-task	daily-task
		other	other
11.	Cultural differences in relation to consolidated company (0 – lack, 1 – small, 2 – average, 3 – biggest)	0	0
		1	1
		2	2
		3	3

Source: own study.

Chapter V.

ANALYSIS OF OWN RESEARCH IN THE SCOPE OF KNOWLEDGE TRANSFER

1. Results of the pilot study

The results of the pilot study of the two companies, acquiring one – Company 1 (F1) and acquired one – Company 2 (F2), allowed to examine 31 variables (features) broken down by general characteristics and knowledge of the examined enterprises.

Table 34 shows the results of the pilot study **stage a**, and Table 35 shows the results of **stage b**.

Table 34. General variables (characteristics) of the studied enterprises – pilot studies stage a results

No.	Indicators	Company 1 (acquiring)	Company 2 (acquired)
1.	Company assets	135.9 (EUR million)	67,1 (mln euro)
2.	Average pay	3,313 (PLN)	4 020 (zł)
3.	Total number of employees	51	459
4.	Percentage of employees with higher education (%)	5%	10%
5.	Departments (production, electromechanical, technical-implementation)	6	3
6.	Revenues from sale	0–100 (PLN million)	101-500 (PLN million)
7.	General assessment of company financial condition (1 – the lowest grade, 4 – the highest grade)	1	1
		2	2
		3	3
		4	4
8.	Whether <i>transition team</i> was established in the company?	YES	YES
		NO	NO
9.	Whether representatives of the acquired company take part in works of the team?	YES	YES
		NO	NO
10.	Average staff qualification level	low	low
		average	average
		high	high
		very high	very high
11.	Type of organizational structure	centralised	centralised
		rather centralised	rather centralised
		rather decentralised	rather decentralised
		other	other

No.	Indicators	Company 1 (acquiring)	Company 2 (acquired)
12.	Applied wage system	piecework	piecework
		incentive wage system	incentive wage system
		daily pay	daily pay
		daily-task	daily-task
		other – daily with bonus	other – daily with bonus
13.	Cultural differences in relation to consolidated company (0 – lack, 1 – small, 2 – average, 3 – biggest)	0	0
		1	1
		2	2
		3	3
14.	Number of employees having access to a computer compared to the total number of employees (in %)	31%	22%
15.	Number of employees having access to data base compared to the total number of employees (in %)	11%	19%

Source: own study.

Table 35. Knowledge variables (characteristics) of the studied enterprises – pilot studies
stage b results

No.	Type of knowledge taken over	Acquiring company		Acquired company	
1.	x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	YES	NO	YES	NO
2.	x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)	YES	NO	YES	NO
3.	x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.)	YES	NO	YES	NO
4.	x_4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	YES	NO	YES	NO
Type of knowledge taken over		Knowledge learning time			
		Acquiring company		Acquired company	
5.	x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	0 (months)		1 (months)	
6.	x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)	4 (months)		1 (months)	
7.	x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.)	5 (months)		6 (months)	
8.	x_4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	2 (months)		3 (months)	

Type of knowledge taken over		Significance (weight) of knowledge	
		Acquiring company	Acquired company
9.	x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	0	6
10.	x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)	4	5
11.	x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.)	2	2
12.	x_4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	1	0,5
Type of knowledge taken over		Explicit knowledge share (%)	
		Acquiring company	Acquired company
13.	x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	0%	90%
14.	x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management unique skills of contractors, etc.)	30%	60%
15.	x_3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.)	20%	40%
16.	x_4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	80%	90%

Source: own study.

Companies vary considerably in value of assets, sales revenues, and level of employment. Company 2 was the initiator of the consolidation (merger by absorption). Company 1 in the year preceding the consolidation has shown a net revenue of PLN 320.1 million, while the Company 2 generated PLN – 228.8 million. In turn the assets of the two companies amounted to PLN 62.1 and PLN 135.9 million, respectively.

The acquisition of professional staff employed directly in production is a condition of mastering technology by the acquiring enterprise. A reflection of importance of the staff employed directly in production in Company 1 is significantly higher average wages in this company.

Table 36 summarizes these indicators and their differences.

Firstly, the differences between activity status indicators and knowledge transferable of both companies were examined.

Table 36. Summary of activity status indicators and knowledge and their differences for pilot studies

No.	Rate	Unit	Com- pany 1	Com- pany 2	Range F1–F2	Range in absolute values F1–F2
1	2	3	4	5	6	7
1.	Company assets	PLN million	135.9	67.1	-68.8	68.8
2.	Average pay	PLN	3.313	4.020	+707	707
3.	Number of employees	people	51	459	+408	408
4.	Percentage of employees with higher education	%	5	10	+5	5
5.	Amount of revenues	PLN million	19.2	241.5	+222.3	222.3
6.	Number of departments	pc.	6	3	-3	3
7.	General assessment of company financial condition (1, 2, 3, 4)	1-6	3	3	0	0
8.	Knowledge learning time (×1)	months	0	1	+1	1
9.	(×2)	months	4	1	-3	3
10.	(×3)	months	5	6	+1	1
11.	(×4)	months	2	3	+1	1
12.	Significance (weight) of knowledge ×1	6–4	0	6	+6	6
13.	×2	4–2	4	5	+1	1
14.	×3	2–1	2	2	0	0
15.	×4	1–0,5	1	0,5	0	0
16.	Explicit knowledge share ×1	%	0	90	+90	90
17.	×2	%	30	60	+30	30
18.	×3	%	20	40	+20	20
19.	×4	%	80	90	+10	10
20.	Number of employees having access to a computer compared to the total number of employees	%	31	22	-9	9
21.	Number of employees having access to data base compared to the total number of employees	%	11	19	+8	8

Source: own study.

Examining the differences between the values concerning both companies, especially in terms of knowledge transfer, is important. Knowledge transfer is best suited to companies with large potential differences, both in terms of size and importance of knowledge. On the other hand, when the consolidation is motivated by other goals, only useful knowledge is mentioned. This distinction has a specific meaning. In the case of searching a way to shorten the time to acquire the necessary knowledge, this can be done at the expense of prolonging the time to master useful knowledge. In this situation, the greater the differences in such knowledge are, the more companies are susceptible to be consolidated. By successively analysing values in table 38, an attempt was made to interpret them.

Assets of the two companies, listed on the first position, are very different. This means that the acquisition will be relatively straightforward both in formal and substantial terms, as decision disputes will be avoided in case of possible divestment. However, it will not be easy in terms of knowledge acquisition. The smaller of the companies have improved furnace operating technology and experienced staff with high competences. This requires a serious effort related to conveying the tacit knowledge associated with technology, skills and experience.

The same applies to the number of employees, as among them are highly qualified professionals. This is also evidenced by the average wage level that is higher in the acquired company. The difference in the number of departments relative to employment is rather apparent. In the first company the number of furnaces in the department is significantly lower than in the acquiring entity.

There is no difference in the overall financial condition.

Unlike indexes that determine the level of acquired knowledge, a significant difference, expressed in the time of learning, is not great. Exception is the difference in the acquired knowledge with respect to x_2 knowledge, which indicates the time of learning it by the acquired company, mainly concerning knowledge related to the experience and skills of executives.

However, given the importance of knowledge, the amount of difference refers to knowledge x_1 . This concerns mastering the new improved technology.

The differences in the share of explicit knowledge are very high only in relation to the technology acquired, as it was part of the knowledge that the first company was most interested in.

In addition to the aforementioned differences, calculated were these in accessing the computer and database. They are a bit bigger in the first company. The arithmetic means and absolute deviations from this value, calculated for individual indicators, show very large variations both in size of the company (assets) and its human potential. However, in terms of knowledge, the situation is different in its individual types, which in turn increases the scope of its possible bilateral transfer.

More information can be provided by an analysis of the structure, which is only possible in the problem of knowledge acquisition due to the presence of homogeneous quantities.

Table 37 contains two types of data. Firstly, the top rows of the table contain data on location of knowledge acquired from Company 2 by Company 1, secondly is the same amount expressed in percent.

Table 37. Structural cross-section of knowledge acquired and transferred according to its types analysed in the study

	Time of knowledge transfer in months			Knowledge structure indexes in%		
	F1	F2	Σ	F1	F2	Σ
x_1	0	1	1	0	100	100
x_2	4	1	5	80	20	100
x_3	5	6	11	45	55	100
x_4	2	3	5	40	60	100
			22			

Source: own study.

Company 1 acquired technological knowledge within a month and knowledge involving experience and performance skills within 6 months. The latter type of knowledge is tacit knowledge, the transfer of which is not simple, requires observation and imitation, and therefore takes a relatively long time, compared to the transfer of explicit knowledge, e.g. in the form of technological documentation. In terms of knowledge x_2 the situation was reversed. Company 1 transferred to Company 2 much more knowledge than it had acquired. These were managerial skills and other elements that were important to the acquiring entity, as Company 2 thus increased its productivity and lowered costs, which brought a significant benefit to the consolidated enterprises. Knowledge of the x_3 type with a high proportion of tacit, poorly measurable elements was transferred in both directions; it was different knowledge, mutually needed. The same can be said about organizational knowledge x_4 .

The second section is the knowledge considered by the participation of companies in each of its categories, presented in Table 38.

Table 38. Structural cross-section of knowledge acquired by companies

	Absolute numbers (months)		Structure indicators (%)	
	F1	F2	F1	F2
x_1	0	1	0,0	9,0
x_2	4	1	36,0	9,0
x_3	5	6	45,0	54,5
x_4	2	3	19,0	27,5
Σ	11	11	100	100

Source: own study.

Company 1 has acquired all kinds of knowledge. In certain cases this was a mutual exchange of knowledge, and acquisition took almost equal time in case of knowledge x_3 and x_4 .

From a knowledge perspective, Company 2 (F2) gained a large amount of knowledge x_2 and x_3 , related to skills and experience.

Company F1 has gained experience in the use of furnace technology. Having data on the time of mastering knowledge and the scales that determine their importance, it is possible to calculate the overall time of knowledge transfer, taking into account its importance. For this purpose, a model of knowledge transfer was used (Figure 27).

As inputs, the values of knowledge and the coefficients from Table 36 were used, i.e. the general set of variables (features) for the pilot study, where actual data concerning the transfer time and the coefficients were placed, established on the basis of expert advice from each company separately. These coefficients differ from the established median values, estimated by experts for the entire group, and can be adjusted after analysis of the pilot study results. After placing the coefficients to the knowledge transfer model (Figure 27), considering the validity of the knowledge, based on the expert consultations of the two companies, the following equation was obtained:

$$\begin{aligned} Y_1 &= 6X_1 + 5X_2 + 2X_3 + 0.5X_4, \\ Y_2 &= 4X_2 + 2X_3 + X_4, \\ Y_1 + Y_2 &\rightarrow \min. \end{aligned} \quad (6)$$

The following results were obtained when the knowledge values and calculation data were placed:

$$\begin{aligned} Y_1 &= 6 \times 1 + 5 \times 1 + 2 \times 6 + 0.5 \times 3, \\ Y_2 &= 4 \times 4 + 2 \times 5 + 1 \times 2, \\ Y_1 + Y_2 &= 24.5 + 28 = 52.5. \end{aligned} \quad (7)$$

These results can be interpreted as follows: the overall time to master the knowledge transferred in both directions is 52.5 months, which is slightly more than four years. However, taking into account that with the appropriate human and material resources it could take place in parallel, this time could be reduced by a maximum of about half. However, this is not often the case. Choice has to be made, focusing on the knowledge most important in terms of business mergers effectiveness. Such manoeuvring is possible not only by simultaneous learning of knowledge, but also by total or temporary restraint of certain non-essential elements of transfer (e.g. adaptation of systems and regulations). In this situation, it is enough to skip or reduce the range of knowledge learnt that is of lesser importance in the model system, and to devote time and material resources to the transfer of knowledge of basic importance. In addition, the transfer manager may impose certain conditions

limiting the transfer time, e.g. in the pilot study described above, it is sufficient to impose in the second equation, a limit to $x_2 \leq 8$ and $x_3 \leq 5$ to shorten the overall transfer time by 13 months.

Verification of taxonomic grouping (by pilot study provided for in the substantial part) is not possible as the pilot group used cannot be split as the taxonomic distance of enterprise 1 from enterprise 2 is the same as 2 to 1. This would mean that both examined companies are not susceptible to transfer and that both are mutually compatible and belong to the same group. It must be stressed, however, that the purpose of the pilot study was not a detailed verification of the test methods applied in the base study, but merely direction of the research process.

The pilot study suggests that in the full group there should be entities with differentiated character, representing different situations in the area of knowledge transfer. Then the conclusions of this study could be used to better understand the transfer process itself and be able to provide the opportunity to change the *due-diligence* analysis and methodology.

2. Results of basic research

Stage I study results

Stage I.A

In **stage I.A**, important factors have been identified that determine the transfer of knowledge in mergers and acquisitions. As essential factors considered were those value, which was greater than the arithmetic mean plus 1/2 of the standard deviation (Annexe 9).

As a result of the research, 25 knowledge factors which received the lowest number of points were rejected.

These factors include:

- complaints analysis,
- analyses, calculations and synthesis,
- intangible goods protection period of which has expired,
- personal experience in occupational safety and health, fire, sanitary and epidemiological fields,
- planning experience,
- product documentation,
- operating records of machinery and equipment,
- record of inspections, periodic and capital repairs,
- emergency procedures,
- configuration of organizational units,

- materials for analysis, calculation and cost synthesis,
- standards and regulations,
- standards for emissions of gases, land contamination and water pollution,
- health and safety regulations, inspection and accident reports,
- fire protection regulations,
- sanitary and epidemiological reports,
- external and internal regulations on the protection of the air, land and water,
- relations with debtors and creditors,
- relations with customers and sales representatives,
- specialization of divisions and organizational units,
- knowledge of production possibilities and delivery dates,
- knowledge of quality regulations,
- principles and organization of autonomous units,
- knowledge of laws and regulations and internal instructions,
- knowledge of statistical and econometric tools.

Other knowledge factors that are considered to be relevant by managers (32 factors) will be further analysed in **stages II** and **III** studies, using group expert assessment.

Stage I.B

In **stage I.B** determined was the validity of factors that influence the success of merger and acquisition processes in relation to knowledge transfer.

For the study method, it was assumed that factors value of which was greater than the arithmetic mean plus $\frac{1}{2}$ standard deviation were more relevant in the analysed aspect. The calculations are contained in Annexe 10, and the results are shown in Table 39.

Table 39. The sums of factors affecting success of merger and acquisition processes in relation to knowledge transfer (stage I.B)

No.	Factors affecting success of merger and acquisition processes	Points 1–5
1.	Precisely designed integration program	249
2.	Clearly defined goals of acquisition	291
3.	Cultural similarity of the enterprises organization (including learning culture of the organization)	285
4.	Properly built and managed <i>transition team</i>	216
5.	Preparation or recognition of the existing knowledge map	288
6.	Degree of knowledge verbalisation	254
7.	Level of knowledge articulation	259
8.	Knowledge distance (understood as difference in knowledge level between the transferor and the receiver)	255

Source: own study.

The factors that (according to experts) mostly influence the success of mergers and acquisitions, in relation to knowledge transfer are as follows:

- clearly defined goals of the acquisition,
- preparation or recognition of an existing knowledge map,
- cultural similarity of the enterprise organization (including the organization learning culture).

The importance of other factors influencing the success of fusion and acquisition processes in relation to knowledge transfer is shown below in descending order:

- level of knowledge articulation,
- knowledge distance (understood as the difference in knowledge level between transferor and receiver),
- degree of knowledge verbalisation,
- precisely designed integration program,
- properly built and managed *transition team*.

Results stage II research

Stage II.A

In **stage II.A**, the experts assigned the identified in **stage I.A** important determinants of knowledge transfer to the four groups of knowledge factors (x_1 , x_2 , x_3 , x_4).

It was assumed that to the four groups qualified was knowledge factor, which was most often indicated by experts in a given group. The raw results and calculations are contained in Annexe 11.

Table 40 contains the data of the knowledge factor group together with the individual factors categorized by the experts into the four groups of knowledge factors (x_1 , x_2 , x_3 , x_4).

Table 40. Assignment of knowledge factors to four groups of knowledge factors (stage II.A) – knowledge map

Knowledge factor groups	Factors determining knowledge transfer in the processes of mergers and acquisitions
x_1 – knowledge that is an individual motive for acquisition	<ul style="list-style-type: none"> – current R & D works within the company – forecasts of research cells – R+D concerning development of the enterprise – ideas, patents, innovations – computer programs, utility models, trademarks – projects – personal relations with suppliers and buyers – production technology – knowledge of production technology

Knowledge factor groups	Factors determining knowledge transfer in the processes of mergers and acquisitions
x_2 – knowledge, including tacit knowledge having significant importance for the acquiring entity	<ul style="list-style-type: none"> – employees with valuable skills and competencies – practical experience of employees in the sphere of sales – practical experience of supervisory staff – skills and competences in collaboration with the environment – personal knowledge of specialised employees – tacit knowledge of financial workers – tacit knowledge of executive workers
x_3 – knowledge, including explicit knowledge of significant importance	<ul style="list-style-type: none"> – information and analysis of competition quality – customer information on the quality, features and prices of the products – information and analysis of product characteristics – technical descriptions and manuals – portfolio of orders and ability of its shaping – product, technology and organizational standards – ability to regulate financial flows – knowledge of R & D by the competition (inventions, innovations, quality, patents) – marketing knowledge of customers – knowledge in the scope of <i>foresight</i> – knowledge of optimum stock shaping – knowledge of costing
x_4 – organisational knowledge due to certain enterprises	<ul style="list-style-type: none"> – documentation and unofficial news concerning quality – ability to optimally shape stocks – explicit knowledge of competitors and markets – suppliers' market knowledge

Source: own study.

The groups of knowledge factors from **stage II.A** will be further analysed in **stage III** survey research, which also uses group experts' assessment.

Stage II.B

Establishing specialized testing methods, appropriate for the analysis of knowledge transfer between consolidated companies was possible through the use of group experts' assessments.

Research methods, which were most often indicated by experts, were considered most suitable for knowledge transfer analysis. The raw results and calculations are contained in Annexe 12.

The results, used in the second part of the interviews, the semi-structured methods are as follows:

- specialized methods which, according to experts, are most suitable for analysing the transfer of knowledge between consolidated companies:
 - nearest neighbour method (Johnson method),
 - Czekanowski method,

- Wrocław taxonomy method (shortest dendrite method),
- median method,
- correlation coefficients (Spearman rank correlation, Kendal coefficient),
- scattering measures (entropy and Taylor's development as a Gini coefficient),
- measure of proximity (Kullback-Leiber distance);
- other research methods:
 - the furthest neighbourhood (Johnston method),
 - *on-line* method,
 - Berry method,
 - centre of gravity method,
 - group average method,
 - dependency ratio (Goodman-Kruskal coefficient).

None of the experts examined proposed a method other than the above-mentioned research methods, appropriate for analysing the transfer of knowledge between consolidated companies. This situation may be caused by the fact that the participants considered the methods they showed as sufficient and did not see the need to supplement them.

Results stage III research

Stage III.A

In the last stage of the group expert's assessments research analysed were 11 pairs of companies consolidated as a result of mergers or acquisitions, with demarcation to acquiring and acquired companies.

Stage III.A allowed to determine which type of knowledge was acquired as a result of the merger or acquisition.

The following assumptions were made for the study:

- $\leq 25\%$ – knowledge acquired at a trace level;
- (25%, 50%) – knowledge acquired to a small extent;
- (50%, 75%) – knowledge acquired to an average extent;
- (75%, 100%) – knowledge acquired to a large extent.

The calculations are contained in Annexe 13, and the results are shown in Table 41.

In case of acquiring companies, the research results indicate average extent of acquiring one of the four groups of knowledge factors, i.e. knowledge, including explicit knowledge of significant importance (x_3).

Other knowledge factors (x_1 , x_2 , x_4) were taken over to a small extent.

Table 41. Type of knowledge acquired as a result of a merger or acquisition – stage IIIA results

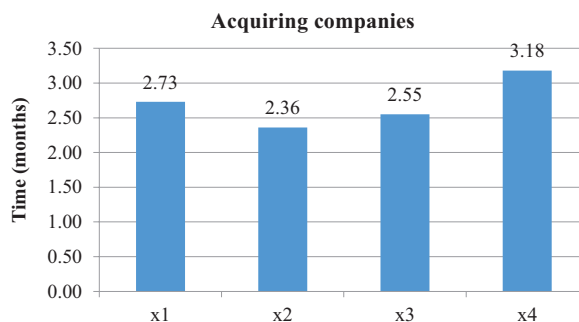
Acquiring companies		Knowledge factor groups				Acquired companies		Knowledge factor groups			
		x ₁	x ₂	x ₃	x ₄			x ₁	x ₂	x ₃	x ₄
11 consolidations	1	41,67%	41,67%	66,67%	66,67%	11 consolidations	1	33,33%	58,33%	41,67%	66,67%
	2	33,33%	58,33%	58,33%	33,33%		2	41,67%	41,67%	66,67%	41,67%
	3	41,67%	41,67%	41,67%	41,67%		3	41,67%	41,67%	33,33%	41,67%
	4	41,67%	41,67%	66,67%	41,67%		4	41,67%	41,67%	41,67%	41,67%
	5	25,00%	33,33%	41,67%	41,67%		5	41,67%	41,67%	41,67%	41,67%
	6	41,67%	41,67%	41,67%	41,67%		6	41,67%	25,00%	41,67%	41,67%
	7	41,67%	25,00%	41,67%	41,67%		7	33,33%	41,67%	41,67%	41,67%
	8	41,67%	25,00%	41,67%	41,67%		8	33,33%	41,67%	41,67%	41,67%
	9	58,33%	58,33%	66,67%	58,33%		9	41,67%	41,67%	33,33%	16,67%
	10	41,67%	66,67%	66,67%	41,67%		10	50,00%	66,67%	41,67%	41,67%
	11	58,33%	66,67%	66,67%	33,33%		11	41,67%	25,00%	16,67%	33,33%
Average of answers "YES"		42,42%	45,45%	54,55%	43,94%	Average of answers "YES"		40,15%	42,42%	40,15%	40,91%

Source: own study.

With regard to acquired companies, all groups of knowledge factors have been acquired to a small extent.

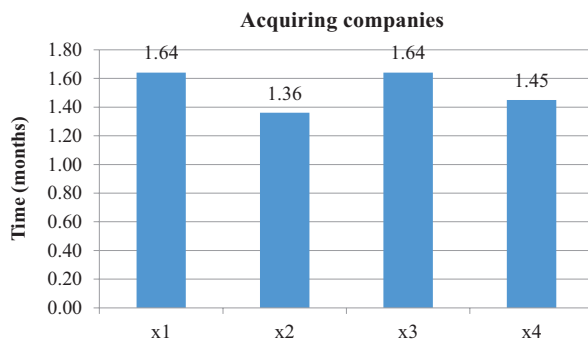
Stage III.B

Based on the obtained research results, graphs showing the arithmetic mean for the acquiring and acquired companies were drawn up, reflecting the time needed to master the four groups of knowledge factors in the merger or acquisition process respectively (Figures 38 and 39).

Figure 38. The time needed to master the four groups of knowledge factors for the acquiring enterprises

Source: own study.

Figure 39. The time needed to master the four groups of knowledge factors for the acquired enterprises



Source: own study.

Experts pointed out that for acquiring companies the shortest time to master knowledge concerns the group of knowledge factors x2 – knowledge, including tacit that is important to the buyer, and is over 2 months.

For the other three groups (knowledge x_1 , x_3 , x_4), mastering the knowledge, according to experts, takes about 3 months.

On the other hand, in the case of the acquired companies, the knowledge acquisition time is shorter and is respectively:

- about 1 month – groups of knowledge factors: x_2 , x_4 (knowledge, including tacit knowledge, significant for the purchaser, organizational knowledge specific for defined companies);
- almost 2 months – groups of knowledge factors x_1 , x_3 (knowledge that is an independent motive of acquisition, knowledge of significant importance).

Annexe 14 contains the calculations and results from **stage III.B**.

Stage III.C

The results obtained in **stage III.C** have allowed to determine the importance (weight) of knowledge in the merger and acquisition processes for the acquiring and acquired companies.

The calculations are contained in Annexe 15, and the results are shown in Table 42.

Table 42. Significance (weight) of knowledge – results of stage III.C

Acquiring companies		Knowledge factor groups				Acquired companies		Knowledge factor groups			
		x_1	x_2	x_3	x_4			x_1	x_2	x_3	x_4
11 consolidations	1	1	3	2	1	11 consolidations	1	1	3	1	2
	2	3	4	1	2		2	1	2	1	1
	3	2	1	3	1		3	1	1	1	1
	4	3	4	2	3		4	1	1	1	1
	5	2	3	1	1		5	1	2	1	1
	6	1	3	2	1		6	4	1	2	1
	7	2	2	1	1		7	1	2	1	1
	8	3	3	4	2		8	1	1	1	1
	9	4	4	4	1		9	1	1	1	1
	10	3	2	1	3		10	1	2	1	1
	11	2	3	1	1		11	1	1	1	1
Average		2,4	2,7	2,1	1,7	Average		1,4	1,6	1,3	1,4

Source: own study.

In the case of acquiring companies, the experts assigned the biggest significance to the group of knowledge factors x_2 (knowledge, including tacit knowledge, significant to the acquiring entity), obtaining 2.7 out of a four-point scale. The significance of the remaining three groups of knowledge factors (x_1 , x_3 , x_4) is at a similar level (2.4, 2.1, 1.7 points).

Research results for acquired companies are likewise. The group of knowledge factors x_2 has also been recognized by experts as being the most important in mergers and acquisitions, yet it gained 1.6 points. The weight of the remaining three groups of knowledge factors is at a similar level, above 1 point.

Stage III.D

Based on the results of the research obtained in **stage III.D**, the type of knowledge (explicit or tacit) of greater importance in the context of its transfer in the merger or acquisition process has been identified.

The type of knowledge (explicit or tacit) that was most often indicated by experts was considered to be of greater importance in the merger or acquisition process.

Results are shown in Table 43, while calculations are in Annexe 16.

According to expert opinion in **stage III.D**, both in case of acquiring and acquired entities the knowledge of greater significance is the explicit one in relation to all four groups of knowledge factors.

Table 43. Type of knowledge of greater significance – results of stage III.D

Acquiring companies		Type of knowledge of bigger importance				Acquired companies		Type of knowledge of bigger importance			
		x ₁	x ₂	x ₃	x ₄			x ₁	x ₂	x ₃	x ₄
11 consolidations	1	1	0	1	1	11 consolidations	1	1	0	1	1
	2	1	0	0	1		2	0	1	0	0
	3	1	1	1	1		3	1	1	1	1
	4	1	1	1	1		4	1	1	1	1
	5	1	1	1	1		5	1	1	1	1
	6	1	1	1	1		6	1	1	1	1
	7	1	1	1	1		7	1	1	1	1
	8	1	0	1	0		8	1	1	1	1
	9	1	1	0	1		9	1	1	1	1
	10	1	0	1	1		10	1	1	1	1
	11	1	0	0	1		11	1	1	1	1
Most common		1	1	1	1	Most common		1	1	1	1
1 – explicit						1 – explicit					
2 – tacit						2 – tacit					

Source: own study.

Stage III.E

In order to identify the relations between knowledge transfer and merger and acquisition transactions, 11 variables were analysed in relation to acquiring and acquired companies.

The results of **stage III.E** are presented in Table 44, while calculations concerning identification of the relations between knowledge transfer and merger and acquisition transactions are contained in Annexes 17 and 18.

Table 44. List of indicators – results of *stage III.E*

No.	Indicators	Company 1 (acquiring)			Company 2 (acquired)		
1.	Company assets (million EUR)	7,682			5,692		
2.	Average pay (EUR)	26,420			28,136		
3.	Total number of employees	59,355			24,251		
4.	Amount of revenues from sales (million EUR)	7,728			7,388		
			number of answers	procent of		number of answers	procent of
5.	General assessment of company financial condition (1 – the lowest grade, 4 – the highest grade)	result: 1	0	0.00%	result: 1	4	36.36%
		result: 2	1	9.09%	result: 2	2	18.18%
		result: 3	7	63.64%	result: 3	3	27.27%
		result: 4	3	27.27%	result: 4	2	18.18%

			number of answers	procent of		number of answers	procent of
6.	Whether <i>transition team</i> as established in the company?	YES	5	45.45%	YES	4	36.36%
		NO	6	54.55%	NO	7	63.64%
7.	Whether representatives of the acquired company take part in works of the team?	YES	4	36.36%	YES	4	36.36%
		NO	7	63.64%	NO	7	63.64%
8.	Average level of employees' qualifications (1 – lowest grade, 4 – highest grade)	result: 1	1	9.09%	result: 1	0	0.00%
		result: 2	5	45.45%	result: 2	1	9.09%
		result: 3	4	36.36%	result: 3	5	45.45%
		result: 4	1	9.09%	result: 4	5	45.45%
9.	Type of organizational structure	centralised	6	54.55%	centralised	0	0.00%
		rather centralised	4	36.36%	rather centralised	5	45.45%
		rather decentralised	0	0.00%	rather decentralised	4	36.36%
		other	1	9.09%	other	2	18.18%
10.	Applied wage system	piecework	7	63.64%	piecework	2	18.18%
		incentive wage system	2	18.18%	incentive wage system	5	45.45%
		daily pay	0	0.00%	daily pay	0	0.00%
		daily-task	0	0.00%	daily-task	0	0.00%
		other	2	18.18%	other	4	36.36%
11.	Cultural differences in relation to consolidated company (1 – lack, 2 – small, 3 – average, 4 – highest)	1	5	45.45%	1	2	18.18%
		2	1	9.09%	2	5	45.45%
		3	5	45.45%	3	4	36.36%
		4	0	0.00%	4	0	0.00%

Source: own study.

In order to further analyse the obtained results, it is assumed that the names of the variables used in calculations have orderly character, hence they are not identical with the names of both the variables from the knowledge transfer model and those used in questionnaires.

The order variables for which weights were determined by surveys were additionally given a numerical index. All variables received an order index.

For example, the knowledge variables used in questionnaires (x_1, x_2, x_3, x_4) obtained the relevant order variables along with the knowledge indicators: ($y_{15.1}$ to $y_{15.4}$) – the importance of knowledge (from 1 to 4, where 1 – the lowest, 4 – the largest).

In general, the variables were divided into two groups:

- quantitative variables:
 - continuous:
 - ❖ y_3 company assets,
 - ❖ y_4 average pay,
 - ❖ y_6 sales,
 - discrete:
 - ❖ y_5 number of employees,
 - ❖ from $y_{14.1}$ to $y_{14.4}$ time of mastering knowledge in months (indicators concerning knowledge);
- order variables:
 - y_7 assessment of general financial situation (1 to 4, 1 – the worst, 4 – the best),
 - y_8 appointment transition team (0 – „no”, 1 – „yes”, „no” < „yes”),
 - y_9 participation of the acquired company in *transition team* (0 – „no”, 1 – „yes”, „no” < „yes”),
 - y_{10} average level of qualification (1 to 4, 1 – the lowest, 4 – the highest),
 - y_{11} type of organizational structure (1 to 4, 1 – the worst, 4 – the best),
 - y_{12} dominant pay system (1 to 4, 1 – the worst, 4 – the best),
 - y_{13} cultural differences (from 0 to 3, 0 – no difference, 3 – the largest),
- knowledge related indicators:
 - from $y_{15.1}$ to $y_{15.4}$ – the importance of knowledge (from 1 to 4, 1 – the lowest, 4 – the largest),
 - from $y_{16.1}$ to $y_{16.4}$ knowledge type (1 – „explicit” knowledge, 2 – „tacit” knowledge), „tacit” < „explicit”.

In addition, the variable y_1 is the number of the successive company, and y_2 includes information about takeover of steelworks („a” – acquiring steelworks, „b” – acquired steelworks). For the order variables, only the dependence measures can be calculated (Spearman’s rank correlation and Kendal coefficient), scattering measures (Taylor index and extension as Gini coefficient), proximity (distance of Kullback-Leiber and χ^2) and dependencies (Goodman-Kruskal coefficient) and common information measure. Information about the concentration of variables is depicted by Lorenz graphs, which simultaneously show the Gini coefficients.

Below is the data on the names and scope of the calculated descriptive indicators, their abbreviations and manner of their presentation:

- the first column contains variable names;
- time – the next number of the variable in the list;
- n – number of proposed observations;
- mean – arithmetic mean; sd – standard deviation;
- median – median;
- trimmed – arithmetic mean after discarding 10;
- mad – median of absolute deviation;
- min – minimal value;
- max – maximal value.
- range – range;
- skew – skewness factor (classical measure based on the third central moment);
- kurtosis – concentration factor (kurtosis – classical measure based on the fourth central moment);
- se – standard error;
- entropie – entropy;
- Gini – Genie's coefficient;
- coefficient of variation;
- var – variance.

Using the above-mentioned indications in Table 45 descriptive values for variables for all objects were shown.

Table 45. Population descriptors for all objects (steelworks)

y_3	y_4	y_5	y_6
Min.: 44.0	Min.: 12000	Min.: 500	Min.: 88.0
1st Qu.: 887.8	1st Qu.: 20125	1st Qu.: 11041	1st Qu.: 947.5
Median: 2983.0	Median: 24500	Median: 16900	Median: 5189.5
Mean: 5963.0	Mean: 26277	Mean: 37144	Mean: 7557.9
3rd Qu.: 6498.0	3rd Qu.: 31000	3rd Qu.: 49925	3rd Qu.: 10571.5
Max.: 28662.0	Max.: 48000	Max.: 224000	Max.: 29985.0
y_7	y_8	y_9	y_{10}
Min.: 1.000	Min.: 0.0000	Min.: 0.0000	Min.: 1.000
1st Qu.: 2.000	1st Qu.: 0.0000	1st Qu.: 0.0000	1st Qu.: 2.250
Median: 3.000	Median: 0.0000	Median: 0.0000	Median: 3.000
Mean: 2.727	Mean: 0.4091	Mean: 0.3636	Mean: 2.955
3rd Qu.: 3.000	3rd Qu.: 1.0000	3rd Qu.: 1.0000	3rd Qu.: 3.750
Max.: 4.000	Max.: 1.0000	Max.: 1.0000	Max.: 4.000

y_{11}	y_{12}	y_{13}	
Min.: 1.000	Min.: 1.000	Min.: 1.000	
1st Qu.: 1.250	1st Qu.: 1.000	1st Qu.: 1.000	
Median: 2.000	Median: 2.000	Median: 2.000	
Mean: 2.182	Mean: 2.409	Mean: 2.091	
3rd Qu.: 3.000	3rd Qu.: 4.250	3rd Qu.: 3.000	
Max.: 4.000	Max.: 5.000	Max.: 3.000	
$y_{14,1}$	$y_{14,2}$	$y_{14,3}$	$y_{14,4}$
Min.: 1.000	Min.: 1.000	Min.: 1.000	Min.: 1.000
1st Qu.: 2.000	1st Qu.: 1.000	1st Qu.: 1.000	1st Qu.: 1.000
Median: 2.000	Median: 1.000	Median: 1.000	Median: 2.000
Mean: 2.182	Mean: 1.864	Mean: 2.091	Mean: 2.318
3rd Qu.: 2.750	3rd Qu.: 2.000	3rd Qu.: 3.000	3rd Qu.: 3.750
Max.: 4.000	Max.: 5.000	Max.: 6.000	Max.: 5.000
$y_{15,1}$	$y_{15,2}$	$y_{15,3}$	$y_{15,4}$
Min.: 1.000	Min.: 1.000	Min.: 1.000	Min.: 1.000
1st Qu.: 1.000	1st Qu.: 1.000	1st Qu.: 1.000	1st Qu.: 1.000
Median: 1.500	Median: 2.000	Median: 1.000	Median: 1.000
Mean: 1.909	Mean: 2.091	Mean: 1.545	Mean: 1.318
3rd Qu.: 3.000	3rd Qu.: 3.000	3rd Qu.: 2.000	3rd Qu.: 1.000
Max.: 4.000	Max.: 4.000	Max.: 4.000	Max.: 3.000
$y_{16,1}$	$y_{16,2}$	$y_{16,3}$	$y_{16,4}$
Min.: 1.000	Min.: 1.000	Min.: 1.000	Min.: 1.000
1st Qu.: 1.000	1st Qu.: 1.000	1st Qu.: 1.000	1st Qu.: 1.000
Median: 1.000	Median: 1.000	Median: 1.000	Median: 1.000
Mean: 1.091	Mean: 1.273	Mean: 1.182	Mean: 1.091
3rd Qu.: 1.000	3rd Qu.: 1.750	3rd Qu.: 1.000	3rd Qu.: 1.000
Max.: 2.000	Max.: 2.000	Max.: 2.000	Max.: 2.000

Source: own study.

The most information of general character is provided by the analysis of the continuous variables, i.e. y_3 , y_4 , y_6 and discrete variable y_5 .

The variable y_3 is the average value of assets of the consolidating metallurgical enterprises. The average (arithmetic mean) value of the assets of the surveyed companies was EUR 5963.5 million. However, the surveyed group shows a considerable spread of assets in particular companies. Range in this group amounts to EUR 28,818 million, which in comparison with $\max = 28,862$ means that it covers the average almost five times. In this situation, the average does not adequately depict the size of assets of the companies in the examined sample. A closer look at this situation by analysing the starting material leads to an explanation of the situation. It shows the fact that the formation of a very high average was decided by the assets of two large metallurgical companies: Mittal Steel Company NV – Arcelor SA and Arcelor Mittal. Both companies had EUR 28,662 and 26,383 million in assets respectively. At the other extreme of very small enterprises in the merger

process were two comparatively very small companies, namely Huta Ostrowiec S.A. (EUR 44 million) and Zawiercie Steelworks (now CMC Zawiercie S.A.) (EUR 70 million).

Excluding these extremes, the average amounted to EUR 6222 million in assets, so even higher. The value of standard deviation, much larger than average, confirms this phenomenon. This leads to conclusions about heterogeneity of the aggregation of the consolidating enterprises. This may be a result of not only differences in the size of enterprises, but also the diversity in motives of consolidations in which knowledge transfer is not always the main reason.

The second, important general indicator that influences the formation of consolidations is sales (y_6). The „demand” for mergers and acquisitions often depends on sales volumes, related not directly with increasing market share (mainly in case of intra-country consolidations), as with obtaining new results. It is also undoubtedly associated with knowledge about these markets and the technological solutions applied there, but also with the high competences of acquired knowledge, without which it would be difficult to master new markets. The average sales volume, according to Table 47, was at the level of EUR 7,557.9 million.

Slightly different characters have variables y_4 and y_5 , which denote wages and employment. They to a lesser extent relate to market issues in consolidated companies – to a greater extent the expertise and competence of the acquired enterprises. In conjunction with the indicators discussed hereinafter, presenting the transfer of knowledge, they broaden the picture of this transfer in relation to knowledge carriers, which are explicit and tacit knowledge resources, lower level managing staff, and the specific competencies of management personnel, highly specialized in the area of management. The coefficients of correlation coefficient for employment (y_5) correlated with each of the indicators of the group $y_{14.1}$ to $y_{16.4}$ confirm the existence of interdependence.

Table 46. Spearman and Kendall rank correlation coefficients

Variables		14.1	14.2	14.3	14.4	15.1	15.2	15.3	15.4	16.1	16.2	16.3	16.4
Coefficient of Kendall	y_5	0,36	0,30	0,25	0,39	0,19	0,43	0,39	0,26	0,34	0,11	0,23	0,35
Coefficient of Spearman	y_5	0,39	0,37	0,35	0,50	0,27	0,55	0,47	0,32	0,40	0,13	0,28	0,42

Source: own study.

The Spearman and Kendall correlation coefficients, as shown in Table 46, respectively, indicate a correlation between employment (y_5) and various knowledge transfer ratios during mergers and acquisitions ($y_{16.1}$ to $y_{16.4}$). In all relations a positive correlation with limited strength was demonstrated. Spearman correlation coefficients are everywhere higher than Kendall's correlation coefficients. Similar correlations

have not been found previously by studying the correlation of knowledge transfer with assets or sales. It shows that in the transfer of knowledge the human factor plays an important role – the greater the number of employees is, the greater the importance of knowledge.

This is not a simplified view that binds the amount of transferred knowledge directly to the number of employees, but rather to the fact that a significant portion of knowledge, in particular the tacit one, is directly related to the human factor. To avoid misunderstandings, it should be emphasized that the number of staff is not the only or even the most important factor in the transfer of knowledge, and therefore the coefficients of rank correlations cannot be higher.

As for variable y_4 – average pay – the analysis did not show the correlation of this variable with variables of knowledge significance because of its transfer.

The above-mentioned relations for all consolidated entities do not exhaust the problem. It can be assumed that there are differences between objects belonging to subsets of the acquiring and acquired entities. Using the data contained in Annexe No. 18 (characteristics and correlations of the acquiring entities and the characteristics and correlations of the acquired entities), a correlation table for employment correlations in both groups and overall with knowledge transfer indicators (Table 47) was drawn up.

Table 47. Comparative statement of correlation between employment and knowledge transfer indicators

y_n	Correlation indicators for y_5 and y_{14}			
	Correlation indicator	Total	Acquiring companies	Acquired companies
14.1	S	0.39	0.49	-0.07
	K	0.30	0.40	-0.06
14.2	S	0.37	0.46	+0.06
	K	0.30	0.35	-0.05
14.3	S	0.34	0.57	-0.09
	K	0.25	0.44	-0.13
14.4	S	0.50	0.61	0.00
	K	0.39	0.47	-0.02

S – Spearman correlation coefficient, K – Kendall correlation coefficient.

Source: own study.

The correlation coefficients of the employment variable with the knowledge transfer variables previously established for the entire group were positive and statistically significant.

This shows that the higher the employment rate in the companies, the more important the type of knowledge acquired.

However, by dividing the group into the acquiring and acquired enterprises, it can be said that this correlation is stronger for the acquiring entities than the acquired ones. This is probably due to the fact that these are the entities in which the right proportions of the number of employees and the needs of production and knowledge resources are maintained.

The situation is different in the subset of the acquiring entities. There, the linear correlation coefficients are very different.

There are almost all negative factors (in Kendall even all) and lack of correlation (y_5 and y_{14}). It can be assumed that such results are affected by disproportionately high employment in relation to the results of production and the transfer of knowledge in acquired objects.

Another variable analysed was the financial situation. The average for the entire group of the acquiring and the acquired entities was as follows:

- entire group 2.727,
- acquiring companies 3.182,
- acquired companies 2.273.

Financial liquidity, debt, economic efficiency and profitability of companies were taken into account¹⁸⁷. The next two indicators of organizational nature occur in the form of zero-one variables. They refer to the appointment of the so-called *transition team* for the v of knowledge and participation of the acquired companies' representatives.

Of the 22 companies, only in 9 specialized knowledge transfer teams were established, of which in 8 there were representatives of the acquired company.

Further indicators labelled $y_{10} - y_{13}$ refer to the environment in which knowledge is transferred. These are: the average level of qualification, the type of organizational structure in which this process is occurring and the pay system and cultural differences.

These variables have an orderly character. For the first three they take values from 1 to 4 and the last one from 0 to 3. The variables y for $n = 10, 11$, and 12 have value character and grow from the lowest to the highest rating. In contrast, in the case of cultural variable, lack of significant cultural differences were identified by „0” and then by successive 1 and 2.

Analysis of the above indicators is very important from the point of view of knowledge transfer. They determine not only the resources and importance of the knowledge of the consolidated entities, but also the environmental conditions in which it occurs.

¹⁸⁷ W. Bień, *Zarządzanie finansami przedsiębiorstwa*, Difin, Warszawa 1999, p. 104.

In addition, an overview of indicators shows that these conditions are different in the acquiring and acquired enterprises. Often the subject and the reason for the transfer is precisely those conditions, e.g. highly efficient organizational system, pay system or lack of cultural conflicts.

Table 48 presents these problems by analysing the average values for the four variables ($y_{10} - y_{13}$) and the three structural cross-sections: acquiring enterprises, the acquired ones and aggregation.

Table 48. Characteristics of the knowledge transfer organizational environment

Environment / variables	Qualification level	Type of organizational structure	Dominating wage system	Cultural differences
	y_{10}	y_{11}	y_{12}	y_{13}
Acquiring companies	2.545	1.636	1.909	2.000
Acquired companies	3.364	2.727	2.909	2.182
Total	2.955	2.182	2.409	2.081

Source: own study.

On the basis of the results obtained, the more favourable conditions of mergers and acquisitions on the part of the acquired companies are clearly visible (except for cultural differences).

In their favour speaks a clearly higher average level of qualifications, organizational structure and pay system. Probably organizational knowledge (in the broad sense of the word) and competence (high average of qualification) were among the main reasons for the consolidation.

The analysis of the determinants (assets, sales, employment) on the basis of which mergers and acquisitions are made gives rise to the development of statistical indicators, i.e. variables concerning knowledge transfer.

These are three groups of variables:

- defining the amount of knowledge transferred according to its four distinction types, i.e. x_1 – knowledge that is an individual motive for the acquisition; x_2 – knowledge, including tacit, relevant to the acquiring unit; x_3 – knowledge, including explicit, of significant importance; x_4 – organizational knowledge relevant to specific companies;
- significance of knowledge;
- share of explicit and tacit knowledge in the knowledge that is the resource of the organization.

Knowledge or its significance cannot be measured directly with the same indicators for all its types. Hence, there is a need to estimate knowledge transfer and find an estimator that approximates an unknown parameter.

By examining the model to estimate the transferred knowledge, the time it takes to master it is best expressed in months, according to its particular genres. It should be emphasized that these variables, denoted by symbols $y_{14,1} - y_{14,4}$ and calculated in months, have a discrete character, as estimates containing the parts of a month (days) would be random and unreliable and could lead to false conclusions. Appropriate estimates broken down by acquiring and acquired enterprises and by the entire group are presented in Table 49.

Table 49. Average time of knowledge acquisition divided by the acquiring and acquired entities

	Time of mastering knowledge in months				Σ
	$y_{14,1}$	$y_{14,2}$	$y_{14,3}$	$y_{14,4}$	
Acquiring companies	31	26	28	35	120
Acquired companies	18	15	18	16	67
Entire group	49	41	46	51	187

Explanations:

$y_{14,1}$ = knowledge that is an individual motive for acquisition,

$y_{14,2}$ = tacit knowledge that is relevant to the acquiring entity,

$y_{14,3}$ = explicit knowledge, of relevance,

$y_{14,4}$ = organisational knowledge.

Source: own study.

The data presented in Table 49 allow us to draw some relevant conclusions.

The resources of transferred knowledge are relatively evenly distributed between the four types of knowledge under analysis. However, one cannot prejudge the existence of the only regularity here, as differences between groups are not relevant. This applies to the entire group and to the acquiring and acquired enterprises. It can be observed that every kind of knowledge is transferred.

Knowledge is transferred primarily by acquiring enterprises. They account for almost 2/3 of all transferred knowledge. This clearly indicates the specificity of the situation in the metallurgical industry.

It raises the question of the internal structure of the knowledge transferred or received, namely whether it is distributed fairly or evenly between entities or rather concentrates on a number of enterprises, key in this respect. These are depicted by the concentration coefficients, calculated on the basis of the fourth moment (formula 8)¹⁸⁸:

¹⁸⁸ www.statsoft.pl, Electronic Statistics Textbook Inc., 1984–2011.

$$\alpha_4 = \frac{m_4}{(m_2)^2} - 3, \quad (8)$$

α_4 = kurtosis (concentration measure)¹⁸⁹,

where „m” = moments 2 and 4.

As „m” the so-called central moments are defined. Moments, which points of reference are average values, are referred to as central moments. Moments of higher orders (α_3 , α_4) are applied to examine asymmetry and excess (flattening) respectively. Table 50 shows the concentration coefficients for the surveyed group and its subsets.

Table 50. Concentration of knowledge transfer in the general metallurgical enterprises group measured by classical measure (kurtosis)

y_n	Knowledge type	Concentration factor for the entire group	Concentration factor for acquiring enterprises	Concentration factor for acquired enterprises
$y_{14.1}$	Knowledge being a separate motive for acquisition	-0.631	-1.702	-1.079
$y_{14.2}$	Knowledge, including tacit knowledge, having a significant importance for the acquiring entity	0.367	-1.435	0.361
$y_{14.3}$	Knowledge, including explicit, of significant importance	0.075	-0.780	1.480
$y_{14.4}$	Organisational knowledge characteristic of certain enterprises	-0.405	-0.233	-0.450

Source: own study.

Kurtosis informs us how big the „scatter” of obtained results is, whether most of them are concentrated around the average – the values are close to the average. If there is a significant concentration of results around the mean (kurtosis is above 0), then we can say that much of the results / observations are similar to one another, and observations significantly different from the average are few. If there is a poor concentration of results around the mean (the kurtosis is below 0), we can say that there are quite a number of results that are far removed from the mean. We can also explain the kurtosis in a different manner. If the kurtosis is low (below zero), then in the data set we can observe more extreme results (far removed from the mean) when the kurtosis is higher, the number of such observations decreases. In the first case we are dealing with a situation where concentration of the population sharpens the normal distribution graph; in the latter, it becomes more flat. In the current study,

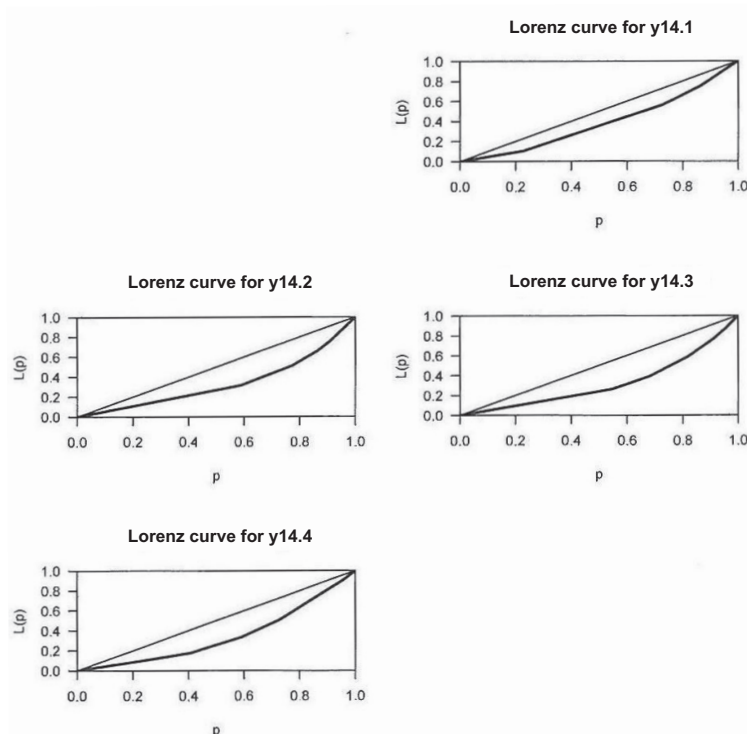
¹⁸⁹ http://www.ue.katowice.pl/uploads/media/SE_132.pdf.

variant I is rather important. Negative or near zero coefficients of kurtosis indicate variant II.

Distribution is flattened, which means that more or less equal knowledge resources are transferred in most of the surveyed enterprises. This particularly applies to knowledge that is the main reason for acquiring enterprises.

This situation is confirmed in the charts of so-called Lorenz curve. Figures 40-42 show the Lorenz curves for the groups of acquiring and acquired enterprises.

Figure 40. Lorenz curves for groups of acquiring enterprises

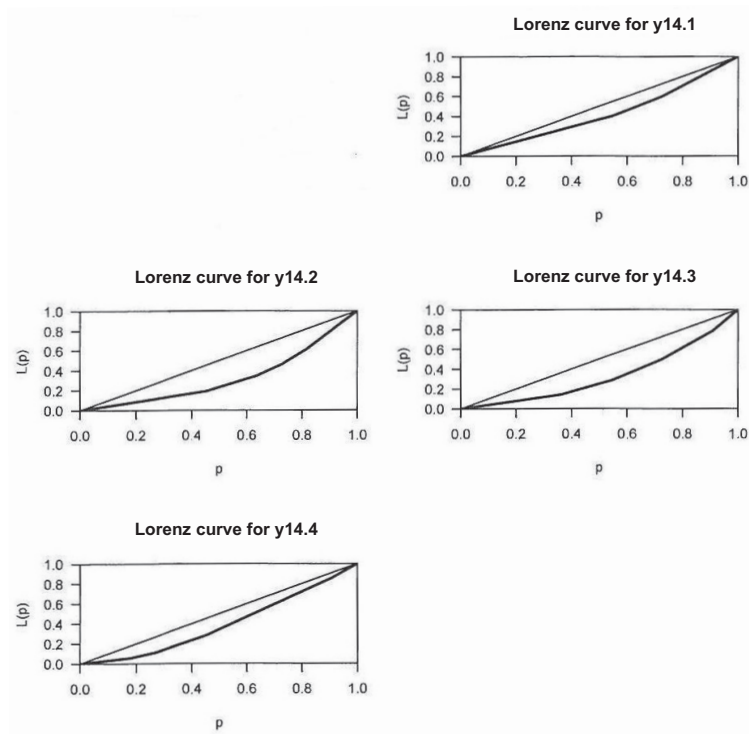


Source: own study.

The chart confirms information from the kurtosis study. By definition, „the surface between the equilibrium distribution line and the concentration curve can be a measure of the degree of concentration”¹⁹⁰.

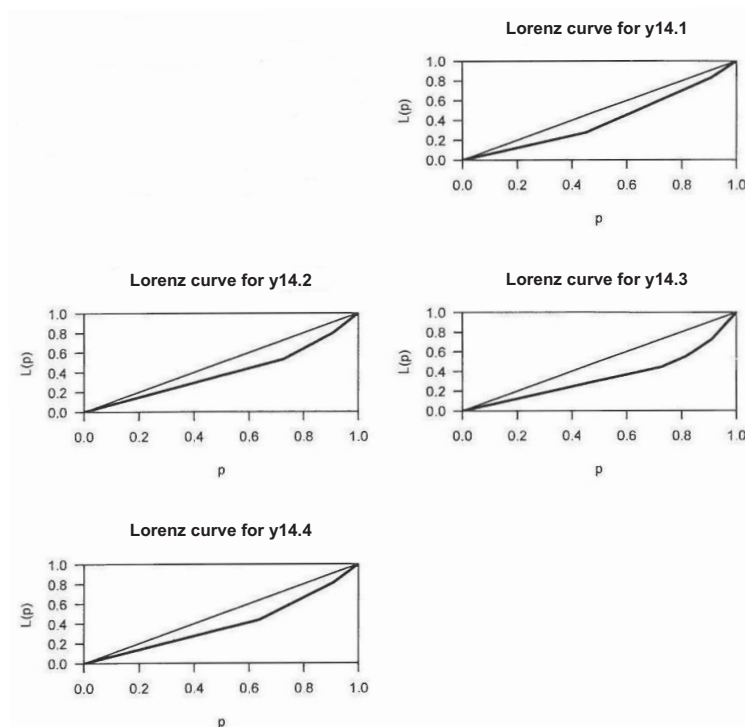
¹⁹⁰ O. Lange, A. Banasiński, *Teoria statystyki*, PWE, Warszawa 1968, p. 173.

Figure 41. Lorenz curves for discrete variables $y_{14.1} - y_{14.4}$ for the subset of acquiring enterprises



Source: own study.

The graph confirms the situation that occurs by analysis of Lorenz's graphs for the entire group. The fields between the curve and the line are small, indicating the lack of concentration of the studied entities.

Figure 42. Lorenz curves for discrete variables $y_{14.1} - y_{14.4}$, for the subset of acquired enterprises

Source: own study.

The analysis of Figure 42 results brings similar conclusions to the previous two. The fields of concentration seem even smaller.

The conclusion of the lack of concentration would be fully confirmed, if not for the fact that the study covered enterprises of unequal size. Assuming that the acquisition of large companies entails a greater transfer of knowledge (in both directions), the fact that the differences are negligible would suggest that either large metallurgical plants are little interested in the transfer of knowledge or the smaller ones are more active in the field. A partial response to this question should be provided by an in-depth study of the differences in transfer between the various entities in the analysis. To this end, Table 51 compares the aggregate knowledge transfer of all types of business to the size of the company, expressed by the „asset” characteristic y_3 .

Table 51. Intensity of knowledge transfer in metallurgical enterprises of various sizes

Companies	ab	Assets million EUR	Transfer total	$(4:3) \times 10^3$
<i>I</i>	2*	3	4	55
British Steel	a	7,843	10	12.75022
Europipe	b	2,650	9	38.29787
Thyssen Stahl	a	12,102	10	8.263097
Thyssen Krupp	b	6,051	7	11.56834
CMC	a	905	10	110.4972
Zawiercie Steelworks (currently CMC Zawiercie S.A.)	b	70	8	1142.857
LNH Holdings	a	6,647	15	22.56657
PHS	b	132	4	303.0303
Celsa Group	a	882	7	79.36508
Huta Ostrowiec SA	b	44	6	1363.626
ZAO Severstal	a	2,866	8	27.91347
Lucchini	b	450	7	155.5556
Evrax	a	4,042	8	19.79218
Vitkovice Steel	b	1,837	8	43.54927
MSC	a	28,662	20	6.97788
Arcelor Mittal	b	26,383	4	1.516128
Tata Steel	a	13,228	15	11.33958
Corus Group	b	5,879	5	8.504848
Salzgitter	a	2,450	8	32.65306
VPE	b	3,100	5	16.12903
Eramet	a	4,874	8	16.41362
Tinfos	b	400	4	100.00000
	x	Σ	186	x

* a – acquiring enterprise, b – acquired enterprise.

Source: own study.

By analysing the data in Table 51, it can be stated that, given the size of the enterprise (in relation to assets), the size of knowledge transferred to/from it is different. It should be noted that assets is not the only characteristic of the enterprise size; there may exist a small but knowledge-absorbing enterprise. Much depends also on the number of employees.

Nevertheless, under certain conditions, the size of an enterprise's assets is related to knowledge and its transfer in such a way that the smaller the assets, the more knowledge resources are transferred.

The general picture of the situation is given here by a comparison of transfer in the group of metallurgical enterprises. The range ($y_{\max} - y_{\min}$) is known to be $28 - 4 = 24$ months, average 15.5 months, and modal 6 months.

The real picture can be obtained only by analysing intensity indices, built as the ratio of transferred knowledge to the value of assets (table 54). The index numerator is measured in the months of learning the knowledge, and the denominator (assets)

in million EUR. The entire index, for preservation of legibility, was multiplied by 103. As long as the range of knowledge is 24, the range of the knowledge transfer intensity in relation to assets is 1363 months / 1 million EUR.

There is an interesting phenomenon here: the smaller the enterprise, the greater the relative transfer of knowledge.

In order to increase the reliability of the test results, the studied group was divided into two smaller groups:

- group 1 – companies with small assets;
- group 2 – companies with large assets. As a dividing line, the median was adopted.

Comparison of the discussed values is shown in Table 52.

Table 52. Comparison of wealth, knowledge and their intensity in small and large metallurgical enterprises

No.	Company		Assets	Knowledge	Index of knowledge to property intensity (4:3) × 10 ⁴
0	1	2*	3	4	5
1.	Huta Ostrowiec SA	b	44	6	1,364
2.	Zawiercie Steelworks (currently CMC Zawiercie S.A.)	b	70	8	1,143
3.	PHS	b	132	4	303
4.	Tinfos	b	400	4	100
5.	Lucchini	b	450	7	156
6.	Celsa Group	a	882	7	79
7.	CMC	a	905	10	110
8.	Vitkovice Steel	b	1,837	8	44
9.	Europipe	b	2,350	9	33
10.	Salzgitter	a	2,450	8	33
11.	ZAO Severstal	a	2,866	8	28
*a = 6	acquiring company		12,386	79	3,397
b = 5	acquired company		$\bar{y}_3 = 1126$	$\bar{y}_{14.1-14.4} = 7,18$	$\bar{y}_i = 309$
12.	VPE	b	3,100	5	16
13.	Evrast	a	4,042	8	20
14.	Eramet	a	4,874	8	16
15.	Corus Group	b	5,879	5	9
16.	Thyssen Krupp	b	6,051	7	12
17.	LNH Holdings	a	6,647	15	23
18.	British Steel	a	7,843	10	13
19.	Thyssen Stahl	a	12,102	10	8
20.	Tata Steel	a	13,228	15	11
21.	Arcelor Mittal	b	26,383	4	2
22.	MSC	a	28,662	20	7
Σ *a = 7	acquiring company		118,811	107	136
Σ b = 4	acquired company		$\bar{y}_3 = 10\ 801$	$\bar{y}_{14.1-14.4} = 9,73$	$\bar{y}_i = 12$

Source: own study.

As the value of assets grows, the knowledge transfer is growing, while the knowledge transferred in the enterprise per unit of assets quickly falls in the group with large assets. In view of the above, it can be stated that the transfer of knowledge in mergers and acquisitions concerns mostly metallurgical enterprises with small assets.

This is confirmed by the average values. In Group 1, the average index of knowledge by assets divided is 309, in group 2, it is only 12. At the same time knowledge in large plants differs slightly from its transfer in small metallurgical enterprises, respectively: group 1 – 7,18 and group 2 – 9,73, while differences in the value of assets in group II are close ten times bigger.

Regarding the index for the division into acquiring and acquired enterprises, the latter ones represent a small majority in group 1 (6: 5), in group 2 – (7: 4); nearly 65% of the entire group are the acquiring enterprises. It is concluded that the situation is shaped by the influx of capital in the form of knowledge to the acquired enterprises in order to modernize them and to increase their competitiveness.

Due to certain artificial character of the division in subsets, one more division into small and large companies was performed by setting the border in the form of median. As a division boundary it was assumed that small entities are plants with a value of assets less than EUR 1 billion. This grouping is based on the criteria accepted (generally) in the industry. Breakdown according to the above-defined criterion is shown in table 53.

Table 53. Breakdown of the sample by enterprise size based on the criterion of 1 billion EUR of assets

Enterprises with assets up to and above 1 billion EUR	ab	Assets	Knowledge	Assets	Knowledge
<i>1</i>	2*	3	4	3	4
British Steel	a			7,843	10
Europipe	b			2,350	9
Thyssen Stahl	a			12,102	10
Thyssen Krupp	b			6,051	7
CMC	a	905	10		
Zawiercie Steelworks (currently CMC Zawiercie S.A.)	b	70	8		
LNM Holdings	a			6,647	15
PHS	b	132	4		
Celsa Group	a	882	7		
Huta Ostrowiec SA	b	44	6		
ZAO Severstal	a			2,866	8
Lucchini	b	450	7		
Evraz	a			4,042	8
Vitkovice Steel	b			1,837	8
MSC	a			28,662	20

Enterprises with assets up to and above 1 billion EUR	ab	Assets	Knowledge	Assets	Knowledge
Arcelor Mittal	b			26,383	4
Tata Steel	a			13,228	15
Corus Group	b			5,879	5
Salzgitter	a			2,450	8
VPE	b			3,100	5
Eramet	a			4,874	8
Tinfos	b	400	4		
Σ	x	2,883	46	128,314	140
ΣΣ	x	x	x	x	186

* a – acquiring enterprise, b – acquired enterprise.

Source: own study.

The intensity transfer rate for large enterprises is $(140:128314) \times 10^4 \approx 11$, while for entities with small assets $(46:2883) \times 10^4 \approx 160$.

Compared to the previous section, the intensity of knowledge transfer among the entities in the weakest asset class is even greater. While for the breakdown according to the median it was 10 times as much for the group below the median (small enterprises), for the breakdown according to the border of EUR 1 billion in assets, it is already 16 times more. Consequently, the conclusion formed in this manner should be, to some extent, considered as justified.

It seems critical to determine which types of knowledge merit special attention in the transfer process, and how the knowledge structure changes when the significance coefficient of a given knowledge for an enterprise is corrected. It has now been found that different types of transferred knowledge are distributed as shown in Table 54.

Table 54. Structure of knowledge importance indicators

	Absolute indicators	Structure indicators (%)
$y_{14.1}$	48	26
$y_{14.2}$	41	22
$y_{14.3}$	46	25
$y_{14.4}$	51	27

Source: own study.

The above calculation shows a relatively equal share of the various types of knowledge in its entirety, with the exception of the organizational knowledge that is transmitted or received at the consolidation of enterprises at a slightly higher degree. The case looks slightly different when knowledge is taken into account that has been corrected with coefficients of knowledge significance, represented by the variables $y_{15.1} - y_{15.4}$. Corrected structural indicators are presented in Table 55.

Table 55 compares absolute values and percentages of structure indicators for different types of knowledge. Indicators of type $y_{15.1} - y_{15.4}$ are higher than $y_{14.1} - y_{14.4}$ as corrected values of knowledge have been defined as the products of months for learning knowledge by its significance. These are positive integers ($y_{14.1} \geq 1$), hence this values cannot be directly compared. One can compare their structure both in absolute numbers and in the form of structure percentage indicators. This will help to clarify the contribution of the transfer of different knowledge types. This is illustrated in the following table (Table 55).

Table 55. Indicators illustrating the time of knowledge mastering (transfer)

Company	Size of knowledge				Knowledge size (time to master knowledge × importance of knowledge)				Structure %
	Unadjusted indicators				Adjusted indicators				
	Y _{14.1}	Y _{14.2}	Y _{14.3}	Y _{14.4}	Y _{14.1} ×Y _{15.1}	Y _{14.2} ×Y _{15.2}	Y _{14.3} ×Y _{15.3}	Y _{14.4} ×Y _{15.4}	
I	2	3	4	5	6	7	8	9	8
British Steel	3	2	1	4	3	4	2	4	4
Europipe	2	1	5	1	2	1	5	2	3
Thyssen Stahl	2	1	3	4	6	4	3	8	6
Thyssen Krupp	1	2	1	3	1	4	1	3	2
CMC	2	1	3	4	4	1	9	4	5
Zawiercie Steelworks (currently CMC Zawiercie S.A.)	1	2	3	2	1	2	3	2	2
LNM Holdings	4	5	2	4	12	20	4	12	13
PHS	1	1	1	1	1	1	1	1	1
Celsa Group	2	1	1	3	4	3	1	3	3
Huta Ostrowiec SA	2	1	1	2	2	2	1	2	2
ZAO Severstal	2	4	1	1	2	12	2	1	5
Lucchini	3	1	2	1	12	1	4	1	5
Evrast	2	1	4	1	4	2	4	1	3
Vitkovice Steel	2	3	1	2	2	6	1	2	3
MSC	4	5	6	5	12	15	24	10	16
Arcelor Mittal	1	1	1	1	1	1	1	1	1
Tata Steel	4	3	4	4	16	12	16	4	13
Corus Group	2	1	1	1	2	1	1	1	1
Salzgitter	2	1	2	3	6	2	2	9	5
VPE	2	1	1	1	2	2	1	1	2
Eramet	3	2	1	2	6	6	1	2	4
Tinfos	1	1	1	1	3	1	1	1	2
Σ	48	41	46	51	104	103	88	75	370
Structure %	26	22	25	27	28	28	24	20	100

Source: own study.

Transfer is now dominated by two types of knowledge (Table 56):

- x_1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies);
- x_2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. specific managerial competencies, unique contractor skills, etc.).

Table 56. Structure of knowledge indicators in its transfer

Transfer indicator	% share	Total transfer indicator	% share	Differences
$y_{14.1}$	26	$y_{14.1} \times y_{15.1}$	28	+2
$y_{14.2}$	22	$y_{14.2} \times y_{15.2}$	28	+6
$y_{14.3}$	25	$y_{14.3} \times y_{15.3}$	24	-1
$y_{14.4}$	27	$y_{14.4} \times y_{15.4}$	20	-7

Source: own study.

The share of other types of knowledge, mainly organizational knowledge specific to certain companies (pay systems, regulations, protocols, important legal documentation, etc.) is clearly falling. Although acquiring or instilling this kind of knowledge is long and tedious, it is not decisive. That is why the time to learn this knowledge is long and in a certain structural cross section their shares is as high as 27%, and after taking into account the weight, it falls to the level of 20%.

The last analytical problem was tacit and explicit knowledge. Analysis of knowledge in this cross section has its own specific character. It is not easy to estimate the tacit knowledge. The only thing that can be done is a diagnosis in which metallurgical enterprise tacit knowledge has a dominant or, conversely, a minor character. Consequently, the study consisted in application of the zero-one rule and, facing the dominance of either tacit or explicit knowledge. This means defining one of them by „0”, the other by „1”. In this case, it was decided to modify the indications, specifying the dominance of tacit knowledge as „2” and the explicit knowledge as „1”. Such an approach is justified by the fact that there are no companies at all where explicit or tacit knowledge does not exist. Under these conditions, „0” would mean lack of one type of knowledge, which does not correspond to reality. Consequently, the symbols „1” and „2” remained. It is important to explain which of the two types of knowledge are marked by „2” and which by „1”. Dominance of explicit or tacit knowledge in individual companies (according to expert estimates) is presented in Table 57. There are not only zero-one indicators, concerning explicit or tacit knowledge, but also their sum, indicating the dominance of one option among the total number of enterprises.

Table 57. Explicit and tacit knowledge in enterprises

No.	Company	Number of explicit knowledge dominations (1)	Number of tacit knowledge dominations (2)
1.	British Steel	3	1
2.	Europipe	3	1
3.	Thyssen Stahl	1	3
4.	Thyssen Krupp	1	3
5.	CMC	4	0
6.	Zawiercie Steelworks (currently CMC Zawiercie S.A.)	4	0
7.	LNM Holdings	4	0
8.	PHS	4	0
9.	Celsa Group	4	0
10.	Huta Ostrowiec SA	4	0
11.	ZAO Severstal	4	0
12.	Lucchini	4	0
13.	Evrast	4	0
14.	Vitkovice Steel	4	0
15.	MSC	2	2
16.	Arcelor Mittal	4	0
17.	Tata Steel	3	1
18.	Corus Group	4	0
19.	Salzgitter	3	1
20.	VPE	4	0
21.	Eramet	2	2
22.	Tinfos	4	0
	Σ	74	14

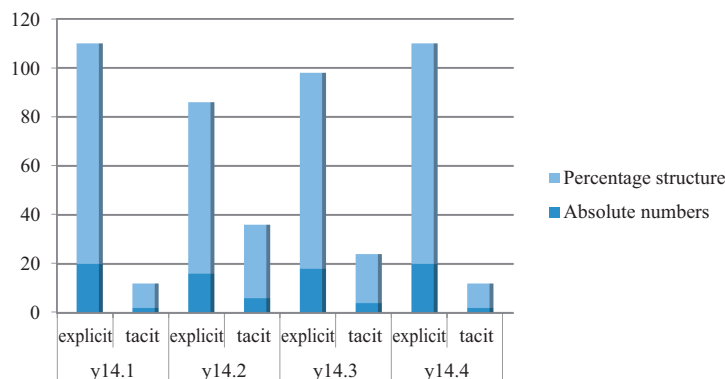
Source: own study.

Explicit knowledge can be seen and counted in the form of paper and electronic documents. In the case of tacit knowledge it is very difficult to estimate the time of its mastery and its significance. Only highly qualified and experienced specialists can undertake this task. However, due to the very strong subjectivism of the ratings, it is difficult to sum these estimates. The conclusion is that hidden knowledge is underestimated. Perhaps some indication may be the number of dominance in particular types of knowledge (variables $y_{14.1} - y_{14.4}$), shown in Table 58 and Figure 43.

Table 58. Explicit and tacit knowledge dominating in enterprises

	$y_{14.1}$		$y_{14.2}$		$y_{14.3}$		$y_{14.4}$	
	explicit	tacit	explicit	tacit	explicit	tacit	explicit	tacit
Absolute numbers	20	2	16	6	18	4	20	2
Percentage structure	90	10	70	30	80	20	90	10

Source: own study.

Figure 43. Explicit and tacit knowledge dominating in enterprises

Source: own study.

From the figures and figure 43 it is clear that explicit knowledge is dominant everywhere. Nevertheless, a relatively large amount of silent knowledge can be observed in the type marked with the symbol $y_{14.2}$. This is knowledge that is important for the acquiring entity, e.g. the specific competencies of managers, unique skills of the contractors, etc. Diagnosing the companies involved in dominance of the tacit knowledge such powerful purchasers (acquiring entities) can be listed as British Steel or Thyssen Stahl. AG (100,000 employees).

It can be said that one of the motives of acquisitions conducted by the surveyed companies was the possession of high-competence management teams or crews in the acquired companies, which consisted of a group of employees with high-potential of tacit knowledge. Such knowledge cannot be documented – it is confirmed in management and production practice; it is as real as possible and is a strong motive for acquiring enterprise.

The above-presented description of the research sample and the characteristics of the surveyed enterprises are crucial and are necessary to distinguish the companies most suitable for consolidation in the form of mergers or acquisitions.

Results of the similarity study of the consolidation companies¹⁹¹

In the research on the distribution of the group of metallurgical enterprises to susceptible and low-susceptible to knowledge transfer within mergers and acquisitions, the application of the algorithm led to a relatively close, optimal distribution.

¹⁹¹ Detailed results and calculations of the similarity research for the consolidating enterprises are contained in Annex 18.

The output matrix was built on the basis of the data contained in Annexe 18. It adopts 23 features and applies to 22 research objects. In subsequent steps procedure has been performed in accordance with the rules discussed above.

Three variants were considered. The first included all 23 characteristics, the second only related to knowledge, the third knowledge-related indicators and the three selected variables; they are assets, number of employees (employment) and the general assessment of the financial position of the enterprises (y_3 , y_5 and y_7 respectively).

In the first variant, transforming the output matrix yields a matrix of taxonomic distance was obtained. Following the chosen procedure of J.A. Hartigan and M.A. Wong centroids (centres of gravity) were obtained for the 2 classes initially assumed as target. Centroids of particular classes are shown in Table 59.

Table 59. Centroids for 1 and 2 class

	y3	y4	y5	y6	y7	y8	y9	y10
1	13338.000	25400.00	110340.00	13300.000	2.800000	1.0000000	0.8000000	2.600000
2	3794.529	26535.29	15615.53	5869.059	2.705882	0.2352941	0.2352941	3.058824
	y11	y12	y13	y14.1	y14.2	y14.3	y14.4	y15.1
1	1.400000	1.400000	2.200000	3.000000	3.200000	3.200000	4.000000	2.800000
2	2.411765	2.705882	2.058824	1.941176	1.470588	1.764706	1.823529	1.647059
	y15.2	y15.3	y15.4	y16.1	y16.2	y16.3	y16.4	
1	3.400000	2.400000	1.800000	1.4	1.400000	1.600000	1.4	
2	1.705882	1.294118	1.176471	1.0	1.235294	1.058824	1.0	

Source: own study.

The allocation of enterprises to one of the two groups is shown in Table 60.

Table 60. Allocation of enterprises to group 1 and 2

British Steel	Europipe	Thyssen Stahl	Thyssen Krupp	CMC
2	2	1	1	2
Huta Zawiercie	LNM Holdings	PHS	Celsa Group	Huta Ostrowiec
2	1	2	2	2
ZA0 Severstal	Lucchini	Evraz	Vitkovice Steel	MSC
2	2	2	2	1
Arcelor Mittal	Tata Steel	Corus Group	Salzgitter	VPE
2	1	2	2	2
Eramet	Tinfos			
2	2			

Source: own study.

The basis for the allocation was establishment of similarity of enterprises in terms of knowledge by comparing distances in multidimensional space. The values of y_n in Table 63 are compared to the values containing the output matrix. Example: variable y_3 in table 63 in class 1 was assigned a size of 13 338 000 and in class 2–3 794 529. In relation to the value in the output matrix equal to 7843 was closer to 3794, which means grading to 2 class. All calculations and graphs were performed

on a computer on the basis of an algorithm and the presented example only explains their procedure. As a result of similarity (proximity) calculation an allocation of enterprises to one of the groups took place (Table 61).

Table 61. Allocation of enterprises

First class:

Thyssen Stahl	Thyssen Krupp	LMN Holdings	MSC	Tata Steel
1	1	1	1	1

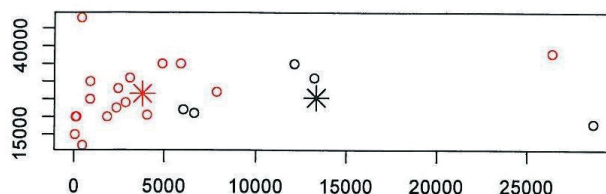
Second class:

British Steel	Europipe	CMC	Huta Zawiercie	PHS
2	2	2	2	2
Celsa Group	Huta Ostrowiec	ZAO Severstal	Lucchini	Evrar
2	2	2	2	2
Vitkovice Steel	Arcelor Mittal	Corus Group	Salzgitter	VPE
2	2	2	2	2
Eramet	Tinfos			
2	2			

Source: own study.

The findings in Table 63 show that enterprises classified in Class 1 are similar in size and quality of knowledge transfer. The influence of individual variables is shown on the plane in two-dimensional plan in Figure 44.

Figure 44. Clusters of enterprises

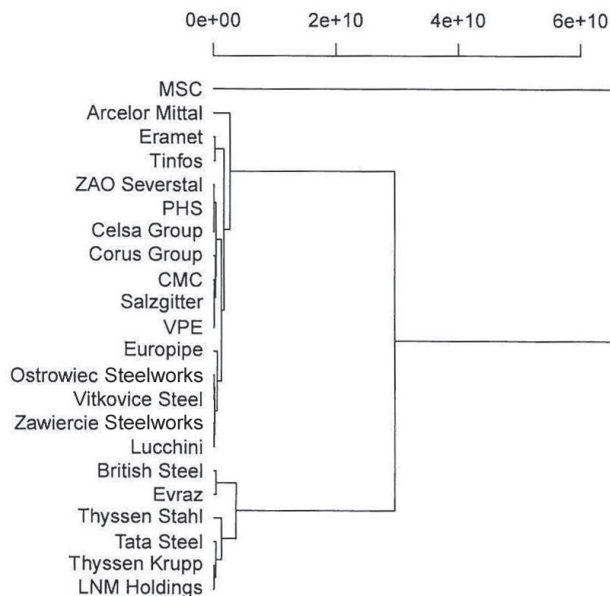


Source: own study.

Circles were used to label individual variables, and centroids (centres of gravity) of fictitious figures, formed by groupings of points. Although from the chart it is possible to read closer and further distances between the points, representing the variables that are subject to mergers and acquisitions, it is not possible, however, to calculate their influence on the allocation to one of the classes, without further analysis.

This function is performed by dendrogram in the form of so-called Berry tree¹⁹² (Figure 45).

¹⁹² B.J.L. Berry, *A method for deriving multi-factor uniform region*, "Geographical Review",

Figure 45. Dendrogram for all variables (Ward)

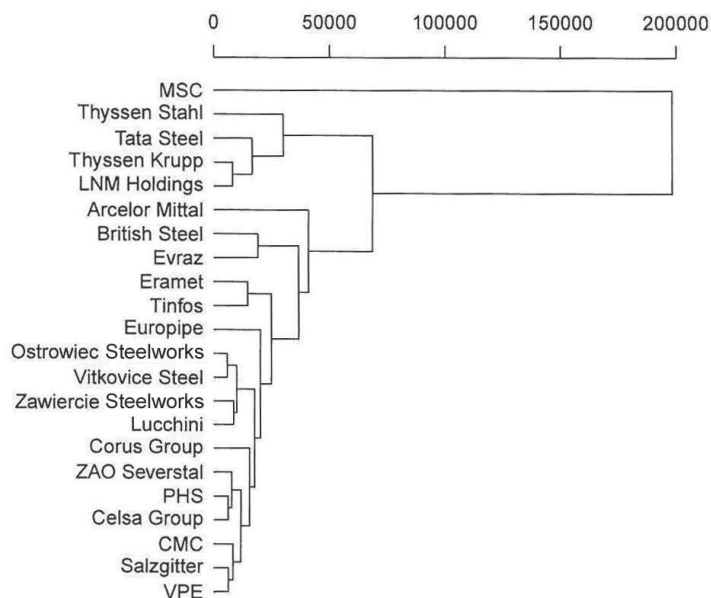
Source: own study.

When analysing the dendrogram, it can be observed that two groups of companies are clearly distinguished. One large covering 17 surveyed entities and the other with five such entities. However, it must be emphasized that the second cluster is comprised of very large enterprises. Distances (similarities) inside clusters are almost the same. The reading of the tree may, however, vary with assumptions different than by Ward. Dendrogram based on the *average* values, will look like in the Figure 46.

This variant preserves (approximately) the proportions of distance inside the groups and between them, but the differences in phase I of the merging of elements (at the bottom) of the tree, which according to Ward were flattened and difficult to read, are much clearer. It can be clearly observed that there is only one significant difference in the distance between the elements in the fairly uniform class 1 containing 5 subjects.

Median-based dendrograms, prepared according to McQuitty, are even more flattened than in the first case (Ward) and do not carry new cognitive content. The dendrograms shown above are described numerically in the following charts.

Table 62 summarizes Wards' joints, using average values in construction of clusters and distance of entities, using the Euclidean distance.

Figure 46. Dendrogram based on *average*

Source: own study.

Table 62. Order of joints acc. to Ward

[1,]	-10	-14	31105339
[2,]	-8	-9	36616016
[3,]	-19	-20	37762521
[4,]	-4	-7	62897289
[5,]	-11	2	63307472
[6,]	-6	-12	69905817
[7,]	-5	3	76282572
[8,]	1	6	143723775
[9,]	-21	-22	208506704
[10,]	-18	7	286342608
[11,]	-17	4	342225264
[12,]	-1	-13	353956251
[13,]	5	10	365338278
[14,]	-2	8	557916276
[15,]	13	14	1235152838
[16,]	-3	11	1264799428
[17,]	9	15	1648857259
[18,]	-16	17	2633070206
[19,]	12	16	3598438900
[20,]	18	19	29520594709
[21,]	-15	20	74737974487

Source: own study.

The numbers shown in Table 62 indicate in columns 2 and 3 the numbering of the item, according to the data in the output table 59 and the height to determine the degree of similarity between the surveyed enterprises. The sign „-” by certain entities requires explanation. It means that a particular element is separate and not previously linked to any other elements. If there is no sign at the number, this indicates existence of a cluster. This can be a cluster of a given order, starting from joining of two elements, until a group consisting of all entities is formed. In the examined case, stoppage of the joining process was assumed upon division into two groups, more or less susceptible to consolidation of enterprises. Both groups were identified and presented in Table 63. The companies belonging to the above-mentioned two clusters were characterized by comparing their assets and employment. The selection of these attributes was based on the analysis of results from the previous sub-section, which indicated that the correlation (especially employment) was greater than the other variables with time of mastering the acquired knowledge.

The first observation concerns group 1. There are only large companies with huge assets and very high employment. The average asset size is 66,690 million EUR, and employment 110,340 people. The range in the first case is large – 22,611 million EUR, but it is mostly influenced by MSC’s assets, amounting to 28,662 million EUR. Taking into account this fact and eliminating the MSC, the range is 7,177 million EUR and is relatively small. It indicates that group 1 is quite homogeneous in terms of assets. This does not mean that it is similar in terms of knowledge transfer, as evidenced by the Euclidean distance.

The situation in group (class) 2 is different. Most of the companies in this group are **much** smaller and the average asset value is 3785 million EUR and is almost three times smaller than in class 1. On the other hand, average employment is almost seven times smaller than in class 1.

Considering the significant diversification of group 2, it can be concluded that among the companies involved are both the recipients and providers of knowledge. Such a situation enhances the susceptibility to knowledge transfer as a result of consolidations through mergers and acquisitions. Two situations are present here. The first is when an enterprise has the knowledge that is missing and needed by another enterprise (usually stronger on the market) and is taken over. Of course, not always, and rarely is knowledge the only reason for merger by absorption, but that does not change the fact of its transfer.

Table 63. Characteristics of enterprises assigned to class 1 and 2

cluster 1 (class)				cluster 2 (class)			
Business name	Numbering	Assets in million EUR	Employment in people	Business name	Numbering	Assets in million EUR	Employment in people
Thyssen Stahl AG	3	12,102	100,000	British Steel	1	7,843	53,900
Thyssen Krupp AG	4	6,051	70,000	Europipe	2	2,350	5,600
LNM Holdings N.V.	7	6,647	75,000	CMC Commercial Metals C.	5	905	11,200
Mittal Steel Company	15	28,662	224,000	Zawiercie Steelworks (currently CMC Zawiercie S.A.)	6	70	11,164
Tata Steel Ltd	17	13,228	82,700	Polskie Huty Stali	8	132	20,000
				Celsa Group	9	882	17,000
				Huta Ostrowiec SA	10	44	25,000
				ZAO Severstal Group	11	2,866	24,000
				Lucchini SpA	12	450	12,000
				Evraz	13	4,042	3,800
				Vitkovice Steel	14	1,837	4,200
				Arcelor Mittal	16	26,383	11,000
				Corus Group Ple	18	5,879	24,000
				Salzgitter AG	19	2,450	12,100
				Vallourec Précision Etirage	20	3,100	16,800
				Eramet SA	21	4,874	1,500
				Tinfos AS	22	400	500
Σ		66,690	551,700	Σ		64,507	253,764
\bar{y}		13,338	110,340	\bar{y}'		3,795	14,927

Source: own study.

The second situation occurs when the acquired enterprise does not have any significant knowledge resource, but on the contrary, after modernization, reorganization and other operations, which also means transfer of knowledge, will be of considerable value to the purchaser, provided that its acquisition is favourable, which usually takes place in reality. In this case, the transfer of knowledge is made in the opposite direction, from the acquiring entity to the acquired one. Group 2 transfer capability is also reflected in its structure, broken down by acquiring entities to the acquired ones. The breakdown occurs according to the median – there are 8 acquiring entities and 9 acquired ones. At the same time, in Group 1, only one entity is acquired, and for reasons unrelated to any significant transfer of knowledge. In Class 2, more susceptible to knowledge transfer, the companies included in Tables 64 and 65 belonged to the acquiring entities to the acquired ones.

Table 64. Acquiring entities

Business name	Numbering	Assets in million EUR
British Steel	1	7,843
CMC Commercial Metals C.	5	905
Celsa Group	9	882
ZAO Severstal Group	11	2,866
Evrast	13	4,042
Arcelor Mittal	16	26,383
Salzgitter AG	19	2,450
Eramet SA	21	4,874
Σ		50,245
\bar{y}_3		6,281

Source: own study.

Table 65. Podmioty przejmowane

Nazwa firmy	Numeracja	Majątek w mln euro
Europipe	2	2,350
Zawiercie Steelworks (currently CMC Zawiercie S.A.)	6	70
Polskie Huty Stali	8	132
Huta Ostrowiec SA	10	44
Lucchini SpA	12	450
Vitkovice Steel	14	1,837
Corus Group Plc	18	5,879
Vallourec Précision Etirage	20	3,100
Tinfos AS	22	400
Σ		14,252
\bar{y}'_3		1,585

Source: own study.

The summary analysis shows that larger and more modern entities dominate among the acquiring enterprises. For example, Celsa Group, a relatively small company with assets worth of EUR 882 million is among acquiring entities, and Arcelor Mittal with assets worth EUR 26,363 million is among acquired ones. Next to the presented regularity, based on the analysis of the size of assets of the merged groups of enterprises, the basic (due to the purpose and nature of the paper) is the analysis of the distribution of clusters according to the size of knowledge transfer. In this paper this is a key issue. While previous taxonomic analyses have allowed to isolate a group more susceptible to knowledge transfer, now the study is deepened and further confirmed by a direct analysis of the knowledge flow intensity, characterizing a particular type of enterprises. Into account taken was neither the time nor the coefficients of the transferred knowledge significance, but their product of variables, which in a sense is the „mass” of the transferred knowledge weighed by its significance. The importance of knowledge can in this case be regarded as the weight assigned to each type of knowledge separately. The sum of these products constitutes the overall size of the transferred knowledge. Thus, e.g. using the recording $y_{14} \times y_{15}$, means the time of mastering knowledge in a given enterprise multiplied by the importance factor for that knowledge, and the sum of these flows for each cluster represents the knowledge that is related to the group of enterprises in a given cluster, in this case groups 1 or 2, resulting from the taxonomic calculation procedure. This value (product) can be defined (referred to) as „flow of knowledge”. Table 66 contains the respective flow rates of the respective companies. Knowledge flow charts according to its type and broken down into classes 1 and 2 as well as the acquiring and acquired entities are contained annexes.

The second important element is to investigate which of the knowledge types mentioned here is transferred within consolidation of enterprises and what is its place in the overall transfer. The analysis will cover the flow of knowledge. The basis of the analysis will be data from Table 68. It is about determining which type of knowledge flow dominates in group 2 and whether in the less susceptible group (1) there are no specific types of knowledge in which it is dominant or at least significant. The starting point of the analysis is to examine the flow of knowledge.

This is insufficient for the purpose of testing the linking susceptibility. Only a study of flow that combines the mentioned factors can give an image that is more relevant to the facts. Table 67 and Figure 47 show the absolute quantities, concerning the flow of knowledge, and the percentage indicators of the structure.

Table 66. Knowledge flows by division into acquiring and acquired entities, and by the degree of consolidation susceptibility

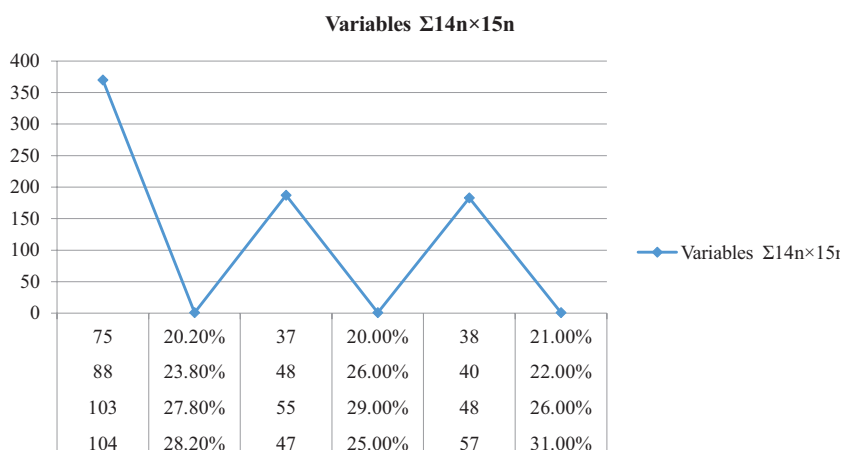
Companies		Acquiring entities		Acquired entities		Group I		Gr Group upa II	
total _{14*15}		total _{14*15}		total _{14*15}		product _{14*15}		product _{14*15}	
British Steel	13	British Steel	13					British Steel	13
Europipe (AG der Dillinger Huttenwerke i Mannesmannröhren-Werke AG)	10			Europipe (AG der Dillinger Huttenwerke and Mannesman- nröhren-Werke AG)	10			Europipe (AG der Dillinger Huttenwerke and Mannesman- nröhren-Werke AG)	10
Thyssen Stahl AG/Krupp Stahl AG	21	Thyssen Stahl AG/Krupp Stahl AG	21			Thyssen Stahl AG/Krupp Stahl AG	21		
Thyssen Krupp AG	9			Thyssen Krupp AG	9	Thyssen Krupp AG	9		
CMC Commercial Metals Company	18	CMC Commercial Metals Company	18					CMC Commercial Metals Company	18
Huta Zawiercie S.A.	8			Huta Zawiercie S.A.	8			Huta Zawiercie S.A.	8
LNM Holdings N.V.	48	LNM Holdings N.V.	48			LNM Holdings N.V.	48		
Polskie Huty Stali	4			Polskie Huty Stali	4			Polskie Huty Stali	4
Celsa Group	11	Celsa Group	11					Celsa Group	11
Ostrowiec Steelworks	7			Ostrowiec Steelworks	7			Ostrowiec Steelworks	7
ZAO Severstal Group	17	ZAO Severstal Group	17					ZAO Severstal Group	17
Lucchini SpA	18			Lucchini SpA	18			Lucchini SpA	18
Evrz	11	Evrz	11					Evrz	11
Vitkovice Steel	11			Vitkovice Steel	11			Vitkovice Steel	11
Mittal Steel Company N.V.	61	Mittal Steel Company N.V.	61			Mittal Steel Company N.V.	61		
Arcelor Mittal (created as a result of acquisition)	4	Arcelor Mittal (created as a result of acquisition)	4					Arcelor Mittal (created as a result of acquisition)	4
Tata Steel Ltd	48	Tata Steel Ltd	48			Tata Steel Ltd	48		
Corus Group Plc	5			Corus Group Plc	5			Corus Group Plc	5
Salzgitter AG	19	Salzgitter AG	19					Salzgitter AG	19
Vallourec Précision Etirage S.A.S/V&M Deutschland GmbH	6			Vallourec Précision Etirage S.A.S/V&M Deutschland GmbH	6			Vallourec Précision Etirage S.A.S/V&M Deutschland GmbH	6
Eramet SA	15	Eramet SA	15					Eramet SA	15
Tinfos AS	6			Tinfos AS	6			Tinfos AS	6
	370		286		84		187		183

Source: own study.

Table 67. Flows of knowledge by type (in units of flow)

No.	Indicators	Variables				
		14.1×15.1	14.2×15.2	14.3×15.3	14.4×15.4	Σ 14×15
1.	Absolute indicators	104	103	88	75	370
2.	Percentage structure	28.2%	27.8%	23.8%	20.2%	100.0%
3.	Knowledge flow in group 1	47	55	48	37	187
4.	Percentage structure	25.0%	29.0%	26.0%	20.0%	100.0%
5.	Knowledge flow in group 2	57	48	40	38	183
6.	Percentage structure	31.0%	26.0%	22.0%	21.0%	100.0%

Source: own study.

Figure 47. Percentage structure of knowledge flow across the entire group and two classes by types

Source: own study.

It is important to note that these are data for entire groups, which does not mean that the situation may sometimes differ from one enterprise to another.

The next step in the analysis is to investigate whether there is a greater knowledge flow in enterprises from group 2 than in group 1.

Table 67 shows the transfer sizes in each knowledge groups in the form of absolute and relative values (structure indices). Absolute values were then referred to enterprise assets and employment in a given knowledge group, creating indicators of the certain knowledge type intensity to assets and employment in a given group and simultaneously multiplying them by 10,000 for image clarity.

The coefficients of knowledge flow rates for particular types relative to assets and employment in individual clusters, as calculated in Table 68, consistently indicate a greater tendency for consolidations in enterprises taxonomically rated into group 2.

Table 68. Intensity indicators for the knowledge flow of a given kind in relation to assets and employment

Group	Indicators	Variables				
		14.1×15.1	14.2×15.2	14.3×15.3	14.4×15.4	Σ
1	Absolute values – percentage structure	47	55	48	37	187
		25%	29	26	20	100
2	Absolute values – percentage structure	57	48	40	38	183
		31%	26	22	21	100
	Absolute differences (I–II)	-10	+7	+8	-1	x
	Percentage differences (I–II)	-6	+3	+4	-1	x
1	Intensity indicator – knowledge transfer to assets	8.2	8.2	7.2	5.5	x
2	Intensity indicator – knowledge transfer to assets	8.8	7.4	6.2	5.9	x
1	Intensity indicator – knowledge transfer to employment	0.85	1.00	0.87	0.67	x
2	Intensity indicator – knowledge transfer to employment	2.24	1.90	1.89	1.49	x

Assets: 1 group 66 690 million EUR, 2 group 64 570 million EUR.

Employment: 1 group 551 700 people, 2 group 253 764 people.

Source: own study.

However, it must be emphasized that it is not completely unambiguous in relation to property. Although the superiority of the knowledge flow in group 2 is strongly determined with regard to the knowledge indicated in 14.1 and 14.4, but in the other two groups is the opposite. It should be emphasized that knowledge defined here as x_1 , and in taxonomy calculation by 14.1×15.1 is decisive. It is a knowledge that is a separate motive for acquisition (patents, inventions, important technologies, etc.) that was flowing (transferred to) group 2 steelworks during their takeover, to modernize them. The second type of knowledge, the transfer of which was higher in group 2 than in group 1, was the high level of organizational knowledge, specific to the companies (pay system, regulations, occupational protection system, security system, etc.).

This flow was marked as x_4 (in model) and 14.1 and 14.4 (in computer program) respectively. This applies to companies such as: Zawiercie Steelworks (now CMC Zawiercie S.A.), Huta Ostrowiec S.A., „Vitkovice Steel” and others, which after the acquisition a newer organizational system was imposed, significantly increasing their efficiency.

It should be emphasized that the inflow of silent knowledge (x_2) was smaller than in large enterprises of group 1. The same applies to general knowledge (market knowledge, relations) marked with symbols x_2 and x_3 and 14.2×15.2 and 14.3×15.3 . However, this does not alter the assessment that the flow of basic types of this knowledge is decisive and indicates an increased transfer in group 2 compared to group 1.

It is even more evident that Group 2 consolidation susceptibility is evident when labour flow rates are compared. This is even more justified in this case than in relation to assets, since the transfer medium is the people (workers) who carry out the transfer.

The data in Table 70 clearly show that group 2 is vulnerable to mergers and acquisitions in terms of knowledge transfer across all indicators of flow, calculated in terms of employment and for all types of knowledge. Particularly great differences with respect to group 1 are in favour of cluster 2 in the field of knowledge, called in brief as technological and organizational. The transfer of new technology and a high organizational culture enabled the acquired companies to increase their value and market share. Unlike asset-based indicators, also competency knowledge (x_2) and explicit of high significance (x_3) are higher than in group 1. This confirms the thesis resulting from the findings of the taxonomic division that enterprises placed in group 2, rather smaller and acquired, are more susceptible to knowledge transfer. The performed analyses concerned all variables determining the location of studied objects (enterprises) in the multi-variable space. However, it was important to make sure that limitation of the number of variables did not result in better results. This is primarily about variables related to the external determinants of knowledge transfer, i.e. data on the economic organizations themselves. One would like to verify whether this would affect the division of the group of enterprises into more or less susceptible to knowledge transfer. For this purpose, the second variant all general variables, primarily related to knowledge and transfer were excluded from the study. In this variant, all the steps of calculation, presented in the text, are not repeated but only the factors concerning grouping of the companies into classes and grouping of variables to verify their impact on the result. Variant II provided for exclusion of all variables not directly related to knowledge transfer. As a result of the calculations performed without variables $y_3 - y_{13}$, a division into classes (clusters) as presented in Table 69 was performed.

Table 69. Taxonomic grouping of metallurgical enterprises, with consideration of only the influence of knowledge variables

First class:

LNM Holdings	MSC	Tata Steel
1	1	1

Second class:

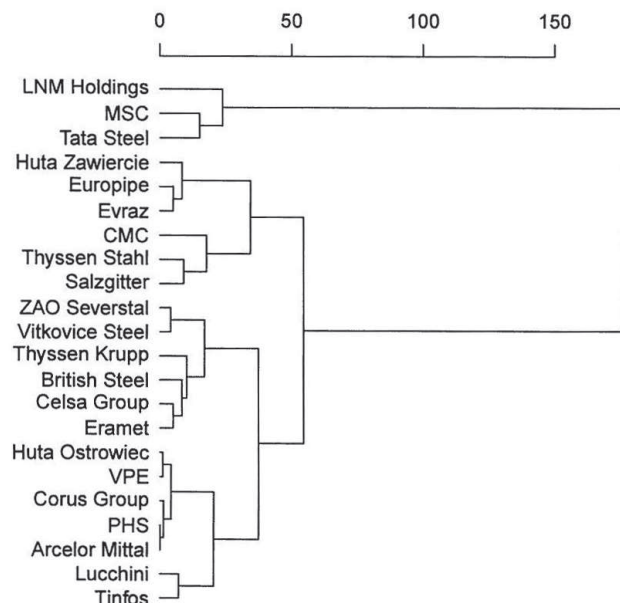
British Steel	Europipe	Thyssen Stahl	Thyssen Krupp	CMC
2	2	2	2	2
Huta Zawiercie	PHS	Celsa Group	Huta Ostrowiec	ZAO Severstal
2	2	2	2	2
Lucchini	Evrast	Vitkovice Steel	Arcelor Mittal	Corus Group
2	2	2	2	2
Salzgitter	VPE	Eramet	Tinfos	
2	2	2	2	

Source: own study.

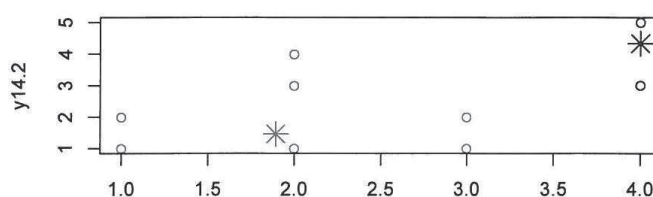
In this variant group 1 is diminished and the image of division is blurred, contrary to the previous findings, showing a significant correlation between the size of the companies involved in the process of consolidation and the division into the acquiring and acquired enterprises. Especially two factors: the size of employment and the place in the consolidation process have a significant impact on the consolidation susceptibility, but limiting the scope of variables to the variables associated with knowledge transfer does not reflect this fact.

This is reflected in formation of the connection tree shown in Figure 48. In the presented situation, a division not in two, but at least four classes is visible, which blurs the impact of the size of enterprises and their role in the consolidation process, i.e. whether they are acquiring or acquired one. This prevents from formulation of appropriate conclusions as to recognition of an enterprise as being suitable for mergers and acquisitions. Also, the distribution of adopted variables, presented as a projection in a two-dimensional space, does not induce the hypothesis that division into classes only with consideration of knowledge-related variables is appropriate for the set objectives.

The large variable scattering shown in Figure 49 does not allow for definition of any their apparent influence on the results of the study. This underlines the need to examine variant III.

Figure 48. Dendrogram for variables concerning only knowledge acc. to Ward method

Source: own study.

Figure 49. Average of variables that illustrate the transfer of knowledge in the consolidation process in the form of a projection on the plane and their centroids in variant II

Source: own study.

In the next variant, the number of general variables was limited to only three, which play an important role, i.e. y_3 , y_5 , y_7 . These are: company assets, staff numbers and general financial situation. The performed calculations (procedure as previously described) led to breakdown of the group into classes shown in Table 70.

Table 70. Division of group into classes in variant III

First class:

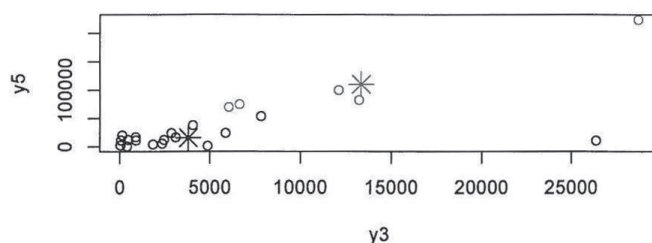
Thyssen Stahl	Thyssen Krupp	LNM Holdings	MSC	Tata Steel
1	1	1	1	1

Second class:

British Steel	Europipe	CMC	Huta Zawiercie	PHS
2	2	2	2	2
Celsa Group	Huta Ostrowiec	ZAO Severstal	Lucchini	Evraz
2	2	2	2	2
Vitkovice Steel	Arcelor Mittal	Corns Group	Salzgitter	VPE
2	2	2	2	2
Erämet	Tinfos			
2	2			

Source: own study.

These are the same results as in the first variant, discussed in detail at the beginning of the subsection and based on all variables. From the first variant they differ only in the lack of concentration of certain variables around the centroid, as in Figure 50.

Figure 50. Average of variables that illustrate the transfer of knowledge in the consolidation process in the form of a projection on the plane and their centroids in variant III

Source: own study.

In this situation, conclusions concerning the characteristics of enterprises susceptible to knowledge transfer, formulated after discussion of variant I remain valid.

3. Analysis and interpretation of research results

In the dissertation a research thesis was presented:

Thesis

Establishing the main determinants of knowledge transfer in processes of mergers and acquisitions allows to determine the time necessary for its performance.

Verification of the thesis

The starting point in the research was to identify the important factors that determine knowledge transfer in the merger and acquisition process. Of the 57 factors, the managers selected 32 most important. At a later stage of research, they were assigned to 4 groups of knowledge factors (x_1 , x_2 , x_3 , x_4), by the experts. This allowed to develop a knowledge map (Table 40), which contains the most significant knowledge factors in processes of mergers and acquisitions.

On the basis of the obtained results, it can be stated that the thesis has been positively verified.

The assessment of importance of the 4 groups of knowledge factors, performed in this dissertation has shown the greatest role of the x_2 group – knowledge, including tacit knowledge that is relevant to the acquiring entity.

This group includes:

- employees with valuable skills and competencies,
- practical experience of employees in the sphere of sales,
- practical experience of supervisory staff,
- skills and competences in cooperation with the environment,
- personal knowledge of specialized staff,
- tacit knowledge of financial workers,
- tacit knowledge of executive workers.

After juxtaposing an x_2 group of knowledge factors, i.e. knowledge of the highest importance in mergers and acquisitions, with research of the group experts' assessment it was stated that the time to master such knowledge is the shortest, both for the acquiring and the acquired entity (is 2.4 and 1.4 months respectively).

The group of factors x_1 , i.e. knowledge that is an individual motive for acquisition, was recognized by the experts as the second most important, taking into account the criterion of knowledge importance. This group contains the following important factors that determine the transfer of knowledge in the processes of mergers and acquisitions:

- current R&D works within the company,
- forecasts of research cells,
- R&D works on enterprise development,
- ideas, patents, innovations,
- computer programs, utility models, trademarks,
- projects,
- personal relations with suppliers and buyers,
- production technology,
- knowledge of production technology.

Time to master knowledge, which is the an individual motive for acquisition in case of the acquiring companies, is 2.7 months, while in case of acquired companies – 1.6 months.

Taking into account the criterion of significance of other groups of knowledge factors, experts also assigned different weights both to the acquiring and the acquired companies.

In case of acquiring companies, as the third most important experts recognized the group x_3 – knowledge, including explicit knowledge, of relevance for which the time of mastery was 2.5 months. Organisational knowledge characteristic of certain enterprises – group x_4 – is in the last place and the time it takes to acquire it is 3.2 months.

On the other hand, in the case of acquired companies the significance of knowledge factors groups x_3 and x_4 is at a similar level. The weights of these groups are 1.32 and 1.36, respectively. Time for mastering knowledge of these two groups for knowledge of x_3 group is 1.6 months, while for group x_4 1.4 months.

The research included in this paper was also aimed at finding the answer to three research questions.

Research question I

Which type of knowledge (explicit or tacit) is more important in the context of its transfer in the merger or acquisition process?

Answer to research question I

Based on the results of the research obtained in **stage III.D**, the type of knowledge (explicit or tacit) of greater importance in the context of its transfer in the merger or acquisition process has been identified.

According to expert opinion in **stage III.D**, both in case of acquiring and acquired entities the knowledge of greater significance is the explicit one in relation to all four groups of knowledge factors.

Research question II

How to practically determine the type and meaning of knowledge?

Answer to research question II

The results of research in **stage I** allowed to find answers to the **research question II**, which aimed at determining the type and importance of knowledge.

The basic problem of knowledge classification is the difficulty to capture its specific aspects through different criteria of division.

In the paper, the procedure for selection and division of knowledge factors related to the set purpose of research was based on a critical analysis of literature of

the subject matter, author's experiences and suggestions of people directly related to the researched subject.

When forming knowledge types into larger groups, the author has proposed introduction of the following variables x_1, x_2, x_3, x_4 .

In **stage II.A** experts were presented with 32 factors determining the transfer of knowledge in the process of mergers and acquisitions, which in **stage I.A** have been considered by managers to be relevant. This allowed experts is to assign factors that determine the knowledge transfer to one of the four groups of knowledge factors (x_1, x_2, x_3, x_4).

To determine the importance of knowledge in **stage I.A** a group of 57 factors of knowledge were studied, due to their significance. Each of the factors that determine the transfer of knowledge in mergers and acquisitions has been rated by managers, who give them individual weights.

As a result of the research, 32 important determinants of knowledge transfer (Annexe 9) have been identified, which, according to managers, are most important in processes of mergers and acquisitions.

Research question III

What factors influence the success of mergers and acquisitions in terms of knowledge transfer?

Answer to research question III

Factors affecting the success of mergers and acquisitions in relation to knowledge transfer in **step I.B** have been presented to managers to determine their significance.

Research results indicate the key role of three factors play in the success of mergers and acquisitions in relation to knowledge transfer.

Among them are:

- clearly defined goals of the acquisition,
- preparation or recognition of an existing knowledge map,
- cultural similarity of the enterprise organization.

The main objective of the paper was to identify the relation between knowledge transfer and merger and acquisition transactions of metallurgical enterprises, indication of the key determinants of the transfer process, and characteristics of knowledge transfer over time.

Implementation of the main aim

Research results of **stage III.E** have allowed us to determine the relation between knowledge transfer and merger and acquisition transactions of companies in the metallurgical industry.

The main dependencies in the studied process are as follows:

- most of the surveyed companies similar knowledge resources are transferred;
- knowledge is transferred primarily by the acquiring enterprises;
- one significant motive for acquisitions is the possession of tacit knowledge by the acquired companies;
- the higher the level of employment in the acquiring and acquired enterprises, the more important the type of knowledge acquired;
- the average pay did not show correlation with variables of knowledge significance because of its transfer;
- the smaller the company's assets are, the bigger knowledge resources are transferred;
- the greater the number of employees of the surveyed companies, the greater the importance of transferred knowledge.

Key determinants of the knowledge transfer process were identified based on the results of the **first stage** study, with particular emphasis on the important determinants of knowledge transfer (**stage I.A**) and the success factors for mergers and acquisitions in relation to knowledge transfer (**stage I.B**).

Characteristics of the knowledge transfer in time has been presented within **stage III.B** of group experts' assessment, which results in the author developing a grid of knowledge transfer activities, performed under specific objective V.

Specific objective I

Development of a knowledge transfer model in the merger and acquisition processes.

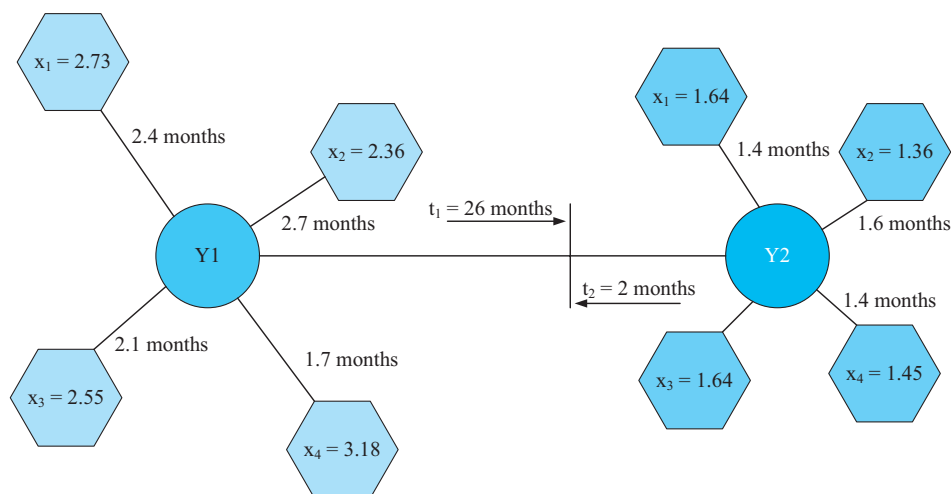
Implementation of specific objective I

The main purpose of developing a model for knowledge transfer is allowing calculation of the total time of knowledge transfer in the process of businesses' consolidation as part of their merger or acquisition.

Specific objective I was met by developing a knowledge transfer model in the merger and acquisition processes, shown in Figure 27. This model determines the total time of knowledge transfer in the integration process in the demarcation of the acquiring and acquired enterprises.

The studies of **stage III** performed in the paper allowed to verify the model indicators compared to their originally assumed values.

With respect to the 11 pairs of enterprises in metallurgical industry that consolidated as a result of merger or acquisition, the model allowed to determine the knowledge transfer time for the acquiring and acquired enterprise (Figure 51).

Figure 51. Verification of knowledge transfer model by means of calculations based on basic research

Legend:

Y1 – acquiring company.

Y2 – acquired company,

x_1, x_2, x_3, x_4 – the importance (weight) of the groups of knowledge factors,

t_1 – time of knowledge transfer from the acquiring company to the acquired one,

t_2 – time of knowledge transfer from the acquired company to the acquiring one.

Source: own study.

The results of the calculations allow to conclude that the transfer of knowledge from the acquiring company in the process of merger or acquisition is 26 months, and from the acquired enterprise it is 2 months (Annexe 14).

Specific objective II

Analysis of the merger and acquisition processes with particular focus on knowledge transfer.

Implementation of specific objective II

Based on the research of the subject matter literature, the analysis of the surveyed enterprises documentation and other elements of the research process, according to the adopted research methodology, analysis of the merger and acquisition process with particular focus on knowledge transfer was performed.

The paper discusses the importance of mergers and acquisitions, indication the motives and forms of their manifestation, and the processes of consolidation and knowledge transfer.

As part of implementation of the specific objective II an analysis was performed, showing the essential importance of mergers and acquisitions in the

forms of knowledge transfer in the economy. The identification of these processes is performed on the example of consolidations done in 2005-2010 in the metallurgical industry in Europe.

Specific objective III

Establishment of specialized research methods suitable for analysis of knowledge transfer between consolidated companies.

Implementation of specific objective III

Establishing specialized testing methods, appropriate for the analysis of knowledge transfer between consolidated companies was possible through the use of group experts' assessments in **stage II.B**.

Among methods which, according to experts, are most suitable for analysing the transfer of knowledge between consolidated enterprises counted were:

- nearest neighbour method (Johnson method),
- Czekanowski method,
- Wrocław taxonomy method (shortest dendrite method),
- median method,
- correlation coefficients (Spearman rank correlation, Kendal coefficient),
- scattering measures: entropy and Taylor's development as a Gini coefficient,
- measure of proximity: Kullback-Leiber distance.

In order to thoroughly analyse the transfer of knowledge in this paper, most of the specialized research methods indicated by experts were used to analyse knowledge transfer between consolidated companies.

Specific objective IV

Development of a tool for assessing susceptibility to knowledge transfer, extending the *due diligence* analysis in the integration process.

Implementation of specific objective IV

The *due-diligence* method is commonly applied to assess the current situation of the enterprise and to identify the existing and potential risks associated with a planned merger or acquisition.

As a result of its application, enterprises are subjected to a multifaceted analysis, including i.a.: commercial, financial, legal and tax status.

It is worth emphasizing the fact that there is no single model of *due-diligence* as the scope of this method depends on the specificity of the examined enterprises.

As a tool for assessing susceptibility to knowledge transfer in the integration process, the author proposes a complementary *checklist* for *due diligence* analysis (Table 71), which is an extension of this method.

The *due-diligence checklist* contains 15 indicators specific for knowledge transfer. The first 4 indicators concern the diagnosis of possession a specific type of knowledge (from four groups of knowledge factors: x_1 , x_2 , x_3 , x_4) by the companies. The following indicators in the *due-diligence checklist* determine:

- knowledge learning time,
- significance (weight) of knowledge,
- type of knowledge (explicit, tacit),
- explicit knowledge share,
- appointment of transition team,
- general assessment of the company's financial condition,
- participation of the acquired company representatives,
- average staff qualification level,
- type of organizational structure,
- the current wage system in force,
- occurrence of cultural differences.

The list developed in course of the studies can be a tool for assessing the susceptibility to knowledge transfer, increasing the chance for its successful completion in the integration process of the consolidates enterprises.

Specific objective V

Development of a knowledge transfer research activities grid.

Implementation of specific objective V

In order to efficiently conduct the process of acquiring and analysing data for knowledge transfer, a knowledge transfer grid (Figure 52) was proposed.

The schedule includes a set of activities illustrating a plan for performing a study of knowledge in a specific order and time.

A grid of activities allows to plan and control the implementation of knowledge transfer in the integration process, while saving time and the resources needed to accomplish this task.

4. Practical recommendations

The basis for development of practical recommendations directed primarily to managers and leaders of M&A processes for the transfer of knowledge in mergers and acquisitions of metallurgical companies is the preparation of methodological

assumptions as a set of procedures and principles in the management process through:

- development of the path for the course of mergers or acquisitions of metallurgical enterprises in market economy conditions;
- performance of analysis of the acquired company assets (human, tangible, financial, informative, and explicit and tacit knowledge) with respect to acquisition using the *due diligence* method;
- diagnosis of strategic knowledge resources and its types;
- identification and implement of methods for smooth transfer of knowledge between business organizations in the processes of mergers and acquisitions;
- performance of an analysis to determine the time required to transfer knowledge in the merger or acquisition process of a metallurgical company.

The author's own research and professional practice have shown recommendations for management practice to optimize knowledge transfer time in the process of mergers and acquisitions of metallurgical enterprises, namely:

- preparation of a plan for mergers and acquisitions in the context of knowledge transfer;
- ensure that the objectives of mergers and acquisitions are well formulated and well established;
- definition of the target status by identifying the knowledge to be acquired after the merger or acquisition;
- preparation of a timetable for the knowledge transfer process;
- assigning leaders/managers, who shall form a *transition team* responsible for the knowledge transfer process, including skills, education, experience, practical skills, personal characteristics, motivation and readiness to learn;
- development of a management system with a special focus on knowledge transfer. With the participation of this system, development of a systematic manner of dealing, thanks to which the transfer of knowledge in the planned consolidation process will be optimal.

In practice, developing a knowledge transfer model verification system (Figure 27) is possible through:

- meeting the conditions of applying the knowledge transfer model,
- stage character of the developed model,
- development of rules for validating the model used.

The author also points to practical recommendations in the field of *due-diligence* analysis, which, after appropriate expansion, can be applied to the transfer of knowledge. Attention should be paid to the following aspects:

- problems of knowledge and its flow within the merger process are usually not self-contained, but are strongly linked to all integration processes that take place during acquisitions and mergers. These include property acquisition, integration of the organization and the acquisition of managers and executives, which is an indispensable element in the transfer of knowledge. In view of the above, it is necessary to take into account the need to synchronize the actions in the scope of consolidation enterprises and consolidation knowledge in space and time. It seems justified to extend the *due diligence* analysis by the issues of knowledge transfer;
- core part of analysis, supplemented according to the author's proposal, is an the *due diligence checklist*. It is proposed to include indicators relevant to knowledge transfer. The layout of questions in this document is shown in Table 71;
- inclusion of analysis areas and description of the necessary documentation.

Table 71. Checklist for *due-diligence* analysis

XVI. Knowledge transfer		Available document	
		Yes	No
1. Relevant indicators		Concerns the possession of certain types of knowledge by companies	
1.1	Knowledge being a separate motive for acquisition	<input type="checkbox"/>	<input type="checkbox"/>
1.2	Knowledge, including tacit knowledge, having a significant importance for the acquiring entity	<input type="checkbox"/>	<input type="checkbox"/>
1.3	Knowledge, including explicit, of significant importance	<input type="checkbox"/>	<input type="checkbox"/>
1.4	Organisational knowledge characteristic of certain enterprises	<input type="checkbox"/>	<input type="checkbox"/>
1.5	Knowledge learning time	<input type="checkbox"/>	<input type="checkbox"/>
1.6	Significance (weight) of knowledge	<input type="checkbox"/>	<input type="checkbox"/>
1.7	Type of knowledge (tacit, explicit)	<input type="checkbox"/>	<input type="checkbox"/>
1.8	Explicit knowledge share	<input type="checkbox"/>	<input type="checkbox"/>
1.9	Appointment of <i>transition team</i>	<input type="checkbox"/>	<input type="checkbox"/>
2.0	General assessment of company financial condition	<input type="checkbox"/>	<input type="checkbox"/>
2.1	Participation of the acquired company representatives	<input type="checkbox"/>	<input type="checkbox"/>
2.2	Average staff qualification level	<input type="checkbox"/>	<input type="checkbox"/>
2.3	Type of organizational structure	<input type="checkbox"/>	<input type="checkbox"/>
2.4	Applied wage system	<input type="checkbox"/>	<input type="checkbox"/>
2.5	Presence of cultural differences	<input type="checkbox"/>	<input type="checkbox"/>

Source: own study.

It should be emphasized that there is not one *due-diligence* analysis model applied in every case. Patterns of analysis vary between industries and also within one another, since even within the same industry the differences between enterprises are significant.

An important factor in the effective process of acquiring and analysing data for knowledge transfer is saving time and resources for its implementation. Therefore, a knowledge transfer grid (Figure 52) was proposed.

Various activities are planned in terms of shortening the implementation time and reducing expenditures. Planning multi-tasking projects that involve multiple individual actions requires application of appropriate methods that allow schedules to be used for them¹⁹³.

Planning a pathway is a project that can be implemented in a variety of manners. The basic task in scheduling is to design steps. The event can be a separate moment in time. The selection of events is performed subjectively, but not forgetting the basic principle that the degree of aggregation should be the same or similar¹⁹⁴. For example, it is not possible to place an event consisting in obtaining a single piece of information and performing an entire analysis of a single subject at the same time. „Activity, or operation, is a necessary action for an event to happen, often not an activity involving consumption of materials, energy, or resources, but simply a condition that must be fulfilled in order for an event to take place¹⁹⁵. An event is usually marked with numbers or capital letters placed in geometric figures, and actions with directed straight lines or arcs.

A network of connections is a set of events and actions that illustrate a plan for performance of a particular task. Activity grids can be used to optimize the execution time of a project, or simply visualize the course of its execution for conducting control. In the discussed case, planning knowledge transfer does not entail the need to optimize the time with such precise methods. It is important, however, to specify the order and time of each particular task, or to indicate the possibility of performing them in some cases in parallel. It is necessary to draw up a list of activities for the proper construction of the activity grid.

In case of knowledge transfer between consolidating enterprises, the list of activities is as follows:

- Design and approval of the research project.
- Developing and completing surveys.
- Using own sources.
- Analysing survey data and acquired documents.
- Creating knowledge transfer concept.
- Completing knowledge transfer model with acquired data.
- Determining the classification of particular types of transferred knowledge.

¹⁹³ T. Trzaskalik, *Modelowanie...*, op. cit., p. 131.

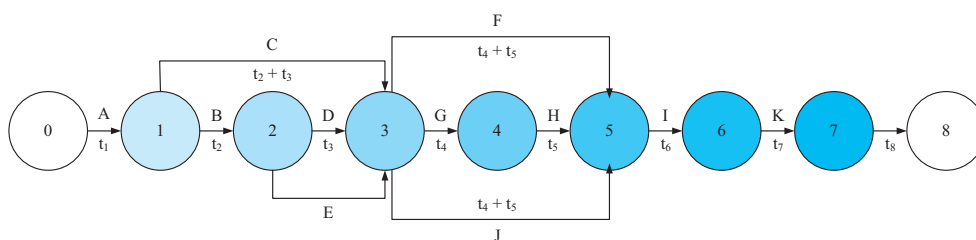
¹⁹⁴ J. Zadęcki, J. Łokuciewska, *Zastosowanie metod sieciowych w budownictwie*, COJB, Warszawa 1975, p. 9.

¹⁹⁵ Ibidem, p. 54.

- Aggregating survey data.
- Dividing, ordering and taxonomic grouping, using the susceptibility assessment tool.
- Results of statistical surveys.
- Summing results.

Following the principles of grid construction discussed above, a grid research plan for knowledge transfer was constructed as presented in Figure 52.

Figure 52. Grid of knowledge transfer study



Source: own study.

In particularly significant projects, when it comes to transfer of knowledge as the main reason for consolidation, one does not have to limit to setting the order and parallelism of the proceedings. One can set a critical path (road) that determines the shortest time for performance of the task by assigning the time of execution to the activities. „The notion of critical time is used to call the longest of all times for passing all the paths connecting these tasks. The path designated in this manner is called the critical path”¹⁹⁶. This will allow planning and control of the task within *due diligence* examination.

¹⁹⁶ T. Trzaskalik, *Modelowanie...*, op. cit., p. 136.

SUMMARY AND FINAL CONCLUSIONS

The main objectives of the work were: identification of the relation between knowledge transfer and merger and acquisition transactions of metallurgical enterprises, indication of the key determinants of the transfer process, and its characteristics over time.

These objectives were achieved as a result of the performed basic research. The research, analyses and proposals contained in the study have allowed for verification of the paper thesis, which has been confirmed. The research questions were also relevant to identification of the relations between knowledge transfer and merger and acquisition transactions of metallurgical enterprises have also been answered.

Based on empirical studies performed, the following general and application conclusions were formulated:

General conclusions:

- Under conditions of unification of entities (metallurgical enterprises) knowledge transfer takes place, in most cases in both directions. It has been diagnosed that the transfer of knowledge from the acquiring enterprise to the acquired one occurs more frequently.
- The direction of knowledge transfer takes place from the acquired entity to the acquiring and vice versa, depending on the needs of the entities participating in the consolidation and their knowledge resources.
- In metallurgical enterprises the transfer of knowledge from the acquiring enterprise to the acquired one dominates.
- The concentration of the metallurgical industry is greater in the European Union and the Euro zone than in the rest of Europe.
- The important factors determining the transfer of knowledge in mergers and acquisitions are the time to master knowledge and its importance.
- The transfer of knowledge as a result of mergers or acquisitions is shorter in case of acquired companies (2 months) than in acquiring, where it is 26 months.
- One significant motive for acquisitions is the possession of tacit knowledge by the acquired companies.
- The higher the level of employment in the acquiring and acquired enterprises, the more important the type of knowledge acquired.

- The average pay did not show the correlation of this variable with variables of knowledge significance because of its transfer.
- The smaller the company's assets are, the bigger knowledge resources are transferred.
- The greater the number of employees of the surveyed companies, the greater the importance of transferred knowledge.

Application conclusions:

- Data entered into the knowledge transfer model should be obtained using the *due diligence* method.
- Enterprises that are most susceptible to knowledge transfer are those which have complementary knowledge and those in which differentiation between general knowledge resources in their specific types and significance has been diagnosed. This requires the use of research methods to assess the type and resources of knowledge in the organization.
- Enterprises most susceptible to knowledge transfer vary in size, assets, employment and financial situation. The analysis of these indicators should be an intrinsic part of the *due diligence* study.
- Enterprises conducting knowledge transfer, in parallel with the overall process of enterprise integration, show the greatest ability to transfer knowledge. Planning the path of knowledge transfer process allows for its optimization.
- Clearly defined goals of acquisition, preparation or recognition of an existing knowledge map, and the cultural similarity of business organizations are necessary preconditions for successful merger and acquisition processes in relation to knowledge transfer.
- Application of specialized research methods is a condition necessary for the success of analysis of knowledge transfer between consolidated companies. These methods include:
 - nearest neighbour method (Johnson method),
 - Czekanowski method,
 - Wrocław taxonomy method (shortest dendrite method),
 - median method,
 - correlation coefficients (Spearman rank correlation, Kendal coefficient),
 - scattering measures (entropy and Taylor's development as a Gini coefficient),
 - measure of proximity (Kullback-Leiber distance).
- The time required to master knowledge as a result of merger or acquisition is 1.2 months shorter on average in case of the acquired companies.

- The knowledge most important in processes of mergers and acquisitions is knowledge (including tacit one), which is important for the acquiring entity, mastery time of which is the shortest, both for the acquiring and the acquired entity.
- The knowledge with bigger significance in the context of its transfer in the process of merger or acquisition is the explicit knowledge in relation to all four groups of knowledge factors.
- It is justified to extend the *due diligence* analysis with a tool of susceptibility to knowledge transfer, which is an inseparable resource in the processes of mergers and acquisitions.

Knowledge, in the context of its transfer in mergers and acquisitions processes, although it constitutes a more or less explicit motive for an acquisition or merger, is relatively rarely assessed, which would estimate the time needed for its transfer. This has a direct impact on the scale of incurred costs, as well as the expected benefits of knowledge transfer.

In this monograph, an attempt was made to identify the characteristics of knowledge that could influence the organization's susceptibility to transfer it, indicating enterprises with greater knowledge transfer capacity.

Currently, one of the method most commonly used in merger and acquisition processes is *due diligence* analysis.

In the paper it has been indicated that, despite extensive external factual support (professional advisers, consultants, etc.), *checklists*, data processed and applied in *due diligence* examinations are incomplete or do not contain any elements concerning knowledge, especially in terms of capability to transfer it.

Although this element is only one of the reasons behind the effects of mergers and acquisitions being different than the expected ones, but as evidenced in this dissertation, worthy of attention and proposals for taking appropriate actions.

Organizational knowledge creates a useful methodological and practical basis, hence the assumption must be made that successful companies are those which consistently and consciously acquire and disseminate knowledge throughout the entire enterprise. However, the problem of assessment and transfer of knowledge still seems to be an area requiring research. It should also be borne in mind that due to its specific character and forms of appearance it requires application of increasingly modern research methods.

The developed research direction, with application of methods and model of knowledge transfer in the processes of mergers and acquisitions of metallurgical companies (Figure 27), under the conditions of modern market economy, touches on only some of the examined issues. Both the scope and degree of detail of the study is limited, therefore, there is a need for further research. Their next direction should

be related to the development of methods of converting tacit knowledge into explicit one, allowing its formalisation in the form of procedures, which in turn will positively influence the speed of its transfer process. Until recently, in the world economy, traditional resources such as labour, land and raw materials were conditions for the competitive advantage. In the global economy, in addition to traditional resources, these are knowledge and information. It is therefore possible to assume that acquiring and developing knowledge and its skilful application are becoming one of the most important challenges for enterprises operating in conditions of global economy.

BIBLIOGRAPHY

1. Aczel D.A., *Statystyka w zarządzaniu*, PWN, Warszawa 2006.
2. Altkorn J. (ed.), *Podstawy marketingu*. Wydawnictwo oo. Franciszkanów, Kraków 1998.
3. Ansoff H.I., *Zarządzanie strategiczne*, PWE, Warszawa 1985.
4. Apanowicz J., *Metodologiczne uwarunkowania pracy naukowej*, Difin, Warszawa 2005.
5. Argote L., Ingram P., *Knowledge transfer: A basis for competitive advantage in firms*, "Organizational Behaviour and Human Decision Processes" 2000, Vol. 82, No. 1.
6. Argote L., *Organizational learning: Creating, retaining and transferring knowledge*, Kluwer Academic Publishers, Boston, 1999.
7. Babbie E., *Badania społeczne w praktyce*, PWN, Warszawa 2004, 2005, 2007, 2009.
8. Badaracco L.J., *Alliances Speer Knowledge Transfer*, „Planning Review” 1991, Vol. 19, No. 2.
9. Baliczyński J., Mesjasz, Stabryła A., *Interpretacja pojęcia wiedzy i gospodarki opartej na wiedzy*, w: A. Stabryła (ed.), *Doskonalenie struktur organizacyjnych przedsiębiorstw w gospodarce opartej na wiedzy*, C.H. Beck, Warsaw 2009.
10. Bałgier J.M., Vuillod S., *Strategie zmian w przedsiębiorstwie. Nowoczesna metoda*, Poltext, Warszawa 1993.
11. Bank Accounting & Finance Journal, Aspen Publishers Inc., June–July 2005.
12. Banks E., *Alternative Risk Transfer: Integrated Risk Management through Insurance. Reinsurance and the Capital Markets*, Wiley, Chichester 2004.
13. Bartlett C., Ghoshal S., *Re-conceptualizing Bartlett and Ghoshal's Classification of National Subsidiary Roles in the Multinational Enterprise*, "Journal of Management Studies", March 2011.
14. Barton L., *Źródła wiedzy*, Harvard School Business, Boston 1995.
15. Bartosiewicz S., *Modele ekonometryczne – kwalifikacja zmiennych występujących w modelu*, in: Z. Hellwig (ed.), *Zarys ekonometrii*, PWE, Warszawa 1970.
16. Becker B.B., Huselid M.A., Ulrich D., *Karta wyników zarządzania zasobami ludzkimi*, Oficyna Ekonomiczna, Kraków 2002.
17. Beckhard R., Hesselbein F., Goldsmith M. (ed.), *Organizacja przyszłości*, Business Press, Warszawa 1998.
18. Beech N., McKenna E., *Zarządzanie zasobami ludzkimi*, Felberg SJA, Warszawa 1999.
19. Beer M., *Organization Change and Development. A System View*, Goodyear Publishing Company, Santa Monica 1980.
20. Bendkowski J., *Praktyczne zarządzanie organizacjami. Kompetencje menedżerskie*, Politechnika Śląska, Gliwice 2011.
21. Berry B.J.L., *A method for deriving multi-faktor uniform region*, "Przegląd Geograficzny" 1981, v. 33, z. 4.
22. Biegańska U., *Cluster Analysis*, [http://endrju.ovh.org/SPSS/files\(cluster.ppt\)](http://endrju.ovh.org/SPSS/files(cluster.ppt)).

23. Bieniok H. and team, *Metody sprawnego zarządzania. Planowanie, organizowanie, motywowanie, kontrola*, Placet, Warszawa 1999.
24. Bień W., *Zarządzanie finansami przedsiębiorstwa*, Difin, Warszawa 1999.
25. Blalock H.M., *Statystyka dla socjologów*, PWN, Warszawa 1977.
26. Bloodgood J.M., Salisbury W.D., *Understanding the influence of organizational change strategies on information technology and knowledge management strategies*, "Decision Support Systems" 2001, Vol. 31, No. 1.
27. Boono, *Managing Intracorporate Knowledge Sharing*, Eburon, Delft 1977.
28. Bratnicki M., Majowska M., *The guiding of organizational entrepreneurship, Improving entrepreneurship effectiveness by combining opportunities and organizational competences*, "Management" 2006, Vol. I.
29. Bresman H., Briskinshaw J., Nobel R., *Knowledge transfer in Innovation Acquisition*, "Journal of Informational Business Studies" 1999, No. 30(3).
30. Brown N., Rappert B., Webster A., *Forsight jako narzędzie zarządzania wiedzą i innowacją*, Polska Agencja Rozwoju Przedsiębiorczości, Warszawa 2010.
31. Brzeziński M., *Zarządzanie innowacjami technicznymi i organizacyjnymi*, Difin, Warszawa 2001.
32. Brzóska J., *Aktywność gospodarcza i przedsiębiorczość. Poradnik dla osób podejmujących samodzielną działalność gospodarczą*, TNOiK, 2002.
33. Brzóska J., Karbownik A., Kruczek M., Szmal A., Żebrucki Z., *Strategiczna Karta Wyników w teorii i praktyce*, Politechnika Śląska, Gliwice 2012.
34. Brzóska J., *Modele strategiczne przedsiębiorstw energetycznych*, Politechnika Śląska, Gliwice 2007.
35. Brzóska J., Pałucha K., Pyka J., Szmal A., *Kreowanie aktywności gospodarczej – podręcznik przedsiębiorczości*, TNOiK, 2003.
36. Brzóska J., Pyka J. (ed.), *Nowoczesność przemysłu i usług w warunkach kryzysu i nowych wyzwań*, TNOiK, Katowice 2013.
37. Cabała P., Koziół L., Mesjasz C.Z., Piekarczyk H., Woźniak K., *Wyniki analizy struktur organizacyjnych przedsiębiorstw w kontekście gospodarki opartej na wiedzy*, in: A. Stabryła (ed.), *Doskonalenie struktur organizacyjnych przedsiębiorstw w gospodarce opartej na wiedzy*, C.H. Beck, Warsaw 2009.
38. Carpenter M.A., Sanders W.G., *Strategie Management. A Dynamic Perspective. Concepts and Cases*, Prentice Hall, Upper Saddle River 2007.
39. Carr D.K., Hard K.J., Trahan W.J., *Zarządzanie procesem zmian*, PWN, Warszawa 1998.
40. Castenow D., *Nowy marketing w praktyce*, PWE, Warszawa 1996.
41. Champy J., *Reengineering Management*, Harper Business, New York 1995.
42. Chesnay M.M., *Zarządzanie strategiczne. Geneza i rozwój*, Poltex, Warszawa 1994.
43. Clark T., *International human resource management. Perspectives, Problems, Polycentrism*. Paper presented to BUIRA Annual Conference Worcester College, Oxford 1994.
44. Clarke L., *Zarządzanie zmianą*, Gebethner & Spółka, Warszawa 1997.
45. *Credit Suisse First Boston, M&A Update*, January 1999.
46. *Culture and Knowledge Transfer, Theoretical Considerations*, "Journal of Service Science & Management" 2010, No. 3, doi:10.4236/jssm.2010.31020, March 2010, <http://www.SciRP.org/journal/jssm>.

47. Cummings J.L., Teng B.S., *Transferring R&D knowledge: The key factors affecting knowledge transfer success*, „Journal of Engineering and Technology Management” 2003, Vol. 20.
48. Cwynar A., Cwynar W., *Zarządzanie wartością spółki kapitałowej. Koncepcje – systemy – narzędzia*, Akademia Finansów, Warszawa 2002.
49. Czakan W., *Dynamika więzi międzyorganizacyjnych przedsiębiorstwa*, Akademia Ekonomiczna w Katowicach, Katowice 2007.
50. Czakan W., *Planowanie i kontrola budżetowa w organizacjach*, Wolters Kluwer, Warszawa 2011.
51. Danon-Boileau N., *Will the new wave of M&A create more value?* Bearing Point, 22.07.2015.
52. Davidson F.J., *Zarządzanie projektami w organizacjach*, WIG-Press, Warszawa 2001.
53. Decker R., Lenz H.J., *Advances in Data Analysis*, Springer, Berlin–Heidelberg–New York 2007.
54. Denize S., Miller K.E., Young L., *Information Exchange: An Actor, Activity and Resource Perspective*, 16th Annual IMP Conference, Bath, UK, 6–9 September 2000.
55. Denzin N., *Sociological Methods: A Sourcebook*, Aldine Transaction, New York 2006.
56. Dodgson M., Gann D., Salter A., *The Management of Technological Innovation – Strategy and Practice*, Oxford University Press, Oxford 2008.
57. Dolińska M., *Zarządzanie wiedzą w uczącej się organizacji*, "Organizacja i Kierowanie" 2000, No. 4.
58. Drucker P.F., *Skuteczne zarządzanie*, PWN, Warszawa 1976.
59. Drucker R., *Zarządzanie w XXI wieku*, MUZA SA, Warszawa 2000.
60. Durlik I., *Inżynieria zarządzania*, part I and II, Placet, Warszawa 2004.
61. Dworczyk M., Szlasa R., *Zarządzanie innowacjami*, Oficyna PWN, Warszawa 2001.
62. Dycz T., *Analiza finansowa*, Akademia Ekonomiczna we Wrocławiu, Wrocław 2000.
63. Dźwigoł-Barosz M., *Levelling the gap in managerial competences in the process of transforming company into an intelligent organization*, Silesian University of Technology, Gliwice 2013.
64. Dźwigoł H., *Business Management*, Alpha Science International Ltd., Oxford 2015.
65. Dźwigoł H., *Systemic approach in the process of company restructuring*, Silesian University of Technology, Gliwice 2010.
66. EBSCOhost, Academic Search Complete, <http://web.ebscohost.com>.
67. Edvinsson L., Malone S.M., *Kapitał intelektualny*, PWN, Warszawa 2001.
68. European Commission, DG Competition, Unit E4: Basic Industries, Manufacturing and Agriculture (mergers), <http://ec.europa.eu/competition>.
69. Fazlagić A., *Kapitał ludzki w Balanced Scorecard*, "Controlling i Rachunkowość Zarządcza" 2003, No. 2.
70. Fend Z., *Expert Consultation – Comprehensive Analysis Method on the 2-mode Network of Expert Consultation*, Dept. of Autom., Tsinghua University, Beijing, China, BCGIN, Shanghai, October 2012.
71. Fijałkowska D., *Controlling strategiczny – awangarda czy praktyka?* "Controlling i Rachunkowość Zarządcza" 2000, No. 4.
72. Fijałkowska D., *System wczesnego ostrzegania w controllingu strategicznym*, "Controlling i Rachunkowość Zarządcza" 2000, No. 2.
73. Filipowicz G., *Zarządzanie kompetencjami zawodowymi*, PWE, Warszawa 2004.

74. Florek K., Łukaszewicz J., Perkal J., Steinhaus H., Zubrzycki S., *Taksonomia Wroclawska*, "Przegląd Antropologiczny" 1951, v. XVIII.
75. Frankfurt-Nachmias Ch., Nachmias D., *Metody badawcze w naukach społecznych*, Zysk i S-ka, Poznań 2001.
76. Frankowski Z., *Zastosowanie metod taksonomicznych w badaniach przestrzennych*, Warszawa 1991.
77. Freund J.E., *Podstawy nowoczesnej statystyki*, PWE, Warszawa 1968.
78. Gabrusewicz W., Kamela-Sowińska A., Poetschke H., *Rachunkowość zarządcza*, PWE, Warszawa 2001.
79. Gąsior A., *Fuzje i przejęcia – kontrowersje na temat opłacalności tych procesów*, "Zeszyty Naukowe. Studia i Prace" No. 17, Wydział Nauk Ekonomicznych i Zarządzania Uniwersytetu Szczecińskiego, Szczecin 2010.
80. Gierszewska G., Romanowska M., *Analiza strategiczna przedsiębiorstwa*, PWE, Warszawa 2000.
81. Gilbert M., Cordey-Hayes M., *Understanding the process of knowledge transfer to achieve successful technological innovation*, "Technovation" 1996, Vol. 16, No 6.
82. Goliszewski J., *Controlling – system koordynacji przedsiębiorstwa*, "Przegląd Organizacji" 1990, No. 8–9.
83. Grabowska J., *Grupowe oceny ekspertów*, "Zeszyty Naukowe", series: "Organizacja i Zarządzanie", v. 78, Politechnika Śląska, Gliwice 2013.
84. Gray C., *Absorptive Capacity, Knowledge Management and Innovation in Entrepreneurial Small Firms*, "International Journal of Entrepreneurial Behaviour & Research" 2006, Vol. 12, No. 6, doi: 10.1108/13552550610710144.
85. Griffin R.W., *Podstawy zarządzania organizacjami*, PWN, Warszawa 1996.
86. Groble A., *Metodologia nauk*, Areus, Znak, Kraków 2006.
87. Grudzewski W.M., Hejduk I.K. (ed.), *Przedsiębiorstwo przyszłości*, Difin, Warszawa 2000.
88. Grudzewski M.W., Hejduk I.K., *Projektowanie systemów zarządzania*, Difin, Warszawa 2001.
89. Grudzewski W.M., Hejduk I.K., *Dlaczego należy zarządzać wiedzą?* in: I.K. Hejduk (ed.), *Teoria i praktyka modelowania systemów logistycznych*, Politechnika Koszalińska, Koszalin 2004.
90. Grudzewski W.M., Hejduk I.K., *Systemy zarządzania wiedzą – nowy paradygmat czy wyzwanie?*, in: I.K. Hejduk (red.), *Przedsiębiorstwo przyszłości – funkcje i rzeczywistość*, ORGMASZ, Warszawa 2004.
91. Gudanowska A., *Mapowanie a foresight – wybrane aspekty metodologiczne jednego ze współczesnych nurtów badawczych w naukach o zarządzaniu*, "Współczesne Zarządzanie" 2012, No. 4.
92. Hammersley M., Atkinson P., *Metody badań terenowych*, Zysk i S-ka, Poznań 2000.
93. Hartigan J.A., Wong M.A., *Algorithm AS 136. A k-means Clustering Algorithm*, „Journal of the Royal Statistical Society”, Series C (Applied Statistics), Vol. 28, No. 1.
94. Hedlund G., *A model of knowledge management and the N-form corporation*, "Strategic Management Journal" 1994, No. 15.
95. Hellwig Z., *Taksonometria ekonomiczna, jej osiągnięcia, zadania i cele*, in: J. Pocięcha (ed.), *Taksonomia – teoria i jej zastosowania*, Akademia Ekonomiczna w Krakowie, Kraków 1990.
96. Herdan A. (ed.), *Fuzje, przejęcia... Wybrane aspekty integracji*, Uniwersytet Jagielloński, Kraków 2008.

97. Herman A., Szablewski A. (ed.), *Zarządzanie wartością firmy*, Poltext, Warszawa 1999.
98. Herman A., *Zarządzanie wartością przedsiębiorstwa w gospodarce opartej na wiedzy. Przedsiębiorstwo przyszłości – nowe paradygmaty zarządzania europejskiego*. Książka poświęcona 50-leciu Instytutu Organizacji i Zarządzania w Przemśle ORGMASZ. ORGMASZ, Warszawa 2003.
99. Hill T., *Can you see big picture*, Barring Point 2005, No. 2.
100. Hofstede G., *Kultury i organizacje. Zaprogramowanie umysłu*, PWE, Warszawa 2007.
101. Hooke J.C., *Fuzje i przejęcia*, Liber, Warszawa 1998.
102. Horngren Ch.T., Foster G., *Cost accounting, a managerial emphasis*, Prentice Hall, New Jersey 1991.
103. Horst B., Drzewiecki Z., *Marketing w firmie. Controlling marketingowy*, TNOiK, Warszawa 1992.
104. Horvarth O., Reichmann T., *Controlling Lexikon*, C.H. Beck, Muenchen 2003.
105. Howard R., *The Learning Imperative Managing People for Continuous Innovation*, in: I. Nonaka, H. Takeuchi (eds.), *The Knowledge Creating Company*, Oxford University Press, New York 1995.
106. <http://sjp.pwn.pl/>.
107. http://www.ue.katowice.pl/uploads/media/SE_132.pdf.
108. Ignaciak E., *Controlling personalny w zarządzaniu przedsiębiorstwem*, "Controlling i Rachunkowość Zarządcza" 2000, No. 8.
109. Investopedia.com, 2005.
110. Janczyk-Strzała E., *Controlling w przedsiębiorstwach produkcyjnych*, CeDeWu PL, Warszawa 2008.
111. Jashapara A., *Zarządzanie wiedzą*, PWE, Warszawa 2006.
112. Jasiński M., Kowalski M., *Falszywa sprzeczność: metodologia jakościowa czy ilościowa?* in: A. Haber (ed.), *Ewaluacja ex post. Teoria i praktyka badawcza*, PARP, Warszawa 2007.
113. Jędralska J., *Controlling w zarządzaniu przedsiębiorstwem międzynarodowym*, Akademia Ekonomiczna w Katowicach, Katowice 2003.
114. Jędralska K., Woźniak-Sobczak B., *System wdrażania kontroingu w przedsiębiorstwie*, Akademia Ekonomiczna w Katowicach, Katowice 2000.
115. Johnson H., *Fuzje i przejęcia. Narzędzie podejmowania decyzji strategicznych*, Liber, Warszawa 2000.
116. Jokiel G., *O celach nauki organizacji i zarządzania*, w: H. Jagoda, J. Lichtarski (ed.), *Nowe kierunki w zarządzaniu przedsiębiorstwem – celowość, skuteczność, efektywność*, Akademia Ekonomiczna we Wrocławiu, Wrocław 2006.
117. Juchnowicz M., *Elastyczne zarządzanie kapitałem ludzkim w organizacji wiedzy*, Difin, Warszawa 2007.
118. Kabyłko G., Morawski M., *Przedsiębiorstwo zorientowane na wiedzę*, Difin, Warszawa 2006.
119. Kaleta A., *Strategia konkurencji we współczesnym przemyśle*, in: *Współdziałanie strategiczne w gospodarce*. Conference materials. Akademia Ekonomiczna, Wrocław 1998.
120. Kamiński A., *Metoda, technika, procedura badawcza w pedagogice empirycznej*, in: R. Wroczyński, T. Pilch (ed.), *Metodologia pedagogiki społecznej*, Ossolineum, Wrocław 1974.

121. Kang J., Rhee M., Kang K.H., *Revisiting Knowledge transfer: Effects of Knowledge characteristics organizational effort for knowledge transfer*, "Expert Systems With Application" 2010, No. 37.
122. Kaplan R.S., Norton D.P., *Strategiczna karta wyników. Jak przełożyć strategię na działanie*, PWN, Warszawa 2001 (2002).
123. Karbownik A. (ed.), *Czynniki kształtujące elementy systemu zarządzania współczesną organizacją*, Politechnika Śląska, Gliwice 2008.
124. Karlof B., *Strategia biznesu, Zarządzanie i Bankowość*, Warszawa 1992.
125. Kendall M.G., Babington Smith B., *The Problem of m Rankings*, "The Annals of Mathematical Statistics" 1939, No. 10(3), September.
126. Kendall M.G., *The advanced Theory of Statistics*, Griffin, London 1964.
127. Kieżun W., *Sprawne zarządzanie organizacją*, Oficyna Wydawnicza AGH, Warszawa 1998.
128. Kleczek R., Kowal W., Woźniczka J., *Strategiczne planowanie marketingowe*, PWE, Warszawa 1996.
129. Kłosowska B., Tokarski A., Tokarski M., Chojnacka E., *Strategie finansowania działalności przedsiębiorstw*, Oficyna Ekonomiczna, Kraków 2006.
130. *Knowledge Transfer in Firms under the Promotion of Dynamic Capability Research*, "Modern Economy" 2015, No. 6, pp. 965–970, SciRes, www.scirp.org/journal/me, <http://dx.doi.org/10.4236/me.2015.69091>, September 2015.
131. Knudsen M.P., *The Relative Importance of Interfirm Relationships and Knowledge Transfer for New Product Development Success*, "Journal of Product Innovation Management" 2007, Vol. 24, No. 2, doi:10.1111/j.1540-5885.2007.00238.x.
132. Ko D.-G., Kirsch L.J., King W.R., *Antecedents of knowledge transfer from consultants to clients in enterprise system implementations*, "Management Information System Quarterly" (Special Issue) 2005, Vol. 29, No. 1.
133. Kogut B., Zander U., *Knowledge of the Firm and Evolutionary Theory of Multinational Corporation*, "Journal of International Business Studies" 1992, No. 34(6).
134. Kogut B., Zander U., *Knowledge of the firm, combinative capabilities and the replication of technology*, "Organization Science" 1992, No. 3.
135. Kołakowski L., *Wśród znajomych. Wybór i posłowie*, Znak, Kraków 2004.
136. Komorowski J., *Budżetowanie jako metoda zarządzania przedsiębiorstwem*, PWN, Warszawa 1997.
137. Konecki K., *Studia z metodologii badań jakościowych. Teoria ugruntowana*, PWN, Warszawa 2000.
138. Kopiński A., *Metody oceny kondycji ekonomicznej przedsiębiorstw*. Prace Naukowe Akademii Ekonomicznej we Wrocławiu No. 590, Wydawnictwo Akademii Ekonomicznej we Wrocławiu, Akademia Ekonomiczna we Wrocławiu, Wrocław 1991.
139. Korporowicz L., *Słownik ważniejszych pojęć*, w: L. Korporowicz (ed.), *Ewaluacja w edukacji*, Oficyna Naukowa, Warszawa 1997.
140. Kostera M., *Antropologia organizacji. Metodologia badań terenowych*, PWN, Warszawa 2005.
141. Koźmiński A.K., Oblój K., *Zarys teorii równowagi organizacyjnej*, PWE, Warszawa 1989.
142. KPMG Polska, Glossary of terms, <http://www.kpmg.com/pl/pl/strony/glossary.aspx#16>, 2016.
143. Kramer T., *Podstawy marketingu*, PWE, Warszawa 2004.

144. Krupski R. (ed.), *Elastyczność organizacji. Zarządzanie przedsiębiorstwem w turbulentnym otoczeniu*, PWE, Warszawa 2005.
145. Krupski R., Przybyła M., *Struktury organizacyjne przedsiębiorstwa ich ugrupowań*, Ossolineum, Wrocław 1996.
146. Krupski R., *Zarządzanie strategiczne. Koncepcje, metody*, Akademia Ekonomiczna we Wrocławiu, Wrocław 1998.
147. Krzyżanowski L., *Podstawy nauk o organizacji i zarządzaniu*, PWN, Warszawa 1994.
148. Krzyżanowski L.J., *O podstawach kierowania organizacjami inaczej. Paradygmaty, metafory, modele. Filozofia, metodologia. Dylematy, trendy*, PWN, Warszawa 1999.
149. Lahti K., Ryan M., Beyerlein M., *Knowledge Transfer and Management Consulting. A Look at the Firm*, "Business Horizons" 2000, Vol. 43(1).
150. Lane J., Lubatkin M., *Relative Absorptive Capacity and Interorganisational Learning*, "Strategic Management Journal" 1998, Vol. 19. No. 5, doi:10.1002/(SICI)1097-0266(199805)19:5<461::AID-S MJ953>3.3.CO;2-C.
151. Lange O., Banasiński A., *Teoria statystyki*, PWE, Warszawa 1968.
152. Laursen K., Salter A., *Searching Low and High: What Type of Firms Use Universities as a Source of Innovation?* "Research Policy" 2004, Vol. 33, No. 8, doi:10.1016/j.respol.2004.07.004.
153. Lewandowski J., *Zarządzanie jakością*, MARCUS, Łódź 1998.
154. Lewandowski M., Kulpa N., *Integracja przedsiębiorstw*, in: W. Frąckowiak (ed.), *Fuzje i przejęcia przedsiębiorstw*, PWE, Warszawa 1998.
155. Lewandowski M., *Znaczenie integracji w procesach fuzji i przejęć przedsiębiorstw*, in: W. Frąckowiak (ed.), *Fuzje i przejęcia przedsiębiorstw*, PWN, Warszawa 1998.
156. Lichtarski J. (red.), *Podstawy nauki o przedsiębiorstwie*, Akademia Ekonomiczna we Wrocławiu, Wrocław 2001.
157. Lichtarski J., *O relacji między podejściem funkcjonalnym i procesowym w zarządzaniu*, in: M. Romanowska, M. Tracki (ed.), *Podejście procesowe w zarządzaniu*, SGH, Warszawa 2004.
158. Lichtarski J., *Struktura organizacyjna przedsiębiorstwa i jej kształtowanie*, in: J. Lichtarski (ed.), *Podstawy nauki o przedsiębiorstwie*, Wydawnictwo Akademii Ekonomicznej we Wrocławiu, Akademia Ekonomiczna we Wrocławiu, Wrocław 2001.
159. Likert R., *A Technique for the Measurement of Attitudes*, „Archives of Psychology” 1932, No. 140.
160. *Lista Due-Diligence*, Gemi, Łaziska Górne 2000.
161. Lubit R., *Tacit Knowledge and Knowledge Management: The Keys to Sustainable Competitive Advantage*, "Organizational Dynamics" 2001, Vol. 29, No. 4.
162. Lula P., *Web missing*. Teaching materials, http://janek.ae.krakow.pl/lulap/WM2008_03mpol7.
163. Luty Z., *Planistyczny rachunek kosztów*, Akademia Ekonomiczna we Wrocławiu, Wrocław 1990.
164. Majchrzak J., *Zarządzanie zmianami w przedsiębiorstwie*, Akademia Ekonomiczna w Poznaniu, Poznań 2002.
165. Malara Z., *Przedsiębiorstwo w globalnej gospodarce. Wyzwania współczesności*, PWN, Warszawa 2006.
166. Malerba F., *Sectoral Systems. How and Why Innovation Differs across Sectors*, in: J. Fagerberg, D. Mowery, R.R. Nelson (eds.), *The Oxford Handbook of Innovation*, Oxford University Press, Oxford 2005.

167. Małkus T., Stabryła A., Wawak S., Woźniak K., *Organizacja systemów zarządzania wiedzą w przedsiębiorstwie*, in: Stabryła A. (ed.), *Improving organizational structures of enterprises in knowledge-based economy*, C.H. Beck, Warsaw 2009.
168. McClure B., *The Basics Of Mergers And Acquisitions*, www.investopedia.com.
169. McGrady S., *Extending Due-Diligence to Improve Mergers and Acquisitions*, *Mergers and Acquisition*, CFA Institut, New York 2015.
170. Meriam G. & C., *Webster's New Collegiate Dictionary*, Mass Company, Springfield 1977.
171. Męczyńska A., *Metoda heurystyczna – grupowa ocena ekspertów w zastosowaniu do analizy procesów, produktów*, in: R. Konsala (ed.), *Komputerowe zintegrowane zarządzanie*. Conference materials, WNT, Warszawa 1999.
172. Męczyńska A., *Wspomaganie procesów zarządzania w przedsiębiorstwie metodami heurystycznymi*. Ph.D. thesis, Politechnika Śląska w Gliwicach, Wydział Organizacji i Zarządzania, Gliwice 2001.
173. Mierzejewska B., *Transfer wiedzy w procesach fuzji i przejęć*, "E-mentor" 2007, No. 1(18).
174. Minbajewa P.B., *Knowledge Transfer in Multinational Corporations*, "Management International Review" 2007, No. 47(4).
175. Miśkiewicz R., Trzaskalik T., Jarek S., *Analiza wielokryterialna w badaniach transferu wiedzy w ramach fuzji i przejęć przedsiębiorstw*, Uniwersytet Ekonomiczny w Katowicach, Katowice 2014.
176. Moorhouse J., *Podstawy marketingu I*, Pret SA, Warszawa 2000.
177. Morgan G., *Obrazy organizacji*, PWN, Warszawa 1997.
178. Morin E., *Socjologie*, Fayard, Paris 1984.
179. Mowery C., Bhaven N.S., *Universities in National Innovation Systems*, in: J. Fagerberg, D. Mowery, R.R. Nelson (eds.), *The Oxford Handbook of Innovation*, Oxford University Press, Oxford 2005.
180. Mreła K., *Struktury organizacyjne. Analiza wielowymiarowa*, PWE, Warszawa 1988.
181. Nair M., *Essentials of Balanced Scorecard*, Wiley, Emerge 2012.
182. Nieminen H., *Organizational Receptivity-Understanding the Inter Organizational Learning Ability*, "Electronic Journal of Knowledge Management" 2005, Vol. 3, No. 2.
183. Niven P., *Balanced scorecard "step by step" for Government and non-profit Agencies*, John Wiley & Sons, Hoboken, New Jersey 2003.
184. Nonaka I., Takeuchi H. (eds.), *The Knowledge – Creating Company*, Oxford University Press, New York 1995.
185. Nonaka I., Takeuchi H., *Kreowanie wiedzy w organizacji*, Poltext, Warszawa 2000.
186. Nonaka I., von Krogh G.G., *Perspective-tacit knowledge and knowledge conversion: Controversy and advancement in organizational knowledge creation theory*, "Organization Science" 2009, Vol. 20, No. 3.
187. *New Comprehensive Encyclopaedia*, volume VI, PWN, Warsaw 1997.
188. Oblój K., *Strategia organizacji*, PWE, Warszawa 2006.
189. Olve N.G., Roy J., Wetter M., *Performance drivers. A practical guide to using Balanced Scorecard*, Wiley, Chichester 2000.
190. Orzeł J., *Rola metod heurystycznych, w tym grupowej oceny ekspertów oraz prawdopodobieństwa subiektywnego w zarządzaniu ryzykiem operacyjnym*, Bank i Kredyt 2005, No. 5.
191. Pawłowicz L., *Wybrane metody taksonomii numerycznej i ich zastosowanie w badaniach ekonomicznych*, Uniwersytet Gdański, Gdańsk 1998.

192. Pilch T., *Zasady badań pedagogicznych*, Żak, Warszawa 1977.
193. Polak A., *Nauczanie organizacji przedsiębiorstw za pomocą mapy wiedzy*, "Przegląd Organizacji" 2012, No. 3.
194. Polanyi M., *The Tacit Dimension*, Garden City, Anchor Books, New York 1967.
195. Probst G., Raub S., Romhardt K., *Zarządzanie wiedzą w organizacji*, Oficyna Ekonomiczna, Kraków 1993.
196. Pugh S., Hickson D.J., Hinnings G.R., Turner C., *The context of Organizations Structure*, "Administrative Science Quarterly" 1969, No. 14.
197. Pyka J., *Nowoczesność przemysłu i usług. Współczesne wyzwania i uwarunkowania rozwoju przemysłu i usług*, TNOiK, Politechnika Śląska, Katowice 2010.
198. Redfield R., Linton R., Herskovitz M., *Memorandum on the Study of acculturation*, "American Anthropologist" 1936, No. 38, in: A. Herdan (ed.), *Fuzje, przejścia... Wybrane aspekty integracji*, Uniwersytet Jagielloński, Kraków 2008.
199. Ring A., Öfverström H., *Contextualised View of Knowledge Transfer in Mergers and Acquisitions*, Göteborg University, Göteborg 2000.
200. Röder F., *Strategic Benefits and Risks of Vertical Integration in International Media Conglomerates and Their Effect on Firm Performance*, University of St. Gallen, Graduate School of Business Administration, Economics, Law and Social Sciences (HSG), St. Gallen, October 15, 2007.
201. Rokita J., *Organizacja ucząca się*, Wydawnictwo Akademii Ekonomicznej w Katowicach, Katowice 2003.
202. Rokita J., *Zarządzanie Strategiczne. Tworzenie i utrzymywanie przewagi konkurencyjnej*, PWE, Warszawa 2005.
203. Ross J.F. de, *Increasing shareholder value through successful business integration and effective postmerger management*, "Management Review" 2003, September.
204. Rowińska-Fronczek M., *Kapitał intelektualny przedsiębiorstwa*, in: J. Lichtarski (ed.), *Podstawy nauki o przedsiębiorstwie*, Wydawnictwo Akademii Ekonomicznej we Wrocławiu, Akademia Ekonomiczna we Wrocławiu, Wrocław 2001.
205. Rummier G., Brache A., *Podnoszenie efektywności organizacji*, PWE, Warszawa 2000.
206. Schein E., *Organizational culture and leadership*, Jostly Bass, San Francisco 1958, w: Strategor, *Zarządzanie firmą*, PWE, Warszawa 2001.
207. Schibany A., Polt W., *Innovation and Networks: An Introduction to The Theme*, in: *Innovation Networks, Cooperation in National Innovation Systems*, OECD, Paris 2001.
208. Senge P.M., *The fifth discipline. Teoria i praktyka organizacji uczących się*, Dom Wydawniczy ABC, Warszawa 1998.
209. Simonen J., *The Effects of R&D Cooperation and Labour Mobility on Innovation*, Ph.D. Thesis, Acta Universitas Ouluensis, University of Oulu, Oulu 2007.
210. Slaughter S.A., Kirsch L.J., *The effectiveness of knowledge transfer portfolios in SPI: A field study*, "Information Systems Research" 2006, September.
211. Stabryła A. (ed.), *Improving organizational structures of enterprises in knowledge-based economy*, C.H. Beck, Warsaw 2009.
212. Stabryła A., *Zarządzanie projektami ekonomicznymi i organizacyjnymi*, PWN Warszawa 2006.
213. Stabryła A., *Zarządzanie strategiczne w teorii i praktyce firmy*, PWN, Warszawa 2007.
214. Stachowicz-Stanusch A., *Potęga wartości. Jak zbudować nieśmiertelną firmę*, Helion, Gliwice, 2007.

215. Statistica.pl, <http://www.statistica.pl/textbook/stelman.html>.
216. Stoner J., Wankel Ch., *Kierowanie*, PWE, Warszawa 1992.
217. Strategor, *Zarządzanie firmą*, PWE, Warszawa 2001.
218. Stuss M.M., *Metody oceniania współczesnej kadry menedżerskiej*, Księgarnia Akademicka, Kraków 2003.
219. Sudarsanam S., *Fuzje i przejęcia*, WIG-Press, Warszawa 1998.
220. Sudoł S., *Badania naukowe w zakresie zarządzania*, in: *Dynamika zarządzania organizacjami. Paradygmaty – Metody – Zastosowania. Księga pamiątkowa wydana z okazji 50-lecia pracy naukowej prof. zw. dr hab. J. Rokity*, Prace Naukowe Akademii Ekonomicznej im. Karola Adamieckiego w Katowicach, Katowice 2007.
221. Szablewski A., *Strategie wzrostu wartości firmy. Studium przypadku*, Poltext, Warszawa 2000.
222. Szablewski A., Tuzimek R., *Wycena i zarządzanie wartością firmy*, Poltext, Warszawa 2004.
223. Szczepankowski P.J., *Fuzje i przejęcia*, PWN, Warszawa 2000.
224. Szczotka F.A., *Podstawy taksonomii numerycznej*, PAN, Warszawa 1996.
225. Trzaskalik T., *Modelowanie optymalizacyjne*, Absolwent, Łódź 2001.
226. Wan J.P., Yang J.M., *Knowledge management in SPI*, "Application Research of Computer" 2002, Vol. 19, No. 5.
227. Wojtowicz A., *Diagnozowanie kultury organizacyjnej w procesie zarządzania strategicznego*, Uniwersytet Ekonomiczny w Krakowie, Kraków 2006.
228. Woźniak K. (ed.), *Narzędzia ekonomiczne w naukach ekonomicznych*, Mfiles.pl, Kraków 2015.
229. Woźniak T., *Budowa wartości firmy na podstawie Zrównoważonej Karty Wyników*, in: A. Szablewski, R. Tuzimek (ed.), *Wycena i zarządzanie wartością firmy*, Poltext, Warszawa 2004.
230. www.statistica.pl/text.book/stelman.html.
231. www.statsoft.pl, Electronic Statistics Textbook Inc., 1984-2011.
232. Yourdan E., *Współczesna analiza strukturalna*, WNT, Warszawa 1996.
233. Zadecki J., Łokuciewska J., *Zastosowanie metod sieciowych w budownictwie*, COJB, Warszawa 1975.
234. Zhang X.G., *Research on knowledge management technology in SPI*, Chinese Academy of Sciences, Doctoral Thesis, 2004.
235. Zheng W., Yang B., McLean G.N., *Linking organizational culture, structure, strategy and organizational effectiveness: Mediating role of knowledge management*, "Journal of Business Research" 2010, Vol. 63, Iss. 7.

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Annexe No. 1

Procedure of selecting the group of experts – STAGE II and STAGE III

Source of arguments	Stage		
	High	Average	Low
Practical experience	0.40		0.20
Conducted theoretical analysis of the issue	0.30	0.23	0.15
Knowledge on foreign experience related to the issue	0.25	0.19	0.125
Intuition	0.05	0.04	0.025

Threshold value $\rho = 0.5$ **Kk ≥ 0.5**

RESPONDENTS	COEFFICIENTS		
No.	kz	ka	Kk
1	0.6	0.85	0.72
2	0.3	0.58	0.44
3	1	0.93	0.97
4	0.9	0.99	0.95
5	1	0.89	0.95
6	1	0.86	0.93
7	0.8	0.83	0.82
8	0.8	0.76	0.78
9	0.9	0.94	0.92
10	1	0.99	1.00
11	0.7	0.76	0.73
12	0.8	0.76	0.78
13	0.3	0.50	0.40
14	0.2	0.71	0.45
15	0.3	0.52	0.41
16	0.4	0.52	0.46
17	0.2	0.60	0.40
18	0.1	0.78	0.44
19	0	0.52	0.26
20	0.1	0.50	0.30
21	0.4	0.78	0.59
22	0.3	0.53	0.41
23	0.1	0.53	0.31

12 experts

Source: own study.

Annexe No. 2

Scenario of semi-structured interview – stage II

Knowledge of the issue – kz	Score	Result
I do not know the issue	0	
I know the issue barely, but it is in sphere of my interests	1, 2, 3	
I know the issue on an average level	4, 5, 6	
I know the issue well	7, 8, 9	
I know the issue very well	10	

Knowledge of the issue – ka	Degree (W / S/ N)*
Practical experience	
Conducted theoretical analysis of the issue	
Knowledge on foreign experience related to the issue Intuition	

STAGE II.A

**ASSIGNMENT OF KNOWLEDGE TRANSFER DETERMINANTS TO
KNOWLEDGE FACTOR GROUPS**

No.	KNOWLEDGE FACTORS	X1	X2	X3	X4
1	Current R & D works within the company				
2	Documentation and unofficial news concerning quality				
3	Information and analysis of competition quality				
4	Customer information on the quality, features and prices of the products				
5	Information and analysis of product characteristics				
6	Technical descriptions and manuals				
7	Portfolio of orders and ability of its shaping				
8	Forecasts of research cells				
9	R+D concerning development of the enterprise				
10	Ideas, patents, innovations				
11	Employees with valuable skills and competencies				
12	Computer programs, utility models, trademarks				
13	Practical experience of employees in the sphere of sales				
14	Projects				
15	Practical experience of supervisory staff				
16	Personal relations with suppliers and buyers				
17	Product, technology and organizational standards				
18	Production technology of				
19	The ability to regulate financial flows				
20	Skills and competences in collaboration with the environment				
21	Ability to optimally shape stocks				
22	Explicit knowledge of competitors and markets				
23	Knowledge of R & D by the competition (inventions, innovations, quality, patents)				

24	Marketing knowledge of customers				
25	Knowledge in the scope of <i>foresight</i>				
26	Personal knowledge of specialized staff				
27	Knowledge of costing				
28	Knowledge of optimum stock shaping				
29	Tacit knowledge of financial workers				
30	Tacit knowledge of executive workers				
31	Knowledge of production technology				
32	Suppliers' market knowledge				

STAGE II.B

ESTABLISHING SPECIALISED STUDY METHODS SUITABLE FOR THE ANALYSIS OF KNOWLEDGE TRANSFER BETWEEN CONSOLIDATED ENTERPRISES

No.	RESEARCH METHODS FOR KNOWLEDGE TRANSFER ANALYSIS	YES/NO
1	Nearest neighbour method (Johnson's method)	
2	Outermost neighbourhood method (Johnston's method)	
3	Czekanowski Method	
4	On-line method	
5	Wrocław taxonomy method (shortest dendrite method)	
6	Berry Method	
7	Gravity centre method	
8	Median method	
9	Group average method	
10	Spearman's rank correlation coefficients: Kendal coefficient	
11	Scattering measures: entropy and Taylor's development as a Gini coefficient	
12	Proximity measures: Kullback-Leiber distance	
13	Dependency measures Goodman-Kruskal coefficient	
14	other (what?)	

PARTICULARS

1. Gender:

☐
☐

Woman

Man

2. Age:

☐
☐
☐
☐

20–25 year

26–35 year

36–50 year

over 50 year

3. Education:

☐
☐
☐

vocational

secondary

whigher

Source: own study.

Annexe No. 3

Procedure for establishing necessary size of the sample – stage I

The number of consolidated entities was high and, assuming that on average each of them employed on the above-mentioned positions, as participants in the knowledge transfer management, about five people, we are dealing with about 400 professionals.

In this situation, the idea of engaging the entire population was abandoned and limited to the sample group. The draw was done using a simplified pattern, applying the knowledge of the entire population of managers:

$$n_p = \frac{N}{1 + \frac{N * d^2}{9 * s^2}} \quad (1)$$

d – desired study accuracy,

where:

$s^2 = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2$ – variance of x characteristic in the general population,

$n = \sum n_i$ – number of the preliminary population,

x_i – value of the examined feature in the initial test,

$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i * n_i$ – weighted mean value of the tested feature in the initial test.

The “ d ” value is determined by the person performing the study, according to the assumed accuracy of the results.

As a result of the calculation, the minimum sample size was set at 80 people.

Source: own study.

¹ www.statsoft.pl (Electronic Statistics Textbook Inc., 1984-2011).

Annexe No. 4

Personal data of the surveyed managers – STAGE I

GENDER	Percentage share	Number of people
Woman	38%	33
Man	62%	53
Total	100%	86

AGE	Percentage share	Number of people
20–25	0%	0
26–35	8%	7
36–50	66%	57
Over 50	26%	22
Total	100%	86

EDUCATION	Percentage share	Number of people
zawod.	0%	0
średnie	8%	7
wyższe	92%	79
Total	100%	86

MANAGEMENT LEVEL	Percentage share	Number of people
highest	15%	13
middle	71%	61
lowest	14%	12
Total	100%	86

SENIORITY	Percentage share	Number of people
up to 5	15%	13
6–10	14%	12
11–15	39%	33
16–25	31%	27
26 and more	1%	1
Total	100%	86

NUMBER OF EMPLOYEES IN ENTERPRISE	Percentage share	Number of people
to 100	0%	0
101–500	2%	2
501–1000	10%	9
1001–2500	55%	47
2501–5000	33%	28
5001–10000	0%	0
over 10000	0%	0
Total	100%	86

Source: own study.

Annexe No. 5List of subjects in the test sample – stage III

Enterprise
British Steel
Europipe
Thyssen Stahl
Thyssen Krupp
CMC
Zawiercie Steelworks
LNM Holdings
PHS
Celsa Group
Ostrowiec Steelworks
ZAO Severstal
Lucchini
Evrast
Vitkovice Steel
MSC
Arcelor Mittal
Tata Steel
Corus Group
Salzgitter
VPE
Eramet
Tinfos

Source: own study.

Annexe No. 6

Survey – pilot study

Dear Sirs!

I kindly ask you to participate in a survey that is anonymous and is a pilot study of the research process.

The aim of the pilot study is to identify the relations between knowledge transfer and mergers and acquisitions.

The survey consists of two stages.

The aim of **stage a** of pilot study is to characterize the 15 general variables (characteristics) of the studied enterprises.

Stage b is aimed at characteristics of 16 variables (features) of knowledge of the studied enterprises.

Please fill in the following two tables.

STAGE A**General variables (characteristics) of the studied enterprises**

No.	GENERAL VARIABLES (FEATURES)	COMPANY 1 (ACQUIRING)	COMPANY 2 (ACQUIRED)
1	Company assets	.....(million EUR)	.....(million EUR)
2	Average pay	..... (PLN)	..... (PLN)
3	Total number of employees		
4	Percentage of employees with higher education (%)		
5	Departments (production, electromechanical, technical-implementation)		
6	Revenues from sale	..... (PLN million)	..... (PLN million)
7	General assessment of company financial condition (1 – the lowest grade, 4 – the highest grade)	1	1
		2	2
		3	3
		4	4
8	Whether <i>transition team</i> was established in the company?	YES	YES
		NO	NO
9	Whether representatives of the acquired company take part in works of the team?	YES	YES
		NO	NO
10	Average staff qualification level	low	low
		average	average
		high	high
		very high	very high

11	Type of organizational structure	centralised	centralised
		rather centralised	rather centralised
		rather decentralised	rather decentralised
		other	other
12	Applied wage system	piecework	piecework
		incentive wage system	incentive wage system
		daily pay	daily pay
		daily-task	daily-task
		other ...	other ...
13	Cultural differences in relation to consolidated company (0 – lack, 2 – low, 3 – average, 4 – biggest)	0	0
		1	1
		2	2
		3	3
14	Number of employees having access to a computer compared to the total number of employees (in %)%%
15	Number of employees having access to data base compared to the total number of employees (in %)%%

STAGE B

Knowledge variables (characteristics) of the studied enterprises

No.	TYPE OF ACQUIRED KNOWLEDGE	ACQUIRING COMPANY		ACQUIRED COMPANY	
1	x1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	YES	NO	YES	NO
2	x2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)	YES	NO	YES	NO
3	x3 – knowledge, including explicit knowledge, of relevance (relations, experience, etc.)	YES	NO	YES	NO
4	x4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	YES	NO	YES	NO
	TYPE OF ACQUIRED KNOWLEDGE	KNOWLEDGE LEARNING TIME			
		ACQUIRING COMPANY		ACQUIRED COMPANY	
5	x1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	..... (months)		..... (months)	
6	x2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)	..... (months)		..... (months)	

7	x3 – knowledge, including explicit knowledge, of significant importance (relations, experience, etc.)	..... (months)	..... (months)
8	x4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	..... (months)	..... (months)

	TYPE OF ACQUIRED KNOWLEDGE	SIGNIFICANCE (WEIGHT) OF KNOWLEDGE	
		ACQUIRING COMPANY	ACQUIRED COMPANY
9	x1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	..... (scale 4–6)	..... (scale 4–6)
10	x2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)	..... (scale 2–4)	..... (scale 2–4)
11	x3 – knowledge, including explicit, of significant importance (relations, experience, etc.)	..... (scale 1–2)	..... (scale 1–2)
12	x4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	..... (scale 0,5–1)	..... (scale 0,5–1)

	TYPE OF ACQUIRED KNOWLEDGE	EXPLICIT KNOWLEDGE SHARE (IN %)	
		ACQUIRING COMPANY	ACQUIRED COMPANY
13	x1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)%%
14	x2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)%%
15	x3 – knowledge, including explicit, of significant importance (relations, experience, etc.)%%
16	x4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)%%

**THANK YOU VERY MUCH FOR PARTICIPATION IN THE STUDY AND
YOUR TIME**

Source: own study.

Annexe No. 7

Survey – managers – STAGE I

Dear Sirs!

I kindly ask you to participate in a survey that is anonymous and constitutes one stage of the research process. The study consists of two stages (**stage I.A** and **I.B**) and particulars.

Stage I.A aims at identifying the important determinants of knowledge transfer in the process of merger and acquisition, while **stage I.B** aims at determining the validity of factors that influence the success of mergers and acquisitions in relation to knowledge transfer.

STAGE I.A**KNOWLEDGE TRANSFER DETERMINANTS**

Please select the most important determinants of knowledge transfer in the process of merger and acquisition, by assigning the appropriate number of points on a five-point scale, where:

1 – lowest grade, 5 – highest grade.

Rate in terms of significance on a scale of 1-5 each of the determinants of knowledge transfer (points: 1 – lowest grade , 5 – highest grade)

No.	CZYNNIKI WIEDZY	Punkty 1–5
1	Complaints analysis	
2	Analyses, calculations and synthesis	
3	Current R & D works within the company	
4	Intangible goods protection period of which has expired	
5	Personal experience in occupational safety and health, fire, sanitary and epidemiological fields.	
6	Planning experience	
7	Product documentation	
8	Documentation and unofficial news concerning quality	
9	Operating records of machinery and equipment	
10	Record of inspections, periodic and capital repairs	
11	Information and analysis of competition quality	
12	Customer information on the quality, features and prices of the products	
13	Instructions for behaving in the event of hazards	
14	Information and analysis of product characteristics	
15	Configuration of organizational units	
16	Materials for analysis, calculation and cost synthesis	
17	Standards and regulations	
18	Standards for emissions of gases, land contamination and water pollution	
19	Technical descriptions and manuals	
20	Portfolio of orders and ability of its shaping	
21	Forecasts of research cells	
22	R+D concerning development of the enterprise	

23	Ideas, patents, innovations	
24	Employees with valuable skills and competencies	
25	Computer programs, utility models, trademarks	
26	Practical experience of employees in the sphere of sales	
27	Health and safety regulations, inspection and accident reports	
28	Fire protection rules	
29	Sanitary and epidemiological reports.	
30	External and internal regulations on the protection of the air, land and water	
31	Projects	
32	Practical experience of supervisory staff	
33	Relations with debtors and creditors	
34	Relations with customers and sales representatives	
35	Personal relations with suppliers and buyers	
36	Product, technology and organizational standards	
37	Specialization of divisions and organizational units	
38	Production technology of	
39	The ability to regulate financial flows	
40	Skills and competences in collaboration with the environment	
41	Ability to optimally shape stocks	
42	Explicit knowledge of competitors and markets	
43	Knowledge of R & D by the competition (inventions, innovations, quality, patents)	
44	Marketing knowledge of customers	
45	Knowledge in the scope of <i>foresight</i>	
46	Personal knowledge of specialized staff	
47	Knowledge of costing	
48	Knowledge of production capabilities and delivery dates	
49	Knowledge of optimum stock shaping	
50	Tacit knowledge of financial workers	
51	Knowledge of quality regulations	
52	Tacit knowledge of executive workers	
53	Principles and organization of autonomous units	
54	Knowledge of laws and regulations and internal instructions	
55	Knowledge of production technology	
56	Knowledge of statistical and econometric tools	
57	Suppliers' market knowledge	

STAGE I.B

FACTORS AFFECTING SUCCESS OF THE MERGERS AND ACQUISITION PROCESSES IN RELATION TO KNOWLEDGE TRANSFER

Please select the factors that affect the success of mergers and acquisitions in relation to knowledge transfer, by assigning the appropriate number of points on a five-point scale, where:

1 – lowest grade, 5 – highest grade.

Rate in terms of significance, on a scale of 1 to 5, each of the factors affecting the success of merger and acquisition processes in relation to knowledge transfer

No.	FACTORS AFFECTING SUCCESS OF THE MERGERS AND ACQUISITION PROCESSES	Points 1–5
1	Precisely designed integration program	
2	Clearly defined goals of acquisition	
3	Cultural similarity of the enterprises organization (including learning culture of the organization)	
4	Properly built and managed <i>transition team</i> ¹	
5	Preparation or recognition of the existing knowledge map	
6	Degree of knowledge verbalisation	
7	Level of knowledge articulation	
8	Knowledge distance (understood as difference in knowledge level between the transferor and the receiver)	

¹ As the *transition team* in the study any type of team established within or outside the organization to transfer knowledge should be understood.

METRYCZKA

1. Gender:

<input type="checkbox"/>	Woman
<input type="checkbox"/>	Man

2. Age:

<input type="checkbox"/>	20–25 years
<input type="checkbox"/>	26–35 years
<input type="checkbox"/>	36–50 years
<input type="checkbox"/>	over 50 years

3. Education:

<input type="checkbox"/>	vocational
<input type="checkbox"/>	secondary
<input type="checkbox"/>	higher

4. Management level:

<input type="checkbox"/>	highest
<input type="checkbox"/>	middle
<input type="checkbox"/>	lowest

5. Length of service in years:

<input type="checkbox"/>	up to 5
<input type="checkbox"/>	6–10
<input type="checkbox"/>	11–15
<input type="checkbox"/>	16–25
<input type="checkbox"/>	26 and more

6. Liczba pracowników przedsiębiorstwa:

<input type="checkbox"/>	to 100
<input type="checkbox"/>	101–500
<input type="checkbox"/>	501–1000
<input type="checkbox"/>	1001–2500
<input type="checkbox"/>	2500–5000
<input type="checkbox"/>	5001–10000
<input type="checkbox"/>	over 10 000

THANK YOU VERY MUCH FOR PARTICIPATION IN THE STUDY AND YOUR TIME

Source: own study.

Annexe No. 8

Survey – group experts’ assessment – stage III

Dear Sirs!

I kindly ask you to participate in a survey that is anonymous and constitutes an integral part of the research process. The survey consists of five stages:

The aim of **stage III.A** is to determine the type of knowledge acquired from four groups of knowledge factors, while **stage III.B** is intended to indicate the time of mastering the acquired knowledge from the four groups of knowledge factors. The aim of **stage III.C** is to determine the importance of four groups of knowledge factors. **Stage III.D** aims at assessing tacit and explicit knowledge in the knowledge transfer process. The last stage of research **stage III.E** involves identification of relations between knowledge transfer and mergers and acquisitions.

STAGE III.A

Please indicate which type of knowledge was acquired as a result of the merger or acquisition.

TYPE OF ACQUIRED KNOWLEDGE	ACQUIRING COMPANY		ACQUIRED COMPANY	
x1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	YES	NO	YES	NO
x2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)	YES	NO	YES	NO
x3 – knowledge, including explicit, of significant importance (relations, experience, etc.)	YES	NO	YES	NO
x4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	YES	NO	YES	NO

STAGE III.B

For each case (x_1 , x_2 , x_3 , x_4), please specify the time that was needed to master the knowledge.

TYPE OF ACQUIRED KNOWLEDGE	KNOWLEDGE LEARNING TIME	
	ACQUIRING COMPANY	ACQUIRED COMPANY
x1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	..... (months)	..... (months)
x2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)	..... (months)	..... (months)
x3 – knowledge, including explicit, of significant importance (relations, experience, etc.)	..... (months)	..... (months)
x4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	..... (months)	..... (months)

STAGE III.C

Please specify the significance (weight) of knowledge in the merger and acquisition process by allocating the appropriate number of points on a four-step scale, where the importance of transferred knowledge is as follows:

- 1 – trace, small,**
- 2 – limited,**
- 3 – significant,**
- 4 – important, decisive.**

TYPE OF ACQUIRED KNOWLEDGE	SIGNIFICANCE (WEIGHT) OF KNOWLEDGE ON THE SCALE 1-4	
	ACQUIRING COMPANY	ACQUIRED COMPANY
x1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)		
x2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)		
x3 – knowledge, including explicit, of significant importance (relations, experience, etc.)		
x4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)		

STAGE III.D

Please indicate which type of knowledge (explicit or tacit) is more important in the context of its transfer in the merger or acquisition process. Please comment on each of the listed four groups (x_1 , x_2 , x_3 , x_4).

TYPE OF ACQUIRED KNOWLEDGE	KNOWLEDGE OF BIGGER IMPORTANCE			
	ACQUIRING COMPANY		ACQUIRED COMPANY	
x1 – knowledge that is an individual motive for acquisition (patents, inventions, important technologies etc.)	explicit	tacit	explicit	tacit
x2 – knowledge, including tacit knowledge that is relevant to the acquiring entity (e.g. particular competences of management, unique skills of contractors, etc.)	explicit	tacit	explicit	tacit
x3 – knowledge, including explicit, of significant importance (relations, experience, etc.)	explicit	tacit	explicit	tacit
x4 – organisational knowledge characteristic of certain enterprises (pay system rules, reports, important legal documents, etc.)	explicit	tacit	explicit	tacit

STAGE III.E

Please comment on the following indicators.

No.	INDICATORS	COMPANY 1 (ACQUIRING)	COMPANY 2 (ACQUIRED)
1	Company assets	.....(million euro)	.....(million euro)
2	Average pay	.....(euro)	.....(euro)
3	Total number of employees		
4	Revenues from sale	.....(million euro)	.....(million euro)
5	General assessment of company financial condition (1 – lowest grade , 4 – highest grade)	1 2 3 4	1 2 3 4
6	Whether transition team was established in the company?	YES NO	YES NO
7	Whether representatives of the acquired company take part in works of the team?	YES NO	YES NO
8	Average staff qualification level (1 – lowest grade , 4 – highest grade)	1 2 3 4	1 2 3 4
9	Type of organizational structure	centralised rather centralised rather decentralised other ...	centralised rather centralised rather decentralised other ...

10	Applied wage system	piece-work piece-work with a bonus daily daily-task other ...	piece-work piece-work with a bonus daily daily-task other ...
11	Cultural differences in relation to consolidated company (0 – lack, 1 – low, 2 – average, 3 – biggest)	1 2 3 4	1 2 3 4

THANK YOU VERY MUCH FOR PARTICIPATION IN THE STUDY AND YOUR TIME

Source: own study.

Annexe No. 9

Results – stage I.A

RESPONDENT	DETERMINANTS OF TRANSFER OF KNOWLEDGE																																																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57			
1	2	4	2	3	2	4	1	4	3	4	2	3	2	3	3	4	3	2	3	2	3	4	2	4	1	1	1	3	3	3	3	2	1	2	3	3	2	3	4	1	2	4	4	5	3	4	3	4	5	4	4	2	5	2	5					
2	2	4	1	1	1	2	3	2	3	2	2	2	3	2	3	3	2	3	2	3	1	1	2	2	1	1	3	2	4	3	3	3	2	3	4	4	3	2	2	2	1	1	3	3	4	4	5	3	4	4	4	2	4	3	4					
3	3	4	4	4	1	4	2	5	4	2	5	5	4	2	3	3	4	3	4	5	5	5	3	5	4	3	3	4	1	3	4	3	3	3	3	4	5	3	2	5	4	2	3	4	4	3	2	4	4	4	1	4	1	4	1	5				
4	2	2	4	3	1	2	1	4	4	3	3	4	2	4	1	1	3	4	3	5	4	4	5	5	2	5	4	2	1	1	1	1	3	3	2	3	3	4	3	5	5	4	4	4	5	2	3	3	4	4	4	3	1	1	4	1	5			
5	1	4	5	3	2	2	2	4	2	1	5	4	5	5	1	4	3	3	5	4	4	5	3	5	4	5	4	5	4	2	2	2	2	4	5	3	3	4	4	4	3	4	4	3	3	4	4	5	5	3	5	5	5	4	2	5	4			
6	2	3	4	4	2	2	2	3	1	1	5	5	1	3	2	3	3	1	4	5	3	5	5	5	4	4	3	4	3	4	4	3	3	3	3	4	4	4	4	3	5	4	5	4	5	5	2	4	3	5	4	3	2	3	2	5				
7	2	2	4	3	2	2	1	1	3	3	2	3	3	1	4	3	4	3	3	5	5	5	5	5	5	5	3	4	4	2	4	4	2	2	4	4	3	2	4	4	5	4	5	4	3	5	5	5	3	3	5	4	4	1	1	4	3	5		
8	2	4	3	3	2	1	1	4	3	1	3	5	2	5	1	1	3	4	2	5	5	3	4	5	4	4	5	2	1	1	3	2	4	3	3	4	4	4	3	4	3	4	4	4	4	5	5	3	5	5	5	3	4	2	1	5	2	4		
9	2	3	4	4	2	2	3	2	2	2	5	4	1	4	2	3	3	3	5	5	4	5	4	4	5	4	3	2	1	3	3	3	4	4	5	4	4	4	4	4	4	4	4	4	5	4	4	4	5	4	4	4	2	4	2	4				
10	1	4	3	4	1	3	2	4	2	2	5	5	5	2	4	4	4	5	5	4	5	5	5	4	4	5	4	2	2	3	5	3	2	4	4	4	2	4	3	5	4	4	3	5	5	4	4	5	4	3	4	4	1	4	3	5				
11	1	4	4	3	2	3	1	5	3	3	4	5	3	5	3	2	3	4	5	5	3	5	5	5	4	5	4	3	3	3	3	2	4	5	5	3	4	4	6	4	5	4	4	4	4	4	2	4	4	4	4	2	4	3	4	5				
12	1	4	2	4	2	3	2	3	4	3	2	4	4	4	1	4	3	2	5	3	4	3	3	4	5	3	2	2	4	5	3	3	2	4	4	5	3	5	4	3	2	4	5	4	5	5	3	4	5	5	3	3	4	1	5	1	3			
13	2	4	3	3	2	2	2	4	3	3	5	5	4	5	1	1	3	4	2	5	4	3	3	4	3	5	4	4	3	4	4	4	3	3	4	3	5	4	4	3	3	3	3	4	4	5	3	5	5	3	5	4	1	5	1	5				
14	2	2	4	3	4	3	2	5	4	3	4	3	3	5	2	3	3	2	4	4	5	5	4	3	3	3	5	3	3	4	4	2	2	3	3	4	4	4	5	4	4	4	4	3	5	5	4	4	3	5	4	3	1	4	2	4				
15	1	3	4	2	2	3	3	5	3	4	3	3	3	2	1	3	3	3	5	4	5	5	3	4	5	4	3	2	4	3	3	2	4	3	4	3	5	4	4	3	5	3	3	4	4	3	4	4	5	3	1	5	2	5						
16	2	3	4	3	3	2	4	2	3	4	5	5	1	4	4	3	5	5	4	5	5	5	5	5	4	3	3	5	4	4	1	4	4	3	3	3	4	5	4	4	4	4	4	4	4	4	3	4	4	3	4	3	1	5	2					
17	3	3	5	3	3	2	3	4	3	2	3	3	5	5	2	4	4	3	5	5	3	5	5	5	4	3	4	4	4	5	4	3	1	1	4	4	3	3	4	5	3	3	5	5	4	3	3	3	4	3	2	1	5	1	3					
18	1	3	2	3	2	3	3	4	3	1	5	4	4	4	1	1	3	3	3	4	4	5	3	4	5	4	4	4	3	3	3	4	3	3	1	3	3	2	4	4	4	4	4	4	5	4	4	4	4	4	5	4	5	2	2	5	1	4		
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21	3	2	4	4	3	2	3	4	4	3	3	4	4	4	2	4	4	4	3	5	5	5	4	5	1	3	3	4	3	5	3	5	3	4	3	4	3	3	4	3	3	4	2	4	4	4	4	4	4	2	3	3	1	3	1	3				
22	3	4	3	2	3	4	4	4	2	4	5	4	1	1	4	3	2	1	5	4	3	4	4	4	2	4	4	4	4	4	4	5	4	2	4	3	4	5	4	3	2	3	4	5	4	4	5	3	5	5	4	5	1	1	5	3	4			
23	1	1	4	1	3	2	1	5	3	4	5	5	4	2	1	4	3	3	4	4	4	4	4	4	2	4	4	3	3	2	3	4	4	4	4	4	4	4	4	5	2	4	5	4	4	4	4	4	5	5	4	5	4	1	5	1	4			
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25	3	4	3	1	3	4	2	5	5	2	4	5	1	2	1	3	3	2	3	4	3	4	4	4	5	3	2	5	5	5	5	3	2	4	4	2	4	3	4	4	5	3	4	4	4	4	4	4	1	4	1	4	1	5	3	5				
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27	1	2	1	5	5	2	1	5	5	5	1	1	5	1	3	1	3	5	5	1	5	5	1	4	1	1	1	1	5	4	1	1	2	5	5	4	1	1	1	1	5	5	4	5	5	3	2	4	2	1	5	3	1	5	2	5				
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29	1	3	1	1	4	2	1	3	3	3	2	1	1	2	2	3	2	1	1	4	2	4	4	2	5	1	2	1	2	3	3	4	2	3	4	4	3	5	5	5	4	4	4	4	4	3	4	1	3	3	2	4	3	1	5	3				
30	1	3	1	1	4	5	1	4	3	4	1	1	2	5	1	4	3	2	5	1	4	5	4	3	5	5	2	1	2	5	4	1	3	4	5	3	5	5	4	5	4	5	3	5	5	4	5	3	3	5	1	1	2	1	2	4	3	2	5	1
31	1	3	5	1	4	4	1	5	1	2	1	1	1	5	2	4	3	3	2	4	5	4	5	4	3	5	4	1	2	4	4	5	2	3	5	3	5	3	4	4	5	3	4	4	5	3	4	2	1	1	1	1	5	1	5	2	5			
32	1	4	4	4	3	2	1	3	1	4	1	2	2	3	1	3	1	2	3	5	1	4	5	5	5	5	2	1	4	5	5	1	4	3	5	3	5	4	4	5	1	4	5	4	5	4	5	1	2	4	2	1	2	2	5	2	2	4	1	
33	2	3	2	4	3	2	2	2	1	4	1	1	1	2	2	4	2	2	3	4	2	5	5	3	5	4	4	1	2	4	4	4	2	4	4	5	3	5	4	4	5	4	4	1	5	4	2	2	3	2	1	1	5	1	1	5	2	4		
34	2	3	5	5	4	2	1	2	1	5	1	2	2	5	1	4	3	3	1	5	1	5	5	4	5	5	2	1	5	5	5	1	3	5	3	5	3	5	5	5	5	5	5	2	5	5	3	1	1	1	3	2	5	2	1	5	1	4		
35	2	1	5	4	2	2	2	2	1	5	1																																																	

DETERMINANTS OF TRANSFER OF KNOWLEDGE																																																											
RESPONDENTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57		
48	2	1	1	3	1	4	2	2	1	3	1	1	1	1	5	1	1	3	2	2	3	1	2	1	5	1	1	1	1	4	1	5	5	1	3	3	3	2	5	3	4	3	3	4	1	3	3	2	4	4	3	1	2	3	1	2			
49	3	3	5	1	3	1	2	2	1	2	1	1	1	1	3	2	2	3	3	1	5	5	3	1	3	1	2	2	3	2	1	4	1	3	3	3	3	3	5	5	1	1	2	1	1	2	4	4	1	1	2	1	1	2	2	1			
50	1	1	5	5	3	2	3	4	2	1	1	1	1	4	3	1	1	3	4	3	5	1	1	1	3	3	1	1	1	3	1	3	2	1	1	3	1	2	5	4	4	5	2	1	1	1	1	1	4	4	2	1	1	2	1	1	2		
51	1	1	4	1	4	1	3	5	4	2	2	1	2	2	1	2	2	1	1	3	4	1	1	3	1	2	2	2	4	2	2	3	3	1	3	1	3	4	5	4	3	2	1	2	1	2	2	3	3	2	1	2	1	2	2	5			
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53	1	2	1	3	2	1	2	5	4	5	2	1	2	1	1	1	2	3	3	2	1	3	1	1	4	1	1	5	4	5	3	4	1	1	2	4	1	3	5	4	4	5	3	1	1	1	1	3	2	3	3	1	1	1	1	2	2		
54	1	1	1	2	1	2	2	3	5	1	1	1	2	1	1	1	1	2	3	3	2	1	1	2	4	2	1	3	2	1	1	1	1	1	3	2	2	1	1	3	5	4	1	2	1	2	1	3	4	1	1	2	1	3	1	5			
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56	2	2	1	1	1	3	2	2	1	4	1	2	1	1	1	1	3	2	3	1	3	2	2	3	5	2	2	1	5	3	1	1	2	1	1	4	2	2	1	1	1	4	4	2	2	2	4	4	3	1	4	2	2	2	1	1	5		
57	1	3	1	3	1	1	5	3	2	2	1	2	1	2	1	2	1	3	3	1	2	3	5	1	1	3	1	1	1	4	1	2	1	2	2	4	2	1	2	1	1	3	3	4	5	5	4	4	4	4	2	5	3	4	1	4	2	5	
58	2	3	3	2	1	2	1	3	1	1	3	2	3	2	1	3	2	1	3	1	1	2	1	3	2	2	1	4	1	2	3	3	1	1	3	3	2	3	1	1	4	1	3	2	1	4	4	1	1	5	3	4	3	1	4	3	5		
59	1	2	3	2	1	2	1	1	1	2	1	3	3	3	1	2	3	2	1	2	2	3	1	1	5	1	1	1	2	3	1	3	2	1	2	2	4	1	3	1	1	1	3	1	3	3	2	4	4	1	2	5	4	5	1	1	5	1	4
60	2	1	5	3	1	3	1	1	1	1	4	3	1	2	1	1	1	3	1	2	3	4	1	2	4	2	2	1	3	2	3	3	3	1	3	2	2	3	1	2	1	4	2	5	3	1	5	5	1	1	3	3	3	2	1	2	2	1	
61	1	2	1	3	1	2	1	4	2	1	4	4	1	1	2	1	1	1	1	3	2	5	1	1	1	3	1	2	4	1	3	3	1	2	1	3	4	1	1	1	2	1	1	3	4	2	4	1	2	2	3	3	1	2	1	2			
62	2	3	1	3	2	2	1	5	2	1	4	4	2	2	1	1	1	1	1	2	5	1	2	1	2	1	2	1	4	2	4	1	1	1	1	4	2	1	1	2	1	1	2	3	4	1	1	2	1	3	3	2	3	4	3	1	1	2	1
63	3	1	1	3	1	3	1	1	2	3	1	4	1	1	2	1	1	2	5	3	4	2	3	1	1	3	2	1	4	3	2	3	2	1	1	1	4	2	1	1	2	1	1	1	1	2	1	1	1	1	2	4	3	4	3	2	3	1	2
64	3	3	1	4	2	1	2	3	3	1	3	3	3	2	3	1	1	1	1	4	1	5	1	2	2	2	2	1	4	2	4	1	3	1	2	4	2	1	1	2	1	2	2	2	1	1	1	4	1	4	3	4	3	3	1	2	1		
65	1	3	3	2	1	1	1	2	1	2	2	4	1	3	1	1	2	2	5	1	4	2	3	1	4	5	2	4	1	3	2	1	3	1	5	4	1	2	1	4	1	2	2	1	2	1	4	2	3	2	5	3	2	3	1	2			
66	3	1	5	3	2	1	2	3	3	1	3	2	2	3	1	2	5	1	3	1	1	1	2	2	3	4	3	4	2	5	1	3	1	2	4	2	1	1	2	4	2	3	2	2	3	2	4	1	3	2	1	4	3	3	4	1	1		
67	3	1	4	4	1	1	1	3	4	2	5	3	4	1	1	1	2	4	4	1	2	2	3	1	1	1	1	4	3	4	4	3	1	1	3	3	2	2	3	4	1	3	3	1	1	1	5	2	5	3	2	4	3	3	1	2			
68	1	3	3	3	2	1	2	1	4	1	2	4	2	1	1	2	1	3	2	1	1	4	2	2	1	1	1	3	1	4	1	1	1	2	1	2	1	1	3	2	1	3	2	1	2	4	3	5	3	2	1	3	1	2	3				
69	1	3	2	1	2	1	1	2	3	2	4	4	1	1	1	1	2	1	1	2	2	4	1	1	1	1	1	1	1	2	1	3	1	2	1	1	1	1	1	2	1	1	4	3	1	1	2	3	3	1	3	3	2	3	1	1	1	3	
70	1	3	1	1	1	2	2	2	1	3	3	5	4	2	1	1	2	4	1	1	2	1	3	5	2	1	3	2	2	1	2	2	2	1	2	1	2	2	1	1	1	2	5	4	2	2	2	4	1	1	1	3	1	3	1	2	1	4	
71	1	3	1	1	1	3	1	1	2	5	3	5	5	4	1	2	1	4	2	1	1	2	3	4	3	1	4	1	4	2	1	1	2	2	3	2	1	1	2	1	1	3	5	3	4	3	2	1	4	1	1	1	2	2	1	1	2	1	
72	1	1	1	1	4	1	2	2	3	3	4	5	4	2	1	1	2	4	1	4	1	3	4	5	2	2	4	2	4	1	1	3	3	1	1	1	3	2	3	1	1	1	5	4	2	3	3	5	4	2	1	1	1	3	2	2	1	1	
73	1	3	2	4	3	1	3	4	3	4	5	3	3	2	3	4	1	4	1	4	1	2	5	5	3	1	2	1	4	2	2	1	2	1	2	1	2	1	4	1	1	1	1	4	4	1	5	3	1	4	1	2	2	3	1	1	1	2	1
74	2	1	5	5	2	2	1	5	5	5	5	3	1	1	3	4	2	5	1	5	5	5	3	2	2	2	2	4	1	1	3	1	1	1	1	2	5	1	1	1	1	1	5	4	1	3	4	2	4	2	2	1	1	1	2	2	1	1	
75	2	1	5	4	1	1	1	4	5	5	5	3	5	3	2	3	5	2	1	2	5	4	5	2	1	4	1	5	2	2	3	4	2	2	2	1	4	1	1	2	2	1	4	2	3	4	3	3	5	2	3	4	1	1	2	2			
76	1	1	5	5	1	2	2	2	5	5	5	5	5	1	4	4	1	5	1	4	5	5	5	5	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	1	1	5	2	1	1	2	1	1	1	2	1	2		
77	3	2	3	5	3	1	4	1	4	3	5	3	4	4	2	2	3	4	2	3	2	5	4	5	2	1	3	3	1	4	2	2	3	2	2	2	2	1	1	1	2	2	2	4	2	5	1	1	1	5	2	2	1	1	1	1	1	1	
78	3	3	3	3	2	3	1	3	4	4	5	5	5	3	1	2	4	5	1	4	5	1	4	5	1	2	5	4	1	5	2	1	1	3	3	3	1	1	1	2	1	1	1	3	1	2	5	2	1	2	2	1	1	2	2	1	2	2	
79	2	2	1	4	1	2	2	4	3	4	5	4	3	2	2	4	3	2	4	2	1	5	5	2	3	5	3	3	4	3	2	1	3	3	2	2	1	2	1	4	2	2	4	2	2	2	3	2	1	5	2	2	2	3	2	1	2		
80	2	2	1	4	2	4	1	3	2	3	3	2	4	3	1	4	4	2	3	3	1	3	3	4	3	3	3	3	3	2	5	3	3	2	1	5	1	1	1	1	1	4	5	5	3	2	3	5	1	1	3	2	4	3	1	1	1	2	
81	3	3	1	1	1	2	2	5	5	2	5	5	4	3	1	4	4	3	5	2	2	5	5	2	3	5	5	1	5	5	1	1	1	4	1	2	2	2	3	1	5	5	4	3</															

244.67	ARITHMETIC MEAN
41.96	STANDARD DEVIATION
20.98	1/2 STANDARD DEVIATION
265.65	ARITHMETIC MEAN 1/2 STANDARD ST.

Source: own study.

Annexe No. 10

Results – stage I.B

RESPONDENTS	FACTORS AFFECTING SUCCESS OF THE MERGERS AND ACQUISITION PROCESSES							
	1	2	3	4	5	6	7	8
1	2	5	1	2	5	1	5	4
2	4	4	2	4	5	4	4	2
3	4	2	2	4	4	4	3	2
4	4	2	3	3	4	4	4	1
5	4	3	2	4	5	4	5	1
6	2	2	1	2	5	1	5	2
7	1	2	1	2	5	1	5	4
8	1	1	3	4	5	5	3	5
9	1	1	2	3	4	4	4	4
10	3	1	3	2	4	4	3	4
11	4	3	5	3	4	4	4	3
12	3	4	2	3	4	3	2	4
13	4	5	1	4	5	3	5	2
14	1	5	2	1	4	2	1	1
15	4	5	1	4	5	4	5	4
16	3	3	5	3	3	3	4	4
17	4	5	4	4	3	3	3	3
18	3	3	5	5	5	5	5	1
19	3	5	5	4	5	4	5	1
20	3	4	5	4	4	5	4	2
21	3	4	5	3	4	3	2	4
22	3	5	3	3	5	4	4	3
23	3	5	4	1	4	5	4	4
24	5	3	5	4	4	4	4	4
25	5	4	4	4	5	4	3	4
26	5	4	4	1	2	5	5	3
27	4	5	4	1	2	5	4	4
28	4	5	4	1	3	4	4	3
29	4	3	5	3	3	5	4	3

RESPONDENTS	FACTORS AFFECTING SUCCESS OF THE MERGERS AND ACQUISITION PROCESSES							
	1	2	3	4	5	6	7	8
30	2	4	5	3	3	2	2	2
31	4	3	3	2	5	5	3	2
32	3	4	2	1	3	3	3	2
33	3	2	3	3	4	4	3	4
34	1	2	3	1	5	1	1	2
35	1	1	2	1	3	1	1	2
36	3	1	2	1	4	4	3	4
37	2	3	2	2	3	4	1	3
38	2	4	3	3	4	4	5	3
39	4	5	3	2	3	4	4	3
40	2	5	1	1	4	4	1	1
41	2	1	1	2	3	4	3	2
42	2	3	3	1	3	4	5	4
43	4	5	3	2	1	3	1	2
44	4	1	5	1	2	4	4	1
45	2	3	4	1	4	2	2	3
46	2	4	4	2	3	1	4	3
47	2	3	5	2	3	4	3	3
48	3	1	2	3	4	1	1	4
49	4	5	4	3	3	2	2	3
50	1	3	5	4	3	2	1	4
51	2	1	5	3	3	2	4	3
52	2	3	4	3	3	5	2	3
53	3	5	4	1	2	4	2	4
54	3	1	4	1	2	4	5	3
55	3	2	5	3	4	3	2	4
56	2	2	5	2	5	2	4	3
57	3	3	5	2	5	3	1	4
58	4	3	4	2	2	2	2	2

RESPONDENTS	FACTORS AFFECTING SUCCESS OF THE MERGERS AND ACQUISITION PROCESSES							
	1	2	3	4	5	6	7	8
59	4	5	5	3	2	2	1	3
60	3	5	4	3	4	3	2	3
61	2	4	4	2	3	3	4	4
62	4	4	4	2	2	3	3	2
63	3	4	3	3	5	1	2	4
64	2	5	5	3	2	1	4	3
65	2	5	3	2	4	3	5	4
66	3	4	4	2	2	3	2	3
67	2	5	4	3	4	1	2	5
68	4	4	4	5	4	4	5	5
69	2	4	4	2	3	1	4	3
70	5	3	5	2	2	3	3	2
71	3	2	2	3	2	3	1	4
72	4	2	4	3	3	3	2	2
73	2	3	2	4	2	2	2	4
74	4	5	1	3	5	1	2	3
75	2	3	2	3	1	2	4	3
76	3	5	1	1	1	2	2	4
77	3	4	3	1	1	2	2	3
78	3	5	2	3	4	3	2	2
79	2	4	2	4	2	1	4	2
80	3	4	2	2	1	3	1	2
81	2	4	3	3	2	1	1	2
82	4	2	3	3	1	1	1	2
83	3	2	4	2	4	3	1	2
84	2	2	4	1	3	1	4	4
85	1	2	4	1	2	1	3	2
86	3	4	3	3	1	2	2	4
S	249	291	285	216	288	254	259	255

262.13	ARITHMETIC MEAN
25.22	STANDARD DEVIATION
12.61	1/2 STANDARD DEVIATION
274.74	ARITHMETIC MEAN 1/2 STANDARD ST.

Source: own study.

Annexe No. 11

Raw results stage II.A

EXPERTS	1	2	3	4	5	6	7	8	9	10	11	12	MOST COMMON	
ASSIGNMENT OF KNOWLEDGE TRANSFER DETERMINANTS TO KNOWLEDGE FACTOR GROUPS	1	1	1	1	2	2	3	1	2	1	4	1	1	1
	2	2	3	4	4	4	4	2	2	4	4	2	4	4
	3	4	3	3	3	3	4	3	3	3	4	4	3	3
	4	4	3	3	4	3	3	4	1	3	3	2	3	3
	5	2	3	3	2	3	2	3	3	3	1	3	2	3
	6	3	3	3	3	2	3	2	3	3	1	3	3	3
	7	3	3	2	3	3	3	3	2	1	3	3	3	3
	8	1	1	2	1	1	1	1	1	1	2	1	1	1
	9	2	1	1	2	3	1	1	1	1	1	1	1	1
	10	1	1	1	3	1	1	1	1	2	1	1	1	1
	11	2	1	2	2	2	3	4	2	2	1	2	2	2
	12	1	1	1	1	1	1	4	1	1	1	1	4	1
	13	2	3	2	2	4	1	2	2	2	2	4	2	2
	14	1	1	1	3	2	1	1	1	1	3	2	1	1
	15	3	2	2	1	3	2	2	2	1	2	2	2	2
	16	1	2	1	1	2	1	3	1	1	1	2	1	1
	17	4	3	3	3	4	3	2	3	2	3	3	2	3
	18	1	4	1	1	4	2	1	2	1	1	2	3	1
	19	3	3	2	4	3	4	3	3	3	2	3	3	3
	20	3	2	3	2	1	2	2	2	2	3	2	3	2
	21	4	3	4	2	4	3	1	4	4	4	1	4	4
	22	1	4	2	4	4	3	4	2	4	4	3	4	4
	23	3	2	3	1	3	1	3	3	1	3	1	3	3
	24	3	4	3	3	4	1	3	3	2	3	3	2	3
	25	1	3	4	3	3	4	1	4	3	3	2	3	3
	26	3	2	2	3	2	2	1	2	2	1	2	2	2
	27	2	3	1	1	3	3	1	3	1	3	3	3	3
	28	3	3	3	2	3	2	3	3	4	3	3	2	3
	29	2	2	4	2	1	2	4	2	1	2	2	2	2
	30	4	2	2	1	2	1	2	2	2	1	4	2	2
	31	1	3	1	4	1	1	4	1	4	1	1	1	1
	32	3	4	4	3	4	1	4	4	3	1	4	1	4

1	x1
2	x2
3	x3
4	x4

Source: own study.

Annexe No. 12

Raw results stage II.B

EXPERTS	1	2	3	4	5	6	7	8	9	10	11	12	MOST COMMON
SPECIALISED METHODS SUITABLE FOR KNOWLEDGE TRANSFER ANALYSIS	1	1	1	1	0	1	0	1	1	1	1	1	1
	2	0	1	0	0	0	1	0	1	0	0	0	0
	3	1	1	1	1	1	1	1	1	0	1	1	0
	4	0	0	0	1	0	0	1	1	1	0	1	0
	5	0	1	1	1	1	1	1	1	1	1	1	1
	6	0	1	1	1	0	0	0	0	1	0	0	0
	7	1	0	0	0	0	0	1	0	1	1	0	1
	8	1	1	0	1	1	1	1	1	1	1	1	1
	9	0	1	1	0	0	0	1	1	0	1	0	1
	10	1	1	1	1	1	1	1	0	1	1	0	1
	11	0	1	1	1	1	1	0	1	1	1	1	1
	12	1	1	1	1	1	1	0	1	1	1	0	1
	13	1	0	0	0	0	1	1	0	1	0	1	0
	14	1	1	1	0	0	0	0	0	1	0	1	0

1 YES
0 NO

Source: own study.

Annexe No. 13

Results – stage III.A

Raw results of stage III.A (CONSOLIDATION 1)

Acquiring company		Possession of specific type of knowledge			
CONSOLIDATION 1		x1	x2	x3	x4
EXPERTS	1	YES	NO	YES	YES
	2	YES	YES	YES	NO
	3	YES	YES	YES	NO
	4	YES	NO	NO	YES
	5	YES	NO	NO	YES
	6	NO	NO	YES	YES
	7	NO	YES	YES	YES
	8	NO	YES	YES	YES
	9	NO	YES	YES	YES
	10	NO	NO	NO	NO
	11	NO	NO	NO	NO
	12	NO	NO	YES	YES
The most common answer:		NO	NO	YES	YES
Percentage of answers "YES"		41.67%	41.67%	66.67%	66.67%

Acquired company		Possession of specific type of knowledge			
CONSOLIDATION 1		x1	x2	x3	x4
EXPERTS	1	YES	YES	YES	YES
	2	YES	NO	YES	NO
	3	NO	YES	NO	NO
	4	NO	YES	NO	YES
	5	NO	NO	NO	YES
	6	NO	NO	YES	YES
	7	NO	YES	NO	YES
	8	YES	YES	NO	YES
	9	YES	YES	YES	YES
	10	NO	YES	NO	NO
	11	NO	NO	NO	NO
	12	NO	NO	YES	YES
The most common answer:		NO	YES	NO	YES
Percentage of answers "YES"		33.33%	58.33%	41.67%	66.67%

Identical answers			
1 - identical 0 - different			
x1	x2	x3	x4
1	0	1	1
1	0	1	1
0	1	0	1
0	0	1	1
0	1	1	1
1	1	1	1
1	1	0	1
0	1	0	1
0	1	1	1
1	0	1	1
1	1	1	1
1	1	1	1

Raw results of stage III.A (CONSOLIDATION 2)

Acquiring company		Possession of specific type of knowledge			
CONSOLIDATION 2		x1	x2	x3	x4
EXPERTS	1	YES	YES	YES	NO
	2	YES	NO	NO	NO
	3	NO	YES	YES	YES
	4	NO	YES	YES	NO
	5	NO	NO	NO	YES
	6	NO	NO	NO	NO
	7	NO	NO	YES	YES
	8	YES	YES	NO	NO
	9	YES	YES	YES	NO
	10	NO	YES	YES	YES
	11	NO	NO	YES	NO
	12	NO	YES	NO	NO
The most common answer:		NO	YES	YES	NO
Percentage of answers "YES"		33.33%	58.33%	58.33%	33.33%

Acquired company		Possession of specific type of knowledge			
CONSOLIDATION 2		x1	x2	x3	x4
EXPERTS	1	YES	NO	YES	YES
	2	YES	YES	YES	NO
	3	YES	YES	YES	NO
	4	YES	NO	NO	YES
	5	YES	NO	NO	YES
	6	NO	NO	YES	YES
	7	NO	YES	YES	YES
	8	NO	YES	YES	NO
	9	NO	YES	YES	NO
	10	NO	NO	NO	NO
	11	NO	NO	NO	NO
	12	NO	NO	YES	NO
The most common answer:		NO	NO	YES	NO
Percentage of answers "YES"		41.67%	41.67%	66.67%	41.67%

Identical answers			
x1	x2	x3	x4
1	0	1	0
1	0	0	1
0	1	1	0
0	0	0	0
0	1	1	1
1	1	0	0
1	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	1	0	1
1	0	0	1

Raw results of stage III.A (CONSOLIDATION 3)

Acquiring company

CONSOLIDATION 3		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	YES	NO	YES	NO
	2	YES	YES	NO	YES
	3	YES	YES	YES	YES
	4	YES	NO	YES	NO
	5	YES	NO	YES	YES
	6	NO	NO	NO	NO
	7	NO	YES	NO	YES
	8	NO	YES	NO	YES
	9	NO	YES	NO	NO
	10	NO	NO	NO	NO
	11	NO	NO	YES	NO
	12	NO	NO	NO	NO

The most common answer:

NO NO NO NO

Percentage of answers
"YES"

41.67% 41.67% 41.67% 41.67%

Acquired company

CONSOLIDATION 3		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	NO	YES	YES	NO
	2	YES	NO	NO	NO
	3	YES	YES	NO	YES
	4	NO	YES	YES	NO
	5	YES	YES	YES	YES
	6	NO	NO	YES	NO
	7	YES	NO	NO	YES
	8	YES	NO	NO	YES
	9	NO	NO	NO	YES
	10	NO	NO	NO	NO
	11	NO	YES	NO	NO
	12	NO	NO	NO	NO

The most common answer:

NO NO NO NO

Percentage of answers
"YES"

41.67% 41.67% 33.33% 41.67%

Identical answers			
x1	x2	x3	x4
0	0	1	1
1	0	1	0
1	1	0	1
0	0	1	1
1	0	1	1
1	1	0	1
0	0	1	1
0	0	1	1
1	0	1	0
1	1	1	1
1	0	0	1
1	1	1	1

Raw results of stage III.A (CONSOLIDATION 4)

Acquiring company

CONSOLIDATION 4		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	NO	YES	NO	YES
	2	YES	NO	YES	NO
	3	YES	YES	YES	NO
	4	NO	YES	NO	NO
	5	NO	YES	NO	YES
	6	NO	NO	NO	NO
	7	YES	NO	YES	NO
	8	YES	NO	YES	NO
	9	YES	NO	YES	YES
	10	NO	NO	YES	YES
	11	NO	YES	YES	YES
	12	NO	NO	YES	NO

The most common answer:

NO NO YES NO

Percentage of answers
"YES"

41.67% 41.67% 66.67% 41.67%

Acquired company

CONSOLIDATION 4		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	YES	NO	YES	NO
	2	YES	YES	NO	YES
	3	YES	YES	YES	YES
	4	YES	NO	YES	NO
	5	YES	NO	YES	YES
	6	NO	NO	NO	NO
	7	NO	YES	NO	YES
	8	NO	YES	NO	YES
	9	NO	YES	NO	NO
	10	NO	NO	NO	NO
	11	NO	NO	YES	NO
	12	NO	NO	NO	NO

The most common answer:

NO NO NO NO

Percentage of answers
"YES"

41.67% 41.67% 41.67% 41.67%

Identical answers			
x1	x2	x3	x4
0	0	0	0
1	0	0	0
1	1	1	0
0	0	0	1
0	0	0	1
1	1	1	1
0	0	0	0
0	0	0	0
0	0	0	0
1	1	0	0
1	0	1	0
1	1	0	1

Raw results of stage III.A (CONSOLIDATION 5)

Acquiring company

CONSOLIDATION 5		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	YES	NO	YES	NO
	2	NO	YES	NO	YES
	3	NO	YES	YES	YES
	4	YES	NO	YES	YES
	5	YES	NO	YES	YES
	6	NO	NO	NO	NO
	7	NO	YES	NO	NO
	8	NO	YES	NO	YES
	9	NO	NO	NO	NO
	10	NO	NO	NO	NO
	11	NO	NO	YES	NO
	12	NO	NO	NO	NO

The most common answer: NO NO NO NO
Percentage
*YES 25.00% 33.33% 41.67% 41.67%

Acquired company

CONSOLIDATION 5		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	YES	YES	NO	NO
	2	YES	NO	YES	YES
	3	YES	YES	YES	YES
	4	YES	YES	NO	NO
	5	YES	YES	NO	YES
	6	NO	NO	NO	NO
	7	NO	NO	YES	YES
	8	NO	NO	YES	YES
	9	NO	NO	YES	NO
	10	NO	NO	NO	NO
	11	NO	YES	NO	NO
	12	NO	NO	NO	NO

The most common answer: NO NO NO NO
Percentage
*YES 41.67% 41.67% 41.67% 41.67%

Identical answers			
x1	x2	x3	x4
1	0	0	1
0	0	0	1
0	1	1	1
1	0	0	0
1	0	0	1
1	1	1	1
1	0	0	0
1	0	0	1
1	1	0	1
1	1	1	1
1	0	0	1
1	1	1	1

Raw results of stage III.A (CONSOLIDATION 6)

Acquiring company

CONSOLIDATION 6		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	YES	YES	NO	NO
	2	YES	NO	YES	YES
	3	YES	YES	YES	YES
	4	YES	YES	NO	NO
	5	YES	YES	NO	YES
	6	NO	NO	NO	NO
	7	NO	NO	YES	YES
	8	NO	NO	YES	YES
	9	NO	NO	YES	NO
	10	NO	NO	NO	NO
	11	NO	YES	NO	NO
	12	NO	NO	NO	NO

The most common answer: NO NO NO NO
Percentage of answers
*YES 41.67% 41.67% 41.67% 41.67%

Acquired company

CONSOLIDATION 6		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	NO	NO	YES	NO
	2	YES	YES	NO	YES
	3	YES	YES	NO	YES
	4	YES	NO	NO	NO
	5	YES	YES	YES	NO
	6	NO	NO	YES	NO
	7	NO	NO	YES	YES
	8	YES	NO	NO	YES
	9	NO	NO	NO	YES
	10	NO	NO	NO	NO
	11	NO	NO	YES	NO
	12	NO	NO	NO	NO

The most common answer: NO NO NO NO
Percentage of answers
*YES 41.67% 25.00% 41.67% 41.67%

Identical answers			
x1	x2	x3	x4
0	0	0	1
1	0	0	1
1	1	0	1
1	0	1	1
1	1	0	0
1	1	0	1
1	1	1	1
0	1	0	1
1	1	0	0
1	1	1	1
1	0	0	1
1	1	1	1

Raw results of stage III.A (CONSOLIDATION 7)

Acquiring company

CONSOLIDATION 7		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	NO	NO	YES	NO
	2	YES	YES	NO	YES
	3	YES	YES	NO	YES
	4	YES	NO	NO	NO
	5	YES	YES	YES	NO
	6	NO	NO	YES	NO
	7	NO	NO	YES	YES
	8	YES	NO	NO	YES
	9	NO	NO	NO	YES
	10	NO	NO	NO	NO
	11	NO	NO	YES	NO
	12	NO	NO	NO	NO

The most common answer: NO NO NO NO
Percentage of answers
"YES" 41.67% 25.00% 41.67% 41.67%

Acquired company

CONSOLIDATION 7		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	YES	YES	NO	NO
	2	NO	NO	YES	YES
	3	YES	YES	YES	YES
	4	YES	YES	NO	NO
	5	YES	YES	NO	YES
	6	NO	NO	NO	NO
	7	NO	NO	YES	YES
	8	NO	NO	YES	YES
	9	NO	NO	YES	NO
	10	NO	NO	NO	NO
	11	NO	YES	NO	NO
	12	NO	NO	NO	NO

The most common answer: NO NO NO NO
Percentage of answers
"YES" 33.33% 41.67% 41.67% 41.67%

Identical answers			
x1	x2	x3	x4
0	0	0	1
0	0	0	1
1	1	0	1
1	0	1	1
1	1	0	0
1	1	0	1
1	1	1	1
0	1	0	1
1	1	0	0
1	1	1	1
1	0	0	1
1	1	1	1

Raw results of stage III.A (CONSOLIDATION 8)

Acquiring company

CONSOLIDATION 8		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	NO	NO	YES	YES
	2	YES	YES	YES	YES
	3	YES	YES	YES	YES
	4	YES	NO	YES	YES
	5	YES	YES	NO	NO
	6	NO	YES	YES	NO
	7	NO	YES	YES	YES
	8	YES	YES	NO	YES
	9	YES	YES	NO	YES
	10	YES	NO	NO	YES
	11	YES	NO	YES	YES
	12	NO	NO	NO	NO

The most common answer: YES YES YES YES
Percentage of answers
"YES" 66.67% 58.33% 58.33% 75.00%

Acquired company

CONSOLIDATION 8		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	NO	NO	YES	NO
	2	YES	YES	NO	YES
	3	YES	YES	NO	YES
	4	YES	NO	NO	NO
	5	YES	YES	NO	NO
	6	NO	NO	YES	NO
	7	NO	NO	YES	YES
	8	YES	NO	NO	NO
	9	NO	NO	NO	NO
	10	NO	NO	NO	NO
	11	NO	NO	YES	NO
	12	NO	NO	NO	NO

The most common answer: NO NO NO NO
Percentage of answers
"YES" 41.67% 25.00% 33.33% 25.00%

Identical answers			
x1	x2	x3	x4
1	1	1	0
1	1	0	1
1	1	0	1
1	1	0	0
1	1	1	1
1	0	1	1
1	0	1	1
0	0	1	0
0	1	1	0
0	1	1	0
1	1	1	1

Raw results of stage III.A (CONSOLIDATION 9)

Acquiring company

CONSOLIDATION 9		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	NO	NO	YES	YES
	2	YES	YES	YES	YES
	3	NO	YES	YES	YES
	4	YES	NO	YES	YES
	5	YES	YES	NO	NO
	6	NO	YES	YES	NO
	7	NO	YES	YES	YES
	8	YES	YES	NO	YES
	9	YES	YES	NO	NO
	10	YES	NO	NO	NO
	11	YES	NO	YES	YES
	12	NO	NO	YES	NO

The most common answer:

YES YES YES YES

Percentage of answers

"YES"

58.33% 58.33% 66.67% 58.33%

Acquired company

CONSOLIDATION 9		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	NO	NO	YES	NO
	2	YES	YES	NO	YES
	3	YES	YES	NO	YES
	4	NO	NO	NO	NO
	5	YES	YES	NO	NO
	6	NO	YES	YES	NO
	7	NO	YES	YES	NO
	8	YES	NO	NO	NO
	9	YES	NO	NO	NO
	10	NO	NO	NO	NO
	11	NO	NO	YES	NO
	12	NO	NO	NO	NO

The most common answer:

NO NO NO NO

Percentage of answers

"YES"

41.67% 41.67% 33.33% 16.67%

Identical answers			
x1	x2	x3	x4
1	1	1	0
1	1	0	1
0	1	0	1
0	1	0	0
1	1	1	1
1	1	1	1
1	1	1	0
1	0	1	0
1	0	1	1
0	1	1	1
0	1	1	0
1	1	0	1

Raw results of stage III.A (CONSOLIDATION 10)

Acquiring company

CONSOLIDATION 10		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	NO	YES	YES	YES
	2	YES	YES	YES	YES
	3	NO	YES	YES	YES
	4	YES	NO	YES	YES
	5	YES	YES	NO	NO
	6	NO	YES	YES	NO
	7	NO	YES	YES	NO
	8	YES	YES	NO	NO
	9	NO	YES	NO	NO
	10	NO	NO	NO	NO
	11	YES	NO	YES	YES
	12	NO	NO	YES	NO

The most common answer:

NO YES YES NO

Percentage of answers

"YES"

41.67% 66.67% 66.67% 41.67%

Acquired company

CONSOLIDATION 10		Possession of specific type of knowledge			
		x1	x2	x3	x4
EXPERTS	1	NO	YES	YES	YES
	2	YES	YES	NO	YES
	3	NO	YES	NO	YES
	4	YES	NO	NO	YES
	5	YES	YES	NO	NO
	6	YES	YES	YES	NO
	7	NO	YES	YES	NO
	8	YES	YES	NO	NO
	9	NO	YES	NO	NO
	10	NO	NO	NO	NO
	11	YES	NO	YES	YES
	12	NO	NO	YES	NO

The most common answer:

NO YES NO NO

Percentage of answers

"YES"

50.00% 66.67% 41.67% 41.67%

Identical answers			
x1	x2	x3	x4
1	1	1	1
1	1	0	1
1	1	0	1
1	1	0	1
1	1	1	1
0	1	1	1
1	1	1	1
1	1	1	1
1	1	1	1
1	1	1	1
1	1	1	1
1	1	1	1
1	1	1	1

Raw results of stage III.A (CONSOLIDATION 11)

Acquiring company

EXPERTS	Possession of specific type of knowledge				
	CONSOLIDATION 11	x1	x2	x3	x4
	1	NO	YES	YES	YES
	2	YES	YES	YES	NO
	3	NO	YES	YES	NO
	4	YES	NO	YES	YES
	5	YES	YES	NO	YES
	6	NO	YES	YES	NO
	7	NO	YES	YES	NO
	8	YES	YES	NO	NO
	9	YES	YES	NO	NO
	10	YES	NO	NO	NO
	11	YES	NO	YES	YES
	12	NO	NO	YES	NO

The most common answer:

YES YES YES NO

Percentage of answers
"YES"

58.33% 66.67% 66.67% 33.33%

Acquired company

EXPERTS	Possession of specific type of knowledge				
	CONSOLIDATION 11	x1	x2	x3	x4
	1	NO	YES	YES	YES
	2	YES	NO	NO	NO
	3	NO	NO	NO	YES
	4	NO	NO	NO	YES
	5	YES	YES	NO	NO
	6	YES	YES	NO	NO
	7	NO	NO	NO	NO
	8	YES	NO	NO	NO
	9	NO	NO	NO	NO
	10	NO	NO	NO	NO
	11	YES	NO	YES	YES
	12	NO	NO	NO	NO

The most common answer:

NO NO NO NO

Percentage of answers
"YES"

41.67% 25.00% 16.67% 33.33%

Identical answers				
x1	x2	x3	x4	
1	1	1	1	1
1	0	0	0	1
1	0	0	0	0
0	1	0	0	1
1	1	1	1	0
0	1	0	0	1
1	0	0	0	1
1	0	1	1	1
0	0	1	1	1
0	1	1	1	1
1	1	1	1	1
1	1	0	1	1

SUMMARY TABLES

ACQUIRING COMPANIES		KNOWLEDGE FACTOR GROUPS				
		x1	x2	x3	x4	
11 CONSOLIDATIONS	1	0	0	1	1	1
	2	0	1	1	0	0
	3	0	0	0	0	0
	4	0	0	1	0	0
	5	0	0	0	0	0
	6	0	0	0	0	0
	7	0	0	0	0	0
	8	1	1	1	1	1
	9	1	1	1	1	1
	10	0	1	1	0	0
	11	1	1	1	0	0
MOST COMMON		0	0	1	0	
1 – YES						
0 – NO						

ACQUIRED COMPANIES		KNOWLEDGE FACTOR GROUPS				
		x1	x2	x3	x4	
11 CONSOLIDATIONS	1	0	1	0	1	1
	2	0	0	1	0	0
	3	0	0	0	0	0
	4	0	0	0	0	0
	5	0	0	0	0	0
	6	0	0	0	0	0
	7	0	0	0	0	0
	8	0	0	0	0	0
	9	0	0	0	0	0
	10	0	1	0	0	0
	11	0	0	0	0	0
MOST COMMON		0	0	0	0	
1 – YES						
0 – NO						

SUMMARY TABLES

ACQUIRING COMPANIES		KNOWLEDGE FACTOR GROUPS				
		x1	x2	x3	x4	
11 CONSOLIDATIONS	1	41.67%	41.67%	66.67%	66.67%	
	2	33.33%	58.33%	58.33%	33.33%	
	3	41.67%	41.67%	41.67%	41.67%	
	4	41.67%	41.67%	66.67%	41.67%	
	5	25.00%	33.33%	41.67%	41.67%	
	6	41.67%	41.67%	41.67%	41.67%	
	7	41.67%	25.00%	41.67%	41.67%	
	8	41.67%	25.00%	41.67%	41.67%	
	9	58.33%	58.33%	66.67%	58.33%	
	10	41.67%	66.67%	66.67%	41.67%	
	11	58.33%	66.67%	66.67%	33.33%	
Average of answers "YES"		42.42%	45.45%	54.55%	43.94%	

ACQUIRED COMPANIES		KNOWLEDGE FACTOR GROUPS				
		x1	x2	x3	x4	
11 CONSOLIDATIONS	1	33.33%	58.33%	41.67%	66.67%	
	2	41.67%	41.67%	66.67%	41.67%	
	3	41.67%	41.67%	33.33%	41.67%	
	4	41.67%	41.67%	41.67%	41.67%	
	5	41.67%	41.67%	41.67%	41.67%	
	6	41.67%	25.00%	41.67%	41.67%	
	7	33.33%	41.67%	41.67%	41.67%	
	8	33.33%	41.67%	41.67%	41.67%	
	9	41.67%	41.67%	33.33%	16.67%	
	10	50.00%	66.67%	41.67%	41.67%	
	11	41.67%	25.00%	16.67%	33.33%	
Average of answers "YES"		40.15%	42.42%	40.15%	40.91%	

Source: own study.

Results – stage III.B

Annexe No. 14

Raw results of stage III.B (CONSOLIDATION 1)

Acquiring company

CONSOLIDATION 1		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	1	3	2	3
	2	3	1	2	3
	3	5	2	1	2
	4	4	2	1	4
	5	6	5	2	5
	6	2	3	2	4
	7	1	2	1	4
	8	3	2	1	4
	9	4	2	2	5
	10	3	3	1	3
	11	2	1	1	4
	12	1	2	1	4
mean		2.92	2.33	1.42	3.75

Acquired company

CONSOLIDATION 1		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	1	2	4	2
	2	2	2	5	1
	3	4	1	4	1
	4	3	1	5	3
	5	3	2	5	1
	6	1	2	6	2
	7	1	1	6	1
	8	2	1	7	1
	9	4	2	5	2
	10	1	1	7	1
	11	1	1	6	1
	12	2	1	5	1
mean		2.08	1.42	5.42	1.42

x1acquired-x1acquiring

Difference (distance in assessment)			
x1	x2	x3	x4
0	-1	2	-1
-1	1	3	-2
-1	-1	3	-1
-1	-1	4	-1
-3	-3	3	-4
-1	-1	4	-2
0	-1	5	-3
-1	-1	6	-3
0	0	3	-3
-2	-2	6	-2
-1	0	5	-3
1	-1	4	-3

Raw results of stage III.B (CONSOLIDATION 2)

Acquiring company

CONSOLIDATION 2		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	1	1	1	3
	2	3	1	3	3
	3	3	1	5	2
	4	4	2	4	4
	5	4	2	6	5
	6	2	1	2	3
	7	1	2	1	4
	8	3	1	3	4
	9	2	2	4	5
	10	3	2	3	3
	11	2	1	2	4
	12	1	1	1	4
mean		2.42	1.42	2.92	3.67

Acquired company

CONSOLIDATION 2		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	2	1	2	2
	2	1	1	1	3
	3	1	1	1	5
	4	1	2	1	4
	5	2	2	2	6
	6	1	1	1	2
	7	2	2	2	1
	8	1	1	1	3
	9	2	2	2	3
	10	2	2	1	3
	11	1	1	2	2
	12	1	3	1	1
mean		1.42	1.58	1.42	2.92

Difference (distance in assessment)			
x1	x2	x3	x4
1	0	1	-1
-2	0	-2	0
-2	0	-4	3
-3	0	-3	0
-2	0	-4	1
-1	0	-1	-1
1	0	1	-3
-2	0	-2	-1
0	0	-2	-2
-1	0	-2	0
-1	0	0	-2
0	2	0	-3

Acquiring company

CONSOLIDATION 3		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	1	1	1	3
	2	3	1	3	3
	3	3	1	5	2
	4	3	1	4	4
	5	4	2	6	5
	6	2	1	2	3
	7	1	2	1	4
	8	3	1	3	4
	9	2	2	4	5
	10	4	2	3	3
	11	2	2	2	4
	12	1	1	1	4
mean		2.42	1.42	2.92	3.67

Wyniki surowe etapu III.B (POŁĄCZENIE 3)

Acquired company

CONSOLIDATION 3		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	2	1	3	1
	2	1	1	2	1
	3	1	1	5	1
	4	1	2	4	2
	5	2	2	5	2
	6	1	1	2	1
	7	2	2	1	2
	8	1	1	3	1
	9	2	2	3	2
	10	2	2	3	2
	11	1	1	2	1
	12	1	3	1	2
mean		1.42	1.58	2.83	1.5

Difference (distance in assessment)			
x1	x2	x3	x4
1	0	2	-2
-2	0	-1	-2
-2	0	0	-1
-2	1	0	-2
-2	0	-1	-3
-1	0	0	-2
1	0	0	-2
-2	0	0	-3
0	0	-1	-3
-2	0	0	-1
-1	-1	0	-3
0	2	0	-2

Acquiring company

CONSOLIDATION 4		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	4	5	1	3
	2	5	4	3	3
	3	4	4	3	2
	4	3	3	3	4
	5	4	5	4	5
	6	2	5	2	3
	7	4	5	1	4
	8	3	5	3	4
	9	2	2	2	5
	10	4	4	4	3
	11	5	6	2	4
	12	3	6	1	4
mean		3.58	4.5	2.42	3.67

Wyniki surowe etapu III.B (POŁĄCZENIE 4)

Acquired company

CONSOLIDATION 4		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	1	3	1	2
	2	1	1	1	1
	3	1	1	1	1
	4	1	1	2	1
	5	2	1	2	2
	6	1	1	1	1
	7	2	2	2	1
	8	1	1	2	1
	9	2	3	1	2
	10	3	1	2	2
	11	1	1	1	1
	12	1	1	1	1
mean		1.42	1.42	1.42	1.33

Difference (distance in assessment)			
x1	x2	x3	x4
-3	-2	0	-1
-4	-3	-2	-2
-3	-3	-2	-1
-2	-2	-1	-3
-2	-4	-2	-3
-1	-4	-1	-2
-2	-3	1	-3
-2	-4	-1	-3
0	1	-1	-3
-1	-3	-2	-1
-4	-5	-1	-3
-2	-5	0	-3

Raw results of stage III.B (CONSOLIDATION 5)

Acquiring company

CONSOLIDATION 5		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	1	3	1	3
	2	3	1	1	3
	3	3	1	1	2
	4	3	1	1	4
	5	4	1	2	5
	6	2	1	1	3
	7	1	2	2	3
	8	3	1	1	4
	9	2	3	2	3
	10	4	1	3	3
	11	2	1	1	4
	12	1	1	1	4
mean		2.42	1.42	1.42	3.42

Acquired company

CONSOLIDATION 5		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	1	3	1	2
	2	1	1	1	1
	3	1	1	1	3
	4	1	1	2	1
	5	2	1	2	2
	6	1	1	1	1
	7	2	2	2	1
	8	1	1	2	1
	9	2	3	1	2
	10	3	1	2	2
	11	2	1	1	1
	12	1	1	1	1
mean		1.5	1.42	1.42	1.5

Difference (distance in assessment)			
x1	x2	x3	x4
0	0	0	-1
-2	0	0	-2
-2	0	0	1
-2	0	1	-3
-2	0	0	-3
-1	0	0	-2
1	0	0	-2
-2	0	1	-3
0	0	-1	-1
-1	0	-1	-1
0	0	0	-3
0	0	0	-3

Raw results of stage III.B (CONSOLIDATION 6)

Acquiring company

CONSOLIDATION 6		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	1	3	1	1
	2	3	1	1	1
	3	3	1	1	1
	4	3	5	1	2
	5	4	4	2	2
	6	2	5	1	1
	7	1	2	2	1
	8	3	3	1	1
	9	2	3	2	1
	10	4	5	3	3
	11	2	5	1	1
	12	1	5	1	1
mean		2.42	3.5	1.42	1.33

Acquired company

CONSOLIDATION 6		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	1	3	1	2
	2	3	1	1	1
	3	3	1	1	3
	4	3	1	2	1
	5	4	1	2	2
	6	4	1	1	1
	7	2	2	2	1
	8	4	1	2	1
	9	2	3	1	2
	10	3	1	3	1
	11	2	1	1	1
	12	1	1	1	1
mean		2.67	1.42	1.5	1.42

Difference (distance in assessment)			
x1	x2	x3	x4
0	0	0	1
0	0	0	0
0	0	0	2
0	-4	1	-1
0	-3	0	0
2	-4	0	0
1	0	0	0
1	-2	1	0
0	0	-1	1
-1	-4	0	-2
0	-4	0	0
0	-4	0	0

Raw results of stage III.B (CONSOLIDATION 7)

Acquiring company

CONSOLIDATION 7		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	1	1	3	1
	2	3	1	1	1
	3	3	1	1	1
	4	3	1	5	2
	5	4	2	4	2
	6	2	1	5	1
	7	1	2	2	1
	8	3	1	3	1
	9	2	2	3	1
	10	4	3	5	3
	11	2	1	5	1
	12	1	1	5	1
mean		2.42	1.42	3.5	1.33

Acquired company

CONSOLIDATION 7		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	1	1	2	1
	2	1	3	1	2
	3	1	3	3	1
	4	2	3	1	2
	5	2	4	2	2
	6	1	4	1	1
	7	2	2	1	3
	8	2	4	1	2
	9	1	2	2	1
	10	3	3	1	3
	11	1	2	1	1
	12	1	1	1	1
mean		1.5	2.67	1.42	1.67

Difference (distance in assessment)			
x1	x2	x3	x4
0	0	-1	0
-2	2	0	1
-2	2	2	0
-1	2	-4	0
-2	2	-2	0
-1	3	-4	0
1	0	-1	2
-1	3	-2	1
-1	0	-1	0
-1	0	-4	0
-1	1	-4	0
0	0	-4	0

Raw results of stage III.B (CONSOLIDATION 8)

Acquiring company

CONSOLIDATION 8		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	3	3	6	3
	2	1	2	5	5
	3	4	5	6	4
	4	5	5	5	5
	5	3	4	7	5
	6	4	5	7	5
	7	2	5	2	2
	8	3	5	3	6
	9	3	6	5	3
	10	5	5	8	6
	11	4	5	6	5
	12	5	5	7	5
mean		3.5	4.58	5.58	4.5

Acquired company

CONSOLIDATION 8		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	1	1	2	2
	2	1	1	1	1
	3	1	1	3	2
	4	2	1	1	1
	5	2	2	2	1
	6	1	1	1	1
	7	2	2	1	1
	8	1	1	1	1
	9	2	1	2	3
	10	1	3	1	1
	11	1	1	1	1
	12	2	1	1	1
mean		1.42	1.33	1.42	1.33

Difference (distance in assessment)			
x1	x2	x3	x4
-2	-2	-4	-1
0	-1	-4	-4
-3	-4	-3	-2
-3	-4	-4	-4
-1	-2	-5	-4
-3	-4	-6	-4
0	-3	-1	-1
-2	-4	-2	-5
-1	-5	-3	0
-4	-2	-7	-5
-3	-4	-5	-4
-3	-4	-6	-4

Raw results of stage III.B (CONSOLIDATION 9)

Acquiring company

CONSOLIDATION 9		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	3	3	3	4
	2	1	2	4	2
	3	4	4	3	4
	4	5	5	4	5
	5	3	3	3	4
	6	4	2	4	4
	7	2	2	2	2
	8	3	3	4	3
	9	3	3	2	3
	10	5	3	4	5
	11	4	3	5	4
	12	5	5	5	5
mean		3.5	3.17	3.58	3.75

Acquired company

CONSOLIDATION 9		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	2	1	2	1
	2	1	1	1	1
	3	1	1	3	2
	4	2	1	1	1
	5	2	2	2	1
	6	1	2	1	2
	7	3	2	1	1
	8	1	1	1	1
	9	2	1	2	3
	10	1	2	1	1
	11	1	2	1	2
	12	2	1	1	1
mean		1.58	1.42	1.42	1.42

Difference (distance in assessment)			
x1	x2	x3	x4
-1	-2	-1	-3
0	-1	-3	-1
-3	-3	0	-2
-3	-4	-3	-4
-1	-1	-1	-3
-3	0	-3	-2
1	0	-1	-1
-2	-2	-3	-2
-1	-2	0	0
-4	-1	-3	-4
-3	-1	-4	-2
-3	-4	-4	-4

Raw results of stage III.B (CONSOLIDATION 10)

Acquiring company

CONSOLIDATION 10		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	3	1	3	4
	2	1	2	4	2
	3	2	1	3	4
	4	2	1	1	2
	5	3	3	3	4
	6	2	1	4	1
	7	2	2	2	2
	8	3	1	2	3
	9	1	1	2	3
	10	2	1	1	1
	11	2	1	1	4
	12	3	1	2	5
mean		2.17	1.33	2.33	2.92

Acquired company

CONSOLIDATION 10		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	2	1	2	1
	2	1	1	1	1
	3	1	1	3	2
	4	2	1	1	1
	5	2	2	2	1
	6	1	2	1	2
	7	3	2	1	1
	8	2	1	1	1
	9	2	1	2	3
	10	1	2	1	1
	11	1	2	1	2
	12	2	1	1	1
mean		1.67	1.42	1.42	1.42

Difference (distance in assessment)			
x1	x2	x3	x4
-1	0	-1	-3
0	-1	-3	-1
-1	0	0	-2
0	0	0	-1
-1	-1	-1	-3
-1	1	-3	1
1	0	-1	-1
-1	0	-1	-2
1	0	0	0
-1	1	0	0
-1	1	0	-2
-1	0	-1	-4

Raw results of stage III.B (CONSOLIDATION 11)

Acquiring company

CONSOLIDATION 11		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	3	1	1	4
	2	4	2	2	2
	3	2	1	2	4
	4	2	1	1	2
	5	3	3	1	2
	6	2	1	2	1
	7	2	2	2	2
	8	3	1	1	3
	9	4	2	1	2
	10	2	3	1	1
	11	2	3	1	4
	12	3	1	2	2
mean		2.67	1.75	1.42	2.42

Acquired company

CONSOLIDATION 11		Time of learning in months			
		x1	x2	x3	x4
EXPERTS	1	2	1	2	1
	2	1	1	2	2
	3	1	2	3	2
	4	2	1	1	1
	5	1	1	2	1
	6	1	2	1	2
	7	1	2	1	1
	8	2	1	1	1
	9	2	1	1	1
	10	1	2	1	1
	11	1	2	1	2
	12	2	1	1	1
mean		1.42	1.42	1.42	1.33

Difference (distance in assessment)			
x1	x2	x3	x4
-1	0	1	-3
-3	-1	0	0
-1	1	1	-2
0	0	0	-1
-2	-2	1	-1
-1	1	-1	1
-1	0	-1	-1
-1	0	0	-2
-2	-1	0	-1
-1	-1	0	0
-1	-1	0	-2
-1	0	-1	-1

SUMMARY TABLES												
ACQUIRING COMPANIES		Time of learning in months					ACQUIRED COMPANIES		Time of learning in months			
		x1	x2	x3	x4				x1	x2	x3	x4
11 CONSOLIDATIONS	1	3	2	1	4	11 CONSOLIDATIONS	1	2	1	5	1	
	2	2	1	3	4		2	1	2	1	3	
	3	2	1	3	4		3	1	2	3	2	
	4	4	5	2	4		4	1	1	1	1	
	5	2	1	1	3		5	2	1	1	2	
	6	2	4	1	1		6	3	1	2	1	
	7	2	1	4	1		7	2	3	1	2	
	8	4	5	6	5		8	1	1	1	1	
	9	4	3	4	4		9	2	1	1	1	
	10	2	1	2	3		10	2	1	1	1	
	11	3	2	1	2		11	1	1	1	1	
mean		2.73	2.36	2.55	3.18	mean		1.64	1.36	1.64	1.45	

41 months

Source: own study.

SUMMARY TABLES										
Time of learning in months					Trans-fer time	Learning time				
x1	x2	x3	x4	x1		x2	x3	x4		
7.2	5.4	2.1	6.8	21.5	2.8	1.6	6.5	1.4		
4.8	2.7	6.3	9.6	23.4	1.4	3.2	1.3	4.2		
4.8	2.7	6.3	9.6	23.4	1.4	3.2	3.9	2.8		
9.6	13.5	4.2	9.6	36.9	1.4	1.6	1.3	1.4		
4.8	2.7	2.1	7.2	16.8	2.8	1.6	1.3	2.8		
4.8	10.8	2.1	2.4	20.1	4.2	1.6	2.6	1.4		
4.8	2.7	8.4	2.4	18.3	2.8	4.8	1.3	2.8		
9.6	13.5	12.6	12	47.7	1.4	1.6	1.3	1.4		
9.6	8.1	8.4	9.6	35.7	2.8	1.6	1.3	1.4		
4.8	2.7	4.2	7.2	18.9	2.8	1.6	1.3	1.4		
7.2	5.4	2.1	4.8	19.5	1.4	1.6	1.3	1.4		
6.5	6.4	5.3	5.4	25.7				2.0		

Annexe No. 15

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Annexe 15

Results – stage III.C

Raw results of stage III.C (CONSOLIDATION 1)

Acquiring company

CONSOLIDATION 1		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	1	2	2	1
	2	1	3	3	1
	3	1	3	3	1
	4	1	4	2	1
	5	2	2	2	2
	6	1	1	1	1
	7	1	3	3	1
	8	2	4	2	2
	9	1	2	2	1
	10	1	3	3	1
	11	1	2	2	1
	12	1	3	3	1
mean		1	3	2	1

Acquired company

CONSOLIDATION 1		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	1	2	2	1
	2	1	2	1	1
	3	1	3	1	1
	4	1	4	2	1
	5	2	2	2	2
	6	1	1	1	3
	7	1	3	1	1
	8	1	3	2	2
	9	1	2	1	2
	10	2	3	1	3
	11	1	2	1	2
	12	1	3	1	1
mean		1.2	2.5	1.3	1.7

x1acquired-x1acquiring

Difference (distance in assessment)			
x1	x2	x3	x4
0	0	0	0
0	-1	-2	0
0	0	-2	0
0	0	0	0
0	0	0	0
0	0	0	2
0	0	-2	0
-1	-1	0	0
0	0	-1	1
1	0	-2	2
0	0	-1	1
0	0	-2	0

Raw results of stage III.C (CONSOLIDATION 2)

Acquiring company

CONSOLIDATION 2		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	2	4	1	2
	2	2	2	1	3
	3	3	3	1	3
	4	4	4	1	2
	5	2	2	2	2
	6	1	4	1	1
	7	3	4	1	3
	8	3	4	2	2
	9	2	4	1	2
	10	3	4	1	3
	11	4	4	1	2
	12	3	3	1	3
mean		3	3.5	1.2	2.3

Acquired company

CONSOLIDATION 2		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	1	2	1	1
	2	1	3	2	1
	3	1	3	2	1
	4	1	2	1	1
	5	2	2	1	2
	6	1	1	1	1
	7	1	3	1	1
	8	2	2	2	2
	9	1	2	1	1
	10	1	3	2	1
	11	1	2	1	1
	12	1	3	1	1
mean		1.2	2.3	1.3	1.2

Difference (distance in assessment)			
x1	x2	x3	x4
-1	-2	0	-1
-1	1	1	-2
-2	0	1	-2
-3	-2	0	-1
0	0	-1	0
0	-3	0	0
-2	-1	0	-2
-1	-2	0	0
-1	-2	0	-1
-2	-1	1	-2
-3	-2	0	-1
-2	0	0	-2

Raw results of stage III.C (CONSOLIDATION 3)

Acquiring company

CONSOLIDATION 3		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	2	1	2	1
	2	3	1	2	2
	3	2	1	3	1
	4	2	1	4	1
	5	2	2	2	2
	6	1	1	2	1
	7	3	1	3	1
	8	2	2	3	2
	9	2	1	2	1
	10	3	1	3	1
	11	2	1	4	2
	12	3	1	3	1
mean		2	1.3	3	1

Acquired company

CONSOLIDATION 3		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	1	1	1	1
	2	1	1	2	1
	3	1	2	2	1
	4	1	2	1	2
	5	2	1	1	2
	6	1	1	1	1
	7	1	1	1	1
	8	2	2	2	2
	9	1	2	1	1
	10	1	1	2	1
	11	1	2	1	1
	12	1	1	1	2
mean		1.2	1.4	1.3	1.3

Difference (distance in assessment)			
x1	x2	x3	x4
-1	0	-1	0
-2	-1	0	-1
-1	1	-1	0
-1	1	-3	1
0	-1	-1	0
0	0	-1	0
-2	0	-2	0
0	0	-1	0
-1	1	-1	0
-2	0	-1	0
-1	0	-3	-1
-2	0	-2	1

Raw results of stage III.B (CONSOLIDATION 4)

Acquiring company

CONSOLIDATION 4		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	3	4	2	1
	2	3	4	2	4
	3	3	3	3	3
	4	3	4	2	3
	5	2	2	2	2
	6	3	4	2	3
	7	3	3	3	3
	8	3	3	3	4
	9	2	4	2	3
	10	3	4	2	1
	11	2	4	4	2
	12	3	4	2	1
mean		3	3.6	2.4	2.5

Acquired company

CONSOLIDATION 4		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	1	1	1	1
	2	1	1	2	1
	3	1	2	1	1
	4	2	1	1	2
	5	2	1	1	2
	6	1	1	1	1
	7	1	1	2	1
	8	2	1	2	2
	9	1	2	1	1
	10	1	1	2	1
	11	1	2	1	1
	12	2	1	1	2
mean		1.3	1.3	1.3	1.3

Difference (distance in assessment)			
x1	x2	x3	x4
-2	-3	-1	0
-2	-3	0	-3
-2	-1	-2	-2
-1	-3	-1	-1
0	-1	-1	0
-2	-3	-1	-2
-2	-2	-1	-2
-1	-2	-1	-2
-1	-2	-1	-2
-2	-3	0	0
-1	-2	-3	-1
-1	-3	-1	1

Raw results of stage III.C (CONSOLIDATION 5)

Acquiring company

CONSOLIDATION 5		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	2	3	1	1
	2	2	4	1	2
	3	3	3	2	1
	4	2	3	1	1
	5	2	2	1	1
	6	2	3	1	1
	7	3	3	1	2
	8	3	4	1	2
	9	2	3	2	1
	10	2	1	1	2
	11	3	2	2	1
	12	2	1	1	1
mean		2	2.7	1.3	1.3

Acquired company

CONSOLIDATION 5		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	1	1	1	1
	2	1	1	2	1
	3	1	2	1	1
	4	2	1	1	2
	5	2	1	1	2
	6	1	2	1	1
	7	1	2	1	1
	8	2	2	2	2
	9	1	2	1	2
	10	1	1	2	1
	11	1	2	1	1
	12	2	1	1	2
mean		1.3	1.5	1.3	1.4

Difference (distance in assessment)			
x1	x2	x3	x4
-1	-2	0	0
-1	-3	1	-1
-2	-1	-1	0
0	-2	0	1
0	-1	0	1
-1	-1	0	0
-2	-1	0	-1
-1	-2	1	0
-1	-1	-1	1
-1	0	1	-1
-2	0	-1	0
0	0	0	1

Raw results of stage III.C (CONSOLIDATION 6)

Acquiring company

CONSOLIDATION 6		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	1	3	1	1
	2	1	3	2	1
	3	1	3	3	1
	4	2	1	1	2
	5	1	1	2	2
	6	1	2	2	1
	7	1	2	2	1
	8	2	3	2	1
	9	1	3	1	2
	10	1	4	2	1
	11	1	3	1	1
	12	2	3	1	2
mean		1	2.6	1.7	1.3

Acquired company

CONSOLIDATION 6		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	4	3	1	1
	2	4	1	1	2
	3	4	1	2	1
	4	4	1	1	1
	5	4	2	1	1
	6	2	1	1	1
	7	4	1	1	2
	8	3	1	3	2
	9	4	2	3	1
	10	4	1	1	2
	11	3	2	2	1
	12	2	1	1	1
mean		3.5	1.4	1.5	1.3

Difference (distance in assessment)			
x1	x2	x3	x4
3	0	0	0
3	-2	-1	1
3	-2	-1	0
2	0	0	-1
3	1	-1	-1
1	-1	-1	0
3	-1	-1	1
1	-2	1	1
3	-1	2	-1
3	-3	-1	1
2	-1	1	0
0	-2	0	-1

Raw results of stage III.C (CONSOLIDATION 7)

Acquiring company

CONSOLIDATION 7		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	1	3	1	1
	2	1	3	2	1
	3	3	3	1	1
	4	2	1	1	2
	5	2	1	2	2
	6	3	2	2	1
	7	2	2	2	1
	8	2	3	2	1
	9	1	2	1	2
	10	1	1	1	1
	11	1	3	1	1
	12	2	3	1	2
mean		2	2.3	1.4	1.3

Acquired company

CONSOLIDATION 7		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	1	1	1	1
	2	1	1	1	1
	3	1	2	2	1
	4	2	1	1	2
	5	1	1	1	2
	6	1	2	1	1
	7	1	2	1	1
	8	1	2	2	2
	9	1	2	1	1
	10	1	1	2	1
	11	1	2	1	1
	12	2	1	1	2
mean		1.2	1.5	1.3	1.3

Difference (distance in assessment)			
x1	x2	x3	x4
0	-2	0	0
0	-2	-1	0
-2	-1	1	0
0	0	0	0
-1	0	-1	0
-2	0	-1	0
-1	0	-1	0
-1	-1	0	1
0	0	0	-1
0	0	1	0
0	-1	0	0
0	-2	0	0

Raw results of stage III.C (CONSOLIDATION 8)

Acquiring company

CONSOLIDATION 8		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	4	3	4	1
	2	4	3	4	1
	3	3	4	2	2
	4	4	1	4	1
	5	3	2	3	1
	6	2	3	4	1
	7	2	2	4	1
	8	3	3	3	3
	9	4	2	4	3
	10	4	3	4	1
	11	3	4	2	2
	12	2	3	4	1
mean		3	2.8	3.5	1.5

Acquired company

CONSOLIDATION 8		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	1	1	1	1
	2	1	1	1	1
	3	1	2	2	1
	4	2	1	1	2
	5	1	1	2	1
	6	1	1	1	1
	7	1	1	1	2
	8	1	1	1	2
	9	1	2	1	1
	10	1	1	2	2
	11	1	2	1	1
	12	2	1	1	2
mean		1.2	1.3	1.3	1.4

Difference (distance in assessment)			
x1	x2	x3	x4
-3	-2	-3	0
-3	-2	-3	0
-2	-2	0	-1
-2	0	-3	1
-2	-1	-1	0
-1	-2	-3	0
-1	-1	-3	1
-2	-2	-2	-1
-3	0	-3	-2
-3	-2	-2	1
-2	-2	-1	-1
0	-2	-3	1

Raw results of stage III.C (CONSOLIDATION 9)

Acquiring company

CONSOLIDATION 9		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	4	3	4	1
	2	4	4	4	1
	3	3	4	3	1
	4	4	3	4	1
	5	4	3	3	2
	6	2	3	4	1
	7	4	3	4	1
	8	3	4	3	2
	9	4	4	3	3
	10	4	4	4	1
	11	4	4	3	2
	12	4	4	4	1
mean		4	3.6	3.6	1.4

Acquired company

CONSOLIDATION 9		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	1	1	1	1
	2	1	1	1	2
	3	1	2	2	1
	4	2	1	1	1
	5	1	1	2	1
	6	2	1	1	1
	7	1	2	1	1
	8	1	1	1	2
	9	1	1	2	1
	10	1	1	2	2
	11	1	1	1	1
	12	2	1	1	2
mean		1.3	1.2	1.3	1.3

Difference (distance in assessment)			
x1	x2	x3	x4
-3	-2	-3	0
-3	-3	-3	1
-2	-2	-1	0
-2	-2	-3	0
-3	-2	-1	-1
0	-2	-3	0
-3	-1	-3	0
-2	-3	-2	0
-3	-3	-1	-2
-3	-3	-2	1
-3	-3	-2	-1
-2	-3	-3	1

Raw results of stage III.C (CONSOLIDATION 10)

Acquiring company

CONSOLIDATION 10		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	3	3	1	3
	2	4	3	1	4
	3	3	2	1	3
	4	2	2	1	1
	5	2	3	2	2
	6	2	3	1	3
	7	4	3	1	1
	8	3	2	2	2
	9	4	2	3	3
	10	3	2	1	3
	11	3	2	2	4
	12	4	2	1	3
mean		3	2.4	1.4	2.7

Acquired company

CONSOLIDATION 10		Significance (weight) of knowledge			
		x1	x2	x3	x4
EXPERTS	1	1	2	1	1
	2	1	2	1	2
	3	1	2	2	1
	4	2	1	1	1
	5	1	2	2	1
	6	2	3	1	1
	7	1	2	1	1
	8	1	1	1	2
	9	1	1	2	1
	10	1	2	2	2
	11	1	1	1	1
	12	2	1	1	2
mean		1.3	1.7	1.3	1.3

Difference (distance in assessment)			
x1	x2	x3	x4
-2	-1	0	-2
-3	-1	0	-2
-2	0	1	-2
0	-1	0	0
-1	-1	0	-1
0	0	0	-2
-3	-1	0	0
-2	-1	-1	0
-3	-1	-1	-2
-2	0	1	-1
-2	-1	-1	-3
-2	-1	0	-1

Raw results of stage III.C (CONSOLIDATION 11)

Acquiring company						Acquired company											
CONSOLIDATION 11		Significance (weight) of knowledge				CONSOLIDATION 11		Significance (weight) of knowledge						Difference (distance in assessment)			
		x1	x2	x3	x4			x1	x2	x3	x4			x1	x2	x3	x4
EXPERTS	1	1	3	1	1	EXPERTS	1	1	1	1			0	-2	0	0	
	2	1	4	2	2		2	1	2	0			-2	-1	0		
	3	2	3	2	1		3	1	1	2			1	-1	-2	0	0
	4	1	3	1	1		4	2	1	1			1	1	-2	0	0
	5	3	2	2	1		5	1	2	1			2	-2	0	-1	1
	6	2	3	1	1		6	2	1	1			1	0	-2	0	0
	7	3	3	2	1		7	1	2	1			1	-2	-1	-1	0
	8	2	2	1	2		8	2	1	1			1	0	-1	0	-1
	9	2	3	2	1		9	1	1	2			1	-1	-2	0	0
	10	2	2	1	2		10	1	1	2			2	-1	-1	1	0
	11	2	3	1	1		11	1	1	1			1	-1	-2	0	0
	12	2	3	1	2		12	1	1	1			2	-1	-2	0	0
mean		2	2.8	1.4	1.3	mean		1.3	1.3	1.3	1.3						

SUMMARY TABLES											
ACQUIRING COMPANIES		KNOWLEDGE FACTOR GROUPS				ACQUIRED COMPANIES		KNOWLEDGE FACTOR GROUPS			
		x1	x2	x3	x4			x1	x2	x3	x4
11 CONSOLIDATIONS	1	1	3	2	1	11 CONSOLIDATIONS	1	1	3	1	2
	2	3	4	1	2		2	1	2	1	1
	3	2	1	3	1		3	1	1	1	1
	4	3	4	2	3		4	1	1	1	1
	5	2	3	1	1		5	1	2	1	1
	6	1	3	2	1		6	4	1	2	1
	7	2	2	1	1		7	1	2	1	1
	8	3	3	4	2		8	1	1	1	1
	9	4	4	4	1		9	1	1	1	1
	10	3	2	1	3		10	1	2	1	1
	11	2	3	1	1		11	1	1	1	1
mean		2.36	2.74	2.08	1.66	mean		1.43	1.57	1.32	1.36

Source: own study.

Annexe No. 16

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Annexe 16

Results – stage III.D

Raw results of stage III.D (CONSOLIDATION 1)

Acquiring company

CONSOLIDATION 1	TYPE OF KNOWLEDGE OF BIGGER			
	x1	x2	x3	x4
EXPERTS	1	explicit	explicit	explicit
	2	explicit	explicit	explicit
	3	explicit	tacit	explicit
	4	explicit	tacit	tacit
	5	tacit	tacit	explicit
	6	explicit	tacit	explicit
	7	tacit	tacit	tacit
	8	explicit	explicit	tacit
	9	explicit	explicit	explicit
	10	tacit	explicit	explicit
	11	tacit	tacit	explicit
	12	tacit	tacit	tacit

The most common answer:

explicit tacit explicit explicit

Acquired company

CONSOLIDATION 1	TYPE OF KNOWLEDGE OF BIGGER			
	x1	x2	x3	x4
EXPERTS	1	explicit	explicit	explicit
	2	explicit	tacit	explicit
	3	explicit	tacit	explicit
	4	tacit	tacit	explicit
	5	tacit	tacit	explicit
	6	explicit	tacit	explicit
	7	tacit	tacit	tacit
	8	tacit	tacit	explicit
	9	explicit	explicit	explicit
	10	explicit	explicit	explicit
	11	explicit	tacit	explicit
	12	tacit	tacit	tacit

The most common answer:

explicit tacit explicit explicit

Identical answers

1 - identical 0 - different

Identical answers			
x1	x2	x3	x4
1	1	1	1
1	0	1	1
1	1	1	1
0	1	0	0
1	1	1	1
1	1	1	1
1	1	1	1
0	0	0	1
1	1	1	1
0	1	1	0
0	1	1	0
1	1	1	1

Raw results of stage III.D (CONSOLIDATION 2)

Acquiring company

CONSOLIDATION 2	TYPE OF KNOWLEDGE OF BIGGER			
	x1	x2	x3	x4
EXPERTS	1	explicit	explicit	explicit
	2	tacit	explicit	explicit
	3	explicit	tacit	explicit
	4	explicit	tacit	tacit
	5	explicit	tacit	explicit
	6	explicit	tacit	explicit
	7	tacit	tacit	explicit
	8	explicit	explicit	tacit
	9	explicit	explicit	explicit
	10	tacit	explicit	explicit
	11	tacit	tacit	explicit
	12	tacit	tacit	tacit

The most common answer:

explicit tacit tacit explicit

Acquired company

CONSOLIDATION 2	TYPE OF KNOWLEDGE OF BIGGER			
	x1	x2	x3	x4
EXPERTS	1	tacit	explicit	tacit
	2	explicit	explicit	tacit
	3	explicit	tacit	tacit
	4	tacit	tacit	tacit
	5	tacit	explicit	tacit
	6	explicit	explicit	explicit
	7	tacit	tacit	tacit
	8	tacit	explicit	tacit
	9	explicit	explicit	tacit
	10	tacit	explicit	explicit
	11	tacit	tacit	explicit
	12	tacit	tacit	tacit

The most common answer:

tacit explicit tacit tacit

Identical answers			
x1	x2	x3	x4
0	1	0	1
0	1	0	0
1	1	0	0
0	1	1	1
0	0	1	1
1	0	1	1
1	1	1	0
0	1	1	1
1	1	0	0
1	1	0	1
1	1	1	1
1	1	1	1

Raw results of stage III.D (CONSOLIDATION 3)

Acquiring company

CONSOLIDATION 3		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	explicit	explicit
	2	tacit	explicit	explicit	explicit
	3	explicit	explicit	explicit	explicit
	4	explicit	explicit	tacit	tacit
	5	explicit	explicit	tacit	explicit
	6	explicit	tacit	explicit	explicit
	7	tacit	tacit	explicit	explicit
	8	explicit	explicit	explicit	tacit
	9	explicit	explicit	tacit	explicit
	10	tacit	explicit	tacit	explicit
	11	tacit	tacit	explicit	explicit
	12	tacit	tacit	explicit	tacit

The most common
answer:

explicit explicit explicit explicit

Acquired company

CONSOLIDATION 3		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	explicit	explicit
	2	tacit	explicit	explicit	explicit
	3	explicit	explicit	explicit	explicit
	4	explicit	explicit	explicit	tacit
	5	explicit	tacit	explicit	explicit
	6	explicit	tacit	explicit	explicit
	7	tacit	tacit	tacit	explicit
	8	explicit	explicit	tacit	tacit
	9	explicit	explicit	tacit	explicit
	10	explicit	explicit	tacit	explicit
	11	tacit	tacit	explicit	explicit
	12	tacit	tacit	tacit	explicit

The most common
answer:

explicit explicit explicit explicit

Identical answers			
x1	x2	x3	x4
1	1	1	1
1	1	1	1
1	1	1	1
1	1	0	1
1	0	0	1
1	1	1	1
1	1	0	1
1	1	0	1
1	1	1	0
0	1	1	1
1	1	1	1
1	1	0	0

Raw results of stage III.D (CONSOLIDATION 4)

Acquiring company

CONSOLIDATION 4		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	explicit	explicit
	2	tacit	explicit	explicit	tacit
	3	explicit	tacit	explicit	explicit
	4	explicit	explicit	tacit	tacit
	5	explicit	explicit	tacit	explicit
	6	explicit	tacit	explicit	explicit
	7	explicit	tacit	explicit	explicit
	8	explicit	explicit	explicit	tacit
	9	explicit	explicit	tacit	explicit
	10	tacit	explicit	tacit	tacit
	11	tacit	tacit	explicit	explicit
	12	tacit	tacit	tacit	tacit

The most common
answer:

explicit explicit explicit explicit

Acquired company

CONSOLIDATION 4		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	explicit	explicit
	2	tacit	tacit	tacit	tacit
	3	tacit	explicit	explicit	explicit
	4	explicit	explicit	tacit	tacit
	5	explicit	explicit	tacit	explicit
	6	explicit	tacit	explicit	explicit
	7	tacit	tacit	explicit	explicit
	8	explicit	explicit	explicit	tacit
	9	explicit	explicit	explicit	explicit
	10	explicit	explicit	tacit	explicit
	11	tacit	tacit	tacit	tacit
	12	tacit	tacit	explicit	tacit

The most common
answer:

explicit explicit explicit explicit

Identical answers			
x1	x2	x3	x4
1	1	1	1
1	0	0	1
0	0	1	1
1	1	1	1
1	1	1	1
1	1	1	1
0	1	1	1
1	1	1	1
1	1	0	1
0	1	1	0
1	1	0	0
1	1	0	1

Raw results of stage III.D (CONSOLIDATION 5)

Acquiring company

CONSOLIDATION 5		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	tacit	explicit
	2	tacit	explicit	explicit	tacit
	3	explicit	tacit	explicit	explicit
	4	explicit	explicit	tacit	tacit
	5	explicit	explicit	tacit	explicit
	6	explicit	tacit	explicit	tacit
	7	explicit	explicit	explicit	explicit
	8	explicit	explicit	explicit	explicit
	9	explicit	tacit	tacit	explicit
	10	tacit	explicit	tacit	explicit
	11	tacit	tacit	explicit	explicit
	12	tacit	tacit	explicit	tacit

The most common answer:

explicit explicit explicit explicit

Acquired company

CONSOLIDATION 5		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	tacit	explicit	tacit
	2	tacit	explicit	explicit	tacit
	3	explicit	tacit	explicit	explicit
	4	explicit	explicit	tacit	tacit
	5	explicit	explicit	explicit	explicit
	6	explicit	tacit	explicit	explicit
	7	explicit	explicit	explicit	explicit
	8	explicit	explicit	explicit	explicit
	9	explicit	explicit	tacit	explicit
	10	tacit	explicit	tacit	tacit
	11	tacit	tacit	explicit	explicit
	12	tacit	tacit	tacit	tacit

The most common answer:

explicit explicit explicit explicit

Identical answers			
x1	x2	x3	x4
1	0	0	0
1	1	1	1
1	1	1	1
1	1	1	1
1	1	0	1
1	1	1	0
1	1	1	1
1	1	1	1
1	0	1	1
1	1	1	0
1	1	1	1
1	1	0	1

Raw results of stage III.D (CONSOLIDATION 6)

Acquiring company

CONSOLIDATION 7		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	tacit	explicit
	2	explicit	explicit	explicit	tacit
	3	explicit	tacit	explicit	explicit
	4	explicit	explicit	tacit	explicit
	5	explicit	explicit	tacit	explicit
	6	explicit	explicit	explicit	tacit
	7	explicit	explicit	explicit	explicit
	8	tacit	explicit	explicit	explicit
	9	explicit	tacit	tacit	explicit
	10	tacit	explicit	tacit	explicit
	11	tacit	tacit	explicit	explicit
	12	tacit	tacit	explicit	tacit

The most common answer:

explicit explicit explicit explicit

Acquired company

CONSOLIDATION 7		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	tacit	explicit
	2	explicit	explicit	explicit	explicit
	3	explicit	tacit	explicit	explicit
	4	explicit	explicit	tacit	tacit
	5	explicit	explicit	tacit	explicit
	6	explicit	explicit	explicit	tacit
	7	explicit	explicit	explicit	explicit
	8	explicit	explicit	explicit	tacit
	9	explicit	tacit	tacit	explicit
	10	tacit	explicit	tacit	explicit
	11	tacit	tacit	explicit	explicit
	12	tacit	tacit	explicit	tacit

The most common answer:

explicit explicit explicit explicit

Identical answers			
x1	x2	x3	x4
1	1	1	1
1	1	1	0
1	1	1	1
1	1	1	0
1	1	1	1
1	1	1	1
1	1	1	1
0	1	1	0
1	1	1	1
1	1	1	1
1	1	1	1
1	1	1	1

Raw results of stage III.D (CONSOLIDATION 7)

Acquiring company

CONSOLIDATION 7		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	tacit	explicit
	2	explicit	explicit	explicit	tacit
	3	explicit	tacit	explicit	explicit
	4	explicit	explicit	tacit	explicit
	5	explicit	explicit	tacit	explicit
	6	explicit	explicit	tacit	tacit
	7	tacit	explicit	explicit	explicit
	8	tacit	explicit	explicit	explicit
	9	explicit	explicit	explicit	explicit
	10	tacit	explicit	explicit	explicit
	11	tacit	tacit	explicit	explicit
	12	tacit	tacit	explicit	tacit

The most common answer:

explicit explicit explicit explicit

Acquired company

CONSOLIDATION 7		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	tacit	explicit
	2	explicit	explicit	tacit	tacit
	3	explicit	tacit	explicit	explicit
	4	explicit	explicit	tacit	explicit
	5	explicit	tacit	tacit	explicit
	6	explicit	tacit	explicit	tacit
	7	explicit	tacit	explicit	explicit
	8	tacit	explicit	explicit	explicit
	9	explicit	explicit	tacit	explicit
	10	tacit	explicit	explicit	explicit
	11	tacit	explicit	explicit	explicit
	12	tacit	explicit	explicit	tacit

The most common answer:

explicit explicit explicit explicit

Identical answers			
x1	x2	x3	x4
1	1	1	1
1	1	0	1
1	1	1	1
1	1	1	1
1	0	1	1
1	0	0	1
0	0	1	1
1	1	1	1
1	1	0	1
1	1	1	1
1	0	1	1
1	0	1	1

Raw results of stage III.D (CONSOLIDATION 8)

Acquiring company

CONSOLIDATION 8		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	tacit	explicit
	2	explicit	explicit	explicit	tacit
	3	explicit	tacit	explicit	tacit
	4	explicit	tacit	tacit	explicit
	5	explicit	tacit	tacit	explicit
	6	explicit	tacit	tacit	tacit
	7	tacit	tacit	explicit	explicit
	8	tacit	explicit	explicit	tacit
	9	explicit	explicit	explicit	tacit
	10	tacit	explicit	explicit	tacit
	11	tacit	tacit	explicit	tacit
	12	tacit	tacit	explicit	tacit

The most common answer:

explicit tacit explicit tacit

Acquired company

CONSOLIDATION 8		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	tacit	explicit
	2	explicit	explicit	explicit	tacit
	3	explicit	tacit	explicit	explicit
	4	explicit	explicit	tacit	explicit
	5	explicit	explicit	tacit	explicit
	6	explicit	explicit	tacit	tacit
	7	tacit	explicit	explicit	explicit
	8	tacit	explicit	explicit	explicit
	9	explicit	explicit	explicit	explicit
	10	tacit	explicit	explicit	explicit
	11	tacit	tacit	explicit	explicit
	12	tacit	tacit	explicit	tacit

The most common answer:

explicit explicit explicit explicit

Identical answers			
x1	x2	x3	x4
1	1	1	1
1	1	1	1
1	1	1	0
1	0	1	1
1	0	1	1
1	0	1	1
1	0	1	1
1	1	1	0
1	1	1	0
1	1	1	0
1	1	1	0
1	1	1	0
1	1	1	1

Raw results of stage III.D (CONSOLIDATION 9)

Acquiring company

CONSOLIDATION 9		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	tacit	explicit
	2	explicit	explicit	explicit	tacit
	3	explicit	explicit	explicit	tacit
	4	explicit	explicit	tacit	explicit
	5	explicit	explicit	tacit	explicit
	6	explicit	tacit	tacit	tacit
	7	tacit	tacit	explicit	explicit
	8	tacit	explicit	explicit	explicit
	9	explicit	explicit	tacit	explicit
	10	tacit	explicit	tacit	explicit
	11	tacit	tacit	tacit	tacit
	12	tacit	tacit	explicit	tacit

The most common answer:

explicit explicit tacit explicit

Acquired company

CONSOLIDATION 9		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	tacit	explicit
	2	explicit	explicit	explicit	tacit
	3	explicit	tacit	explicit	tacit
	4	explicit	explicit	tacit	explicit
	5	explicit	explicit	tacit	explicit
	6	explicit	explicit	tacit	tacit
	7	tacit	tacit	explicit	explicit
	8	tacit	explicit	explicit	explicit
	9	explicit	explicit	explicit	explicit
	10	tacit	explicit	explicit	explicit
	11	tacit	tacit	explicit	tacit
	12	tacit	tacit	explicit	tacit

The most common answer:

explicit explicit explicit explicit

Identical answers			
x1	x2	x3	x4
1	1	1	1
1	1	1	1
1	0	1	1
1	1	1	1
1	1	1	1
1	0	1	1
1	1	1	1
1	1	1	1
1	1	0	1
1	1	0	1
1	1	0	1
1	1	1	1

Raw results of stage III.D (CONSOLIDATION 10)

Acquiring company

CONSOLIDATION 10		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	tacit	explicit
	2	explicit	explicit	explicit	tacit
	3	explicit	tacit	explicit	tacit
	4	explicit	tacit	tacit	explicit
	5	explicit	tacit	tacit	explicit
	6	explicit	tacit	tacit	tacit
	7	tacit	tacit	explicit	explicit
	8	tacit	explicit	explicit	explicit
	9	explicit	tacit	explicit	explicit
	10	explicit	tacit	explicit	explicit
	11	tacit	tacit	explicit	tacit
	12	tacit	tacit	explicit	tacit

The most common answer:

explicit tacit explicit explicit

Acquired company

CONSOLIDATION 10		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	tacit	explicit
	2	explicit	explicit	explicit	tacit
	3	explicit	explicit	explicit	tacit
	4	explicit	explicit	tacit	explicit
	5	explicit	explicit	tacit	explicit
	6	explicit	tacit	tacit	tacit
	7	explicit	tacit	explicit	explicit
	8	tacit	explicit	explicit	explicit
	9	explicit	explicit	explicit	explicit
	10	tacit	explicit	explicit	explicit
	11	tacit	tacit	explicit	tacit
	12	tacit	tacit	explicit	tacit

The most common answer:

explicit explicit explicit explicit

Identical answers			
x1	x2	x3	x4
1	1	1	1
1	1	1	1
1	0	1	1
1	0	1	1
1	0	1	1
0	1	1	1
1	1	1	1
1	0	1	1
0	0	1	1
1	1	1	1
1	1	1	1

Raw results of stage III.D (CONSOLIDATION 11)

Acquiring company

CONSOLIDATION 11		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	tacit	explicit
	2	explicit	explicit	explicit	tacit
	3	explicit	tacit	explicit	tacit
	4	explicit	tacit	tacit	explicit
	5	tacit	tacit	tacit	explicit
	6	tacit	explicit	tacit	tacit
	7	tacit	explicit	explicit	explicit
	8	tacit	explicit	explicit	explicit
	9	explicit	tacit	tacit	explicit
	10	explicit	tacit	tacit	explicit
	11	explicit	tacit	tacit	explicit
	12	tacit	tacit	explicit	explicit

The most common answer:

explicit tacit tacit explicit

Acquired company

CONSOLIDATION 11		TYPE OF KNOWLEDGE OF BIGGER			
		x1	x2	x3	x4
EXPERTS	1	explicit	explicit	tacit	explicit
	2	explicit	explicit	explicit	explicit
	3	explicit	explicit	explicit	explicit
	4	explicit	explicit	tacit	explicit
	5	explicit	tacit	tacit	explicit
	6	explicit	tacit	tacit	tacit
	7	tacit	tacit	explicit	explicit
	8	tacit	explicit	explicit	explicit
	9	explicit	explicit	explicit	explicit
	10	explicit	explicit	explicit	explicit
	11	tacit	explicit	explicit	tacit
	12	tacit	tacit	explicit	tacit

The most common answer:

explicit explicit explicit explicit

Identical answers			
x1	x2	x3	x4
1	1	1	1
1	1	1	0
1	0	1	0
1	0	1	1
0	1	1	1
0	0	1	1
1	0	1	1
1	1	1	1
1	0	0	1
1	0	0	1
0	0	0	0
1	1	1	0

SUMMARY TABLES

ACQUIRING COMPANIES		TYPE OF KNOWLEDGE OF BIGGER			
11 CONSOLIDATIONS		x1	x2	x3	x4
	1	explicit	tacit	explicit	explicit
	2	explicit	tacit	tacit	explicit
	3	explicit	explicit	explicit	explicit
	4	explicit	explicit	explicit	explicit
	5	explicit	explicit	explicit	explicit
	6	explicit	explicit	explicit	explicit
	7	explicit	explicit	explicit	explicit
	8	explicit	tacit	explicit	tacit
	9	explicit	explicit	tacit	explicit
	10	explicit	tacit	explicit	explicit
	11	explicit	tacit	tacit	explicit

MOST PRESENT

explicit explicit explicit explicit

ACQUIRED COMPANIES		TYPE OF KNOWLEDGE OF BIGGER			
11 CONSOLIDATIONS		x1	x2	x3	x4
	1	explicit	tacit	explicit	explicit
	2	tacit	explicit	tacit	tacit
	3	explicit	explicit	explicit	explicit
	4	explicit	explicit	explicit	explicit
	5	explicit	explicit	explicit	explicit
	6	explicit	explicit	explicit	explicit
	7	explicit	explicit	explicit	explicit
	8	explicit	explicit	explicit	explicit
	9	explicit	explicit	explicit	explicit
	10	explicit	explicit	explicit	explicit
	11	explicit	explicit	explicit	explicit

MOST PRESENT

explicit explicit explicit explicit

SUMMARY TABLES

ACQUIRING COMPANIES		TYPE OF KNOWLEDGE OF BIGGER			
11 CONSOLIDATIONS		x1	x2	x3	x4
	1	1	0	1	1
	2	1	0	0	1
	3	1	1	1	1
	4	1	1	1	1
	5	1	1	1	1
	6	1	1	1	1
	7	1	1	1	1
	8	1	0	1	0
	9	1	1	0	1
	10	1	0	1	1
	11	1	0	0	1

MOST COMMON

1 1 1 1

1 - EXPLICIT
2 - TACIT

ACQUIRED COMPANIES		TYPE OF KNOWLEDGE OF BIGGER			
11 CONSOLIDATIONS		x1	x2	x3	x4
	1	1	0	1	1
	2	0	1	0	0
	3	1	1	1	1
	4	1	1	1	1
	5	1	1	1	1
	6	1	1	1	1
	7	1	1	1	1
	8	1	1	1	1
	9	1	1	1	1
	10	1	1	1	1
	11	1	1	1	1

MOST COMMON

1 1 1 1

1 - EXPLICIT
2 - TACIT

Source: own study.

Annexe No. 17

Results – stage III.E

CONSOLIDATION 1

No.	INDICATORS	COMPANY 1 (ACQUIRING)	COMPANY 2 (ACQUIRED)
1	Company assets (million EUR)	7,843.00	18,268.00
2	Average pay (EUR)	27,120.00	22,500.00
3	Total number of employees	53,900	5,600
4	Amount of revenues from sales (million EUR)	9214.00	18268.00
5	General assessment of company financial condition (1 – lowest grade, 4 – highest grade)	3	3
6	Whether transition team was established in the company?	NO	NO
7	Whether representatives of the acquired company take part in works of the team?	NO	NO
8	Average level of employees' qualifications (1 – lowest grade, 4 – highest grade)	3	3
9	Type of organizational structure	2 rather centralised	3 rather decentralised
10	Applied wage system	piecework	other
11	Cultural differences in relation to consolidated company (1 – lack, 2 – insignificant, 3 – medium, 4 – biggest)	1 none	2 small

CONSOLIDATION 2

No.	INDICATORS	COMPANY 1 (ACQUIRING)	COMPANY 2 (ACQUIRED)
1	Company assets (million EUR)	12,102.00	6,051.00
2	Average pay (EUR)	35,000.00	32,000.00
3	Total number of employees	100,000	70,000
4	Amount of revenues from sales (million EUR)	20,451.00	12,782.00
5	General assessment of company financial condition (1 – lowest grade, 4 – highest grade)	3	2
6	Whether transition team was established in the company?	YES	YES
7	Whether representatives of the acquired company take part in works of the team?	YES	YES
8	Average level of employees' qualifications (1 – lowest grade, 4 – highest grade)	4	4
9	Type of organizational structure	2 rather centralised	2 rather centralised
10	Applied wage system	incentive wage system	incentive wage system
11	Cultural differences in relation to consolidated company (1 – lack, 2 – insignificant, 3 – medium, 4 – biggest)	1 none	1 none

CONSOLIDATION 3

No.	INDICATORS	COMPANY 1 (ACQUIRING)	COMPANY 2 (ACQUIRED)
1	Company assets (million EUR)	905.00	70.00
2	Average pay (EUR)	30,000.00	20,000.00
3	Total number of employees	11,200	1,164
4	Amount of revenues from sales (million EUR)	700.00	150.00
5	General assessment of company financial condition (1 – lowest grade, 4 – highest grade)	3	2
6	Whether transition team was established in the company?	NO	NO
7	Whether representatives of the acquired company take part in works of the team?	NO	NO
8	Average level of employees' qualifications (1 – lowest grade, 4 – highest grade)	2	3
9	Type of organizational structure	2 rather centralised	3 rather decentralised
10	Applied wage system	other	incentive wage system
11	Cultural differences in relation to consolidated company (1 – lack, 2 – insignificant, 3 – medium, 4 – biggest)	2 small	2 small

CONSOLIDATION 4

No.	INDICATORS	COMPANY 1 (ACQUIRING)	COMPANY 2 (ACQUIRED)
1	Company assets (million EUR)	6,647	132
2	Average pay (EUR)	21,000	20,000
3	Total number of employees	75,000	20,000
4	Amount of revenues from sales (million EUR)	6,737	257
5	General assessment of company financial condition (1 – lowest grade, 4 – highest grade)	3	1
6	Whether transition team was established in the company?	YES	NO
7	Whether representatives of the acquired company take part in works of the team?	NO	NO
8	Average level of employees' qualifications (1 – lowest grade, 4 – highest grade)	2	3
9	Type of organizational structure	1 centralised	2 rather centralised
10	Applied wage system	piecework	incentive wage system
11	Cultural differences in relation to consolidated company (1 – lack, 2 – insignificant, 3 – medium, 4 – biggest)	3 secondary	3 medium

CONSOLIDATION 5

No.	INDICATORS	COMPANY 1 (ACQUIRING)	COMPANY 2 (ACQUIRED)
1	Company assets (million EUR)	882	44
2	Average pay (EUR)	25,000	15,000
3	Total number of employees	17,000	2,500
4	Amount of revenues from sales (million EUR)	1,690	88
5	General assessment of company financial condition (1 – lowest grade, 4 – highest grade)	3	1
6	Whether transition team was established in the company?	NO	NO
7	Whether representatives of the acquired company take part in works of the team?	NO	NO
8	Average level of employees' qualifications (1 – lowest grade, 4 – highest grade)	3	3
9	Type of organizational structure	4 other	2 rather centralised
10	Applied wage system	other	incentive wage system
11	Cultural differences in relation to consolidated company (1 – lack, 2 – insignificant, 3 – medium, 4 – biggest)	3 medium	2 small

CONSOLIDATION 6

No.	INDICATORS	COMPANY 1 (ACQUIRING)	COMPANY 2 (ACQUIRED)
1	Company assets (million EUR)	2,866	450
2	Average pay (EUR)	20,000	28,000
3	Total number of employees	24,000	12,000
4	Amount of revenues from sales (million EUR)	4,042	2400
5	General assessment of company financial condition (1 – lowest grade, 4 – highest grade)	4	1
6	Whether transition team was established in the company?	NO	NO
7	Whether representatives of the acquired company take part in works of the team?	NO	NO
8	Average level of employees' qualifications (1 – lowest grade, 4 – highest grade)	3	2
9	Type of organizational structure	1 centralised	2 rather centralised
10	Applied wage system	piecework	piecework
11	Cultural differences in relation to consolidated company (1 – lack, 2 – insignificant, 3 – medium, 4 – biggest)	1 none	2 small

CONSOLIDATION 7

No.	INDICATORS	COMPANY 1 (ACQUIRING)	COMPANY 2 (ACQUIRED)
1	Company assets (million EUR)	4,042	1,837
2	Average pay (EUR)	20,500	20,000
3	Total number of employees	38,000	4,200
4	Amount of revenues from sales (million EUR)	2,646	110
5	General assessment of company financial condition (1 – lowest grade, 4 – highest grade)	4	1
6	Whether transition team was established in the company?	NO	NO
7	Whether representatives of the acquired company take part in works of the team?	NO	NO
8	Average level of employees' qualifications (1 – lowest grade, 4 – highest grade)	2	3
9	Type of organizational structure	1 centralised	2 rather centralised
10	Applied wage system	piecework	piecework
11	Cultural differences in relation to consolidated company (1 – lack, 2 – insignificant, 3 – medium, 4 – biggest)	1 none	1

CONSOLIDATION 8

No.	INDICATORS	COMPANY 1 (ACQUIRING)	COMPANY 2 (ACQUIRED)
1	Company assets (million EUR)	28,662	26,383
2	Average pay (EUR)	18,000	38,000
3	Total number of employees	224,000	110,000
4	Amount of revenues from sales (million EUR)	20,651	29,985
5	General assessment of company financial condition (1 – lowest grade, 4 – highest grade)	2	4
6	Whether transition team was established in the company?	YES	YES
7	Whether representatives of the acquired company take part in works of the team?	YES	YES
8	Average level of employees' qualifications (1 – lowest grade, 4 – highest grade)	1	4
9	Type of organizational structure	1 centralised	4 other
10	Applied wage system	piecework	other
11	Cultural differences in relation to consolidated company (1 – lack, 2 – insignificant, 3 – medium, 4 – biggest)	3 medium	3 medium

CONSOLIDATION 9

No.	INDICATORS	COMPANY 1 (ACQUIRING)	COMPANY 2 (ACQUIRED)
1	Company assets (million EUR)	13,228	5,879
2	Average pay (EUR)	31,000	35,000
3	Total number of employees	82,700	24,000
4	Amount of revenues from sales (million EUR)	5,879	11,024
5	General assessment of company financial condition (1 – lowest grade, 4 – highest grade)	4	3
6	Whether transition team was established in the company?	YES	YES
7	Whether representatives of the acquired company take part in works of the team?	YES	YES
8	Average level of employees' qualifications (1 – lowest grade, 4 – highest grade)	2	4
9	Type of organizational structure	1 centralised	3 rather decentralised
10	Applied wage system	piecework	other
11	Cultural differences in relation to consolidated company (1 – lack, 2 – insignificant, 3 – medium, 4 – biggest)	3 medium	3 medium

CONSOLIDATION 10

No.	INDICATORS	COMPANY 1 (ACQUIRING)	COMPANY 2 (ACQUIRED)
1	Company assets (million EUR)	2,450	3,100
2	Average pay (EUR)	28,000	31,000
3	Total number of employees	12,100	16,800
4	Amount of revenues from sales (million EUR)	8,500	6,000
5	General assessment of company financial condition (1 – lowest grade, 4 – highest grade)	3	3
6	Whether transition team was established in the company?	YES	YES
7	Whether representatives of the acquired company take part in works of the team?	YES	YES
8	Average level of employees' qualifications (1 – lowest grade, 4 – highest grade)	3	4
9	Type of organizational structure	1 centralised	3 rather decentralised
10	Applied wage system	piecework	incentive wage system
11	Cultural differences in relation to consolidated company (1 – lack, 2 – insignificant, 3 – medium, 4 – biggest)	1 none	2 small

CONSOLIDATION 11

No.	INDICATORS	COMPANY 1 (ACQUIRING)	COMPANY 2 (ACQUIRED)
1	Company assets (million EUR)	4,874	400
2	Average pay (EUR)	35,000	48,000
3	Total number of employees	15,000	500
4	Amount of revenues from sales (million EUR)	4,500	200
5	General assessment of company financial condition (1 – lowest grade, 4 – highest grade)	3	4
6	Whether transition team was established in the company?	NO	NO
7	Whether representatives of the acquired company take part in works of the team?	NO	NO
8	Average level of employees' qualifications (1 – lowest grade, 4 – highest grade)	2	4
9	Type of organizational structure	2 rather centralised	4 other
10	Applied wage system	incentive wage system	other
11	Cultural differences in relation to consolidated company (1 – lack, 2 – insignificant, 3 – medium, 4 – biggest)	3 medium	3 medium

SUMMARY TABLE							
No.	INDICATORS	COMPANY 1 (ACQUIRING)			COMPANY 2 (ACQUIRED)		
1	Company assets (million EUR)	7,682			5,692		
2	Average pay (EUR)	26,420			28,136		
3	Total number of employees	59,355			24,251		
4	Amount of revenues from sales (million EUR)	7,728			7,388		
			number of answers	percent of		number of answers	percent of
5	General assessment of company financial condition (1 – lowest grade, 4 – highest grade)	result: 1	0	0.00%	result: 1	4	36.36%
		result: 2	1	9.09%	result: 2	2	18.18%
		result: 3	7	63.64%	result: 3	3	27.27%
		result: 4	3	27.27%	result: 4	2	18.18%
6	Whether transition team was established in the company?	YES	5	45.45%	YES	4	36.36%
		NO	6	54.55%	NO	7	63.64%
7	Whether representatives of the acquired company take part in works of the team?	YES	4	36.36%	YES	4	36.36%
		NO	7	63.64%	NO	7	63.64%
8	Average level of employees' qualifications (1 – lowest grade, 4 – highest grade)	result: 1	1	9.09%	result: 1	0	0.00%
		result: 2	5	45.45%	result: 2	1	9.09%
		result: 3	4	36.36%	result: 3	5	45.45%
		result: 4	1	9.09%	result: 4	5	45.45%
9	Type of organizational structure	centralised	6	54.55%	centralised	0	0.00%
		rather centralised	4	36.36%	rather centralised	5	45.45%
		rather decentralised	0	0.00%	rather decentralised	4	36.36%
		other	1	9.09%	other	2	18.18%
10	Applied wage system	piecework	7	63.64%	piecework	2	18.18%
		incentive wage system	2	18.18%	incentive wage system	5	45.45%
		daily pay	0	0.00%	daily pay	0	0.00%
		daily-task	0	0.00%	daily-task	0	0.00%
		other	2	18.18%	other	4	36.36%
11	Cultural differences in relation to consolidated company (1 – lack, 2 – insignificant, 3 – medium, 4 – biggest)	1 – lack	5	45.45%	1 – lack	2	18.18%
		2 – small	1	9.09%	2 – small	5	45.45%
		3 – medium	5	45.45%	3 – medium	4	36.36%
		4 – biggest	0	0.00%	4 – biggest	0	0.00%

Source: own study.

Annexe No. 18**Taxonomical calculations for selected steelworks**

4th April 2014

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1. Description of variables

Variable names are mostly adopted according to the numbering of columns in the source table containing the input data. In general, the variables were divided into two groups:

- quantitative variables:
 - continuous:
 - ❖ y3 – company assets,
 - ❖ y4 – average pay,
 - ❖ y6 – sales,
 - discrete:
 - ❖ y5 – number of employees,
 - ❖ y14.1 to y14.4 – time to master the knowledge in months (knowledge-related indicators),
- order variables:
 - y7 – assessment of general financial situation (1 to 4, 1 – the worst, 4 – the best),
 - y8 – appointment transition team (0 – „no”, 1 – „yes”, „no” < „yes”),
 - y9 – participation of the acquired company in Transition Team (0 – „no”, 1 – „yes”, „no” < „yes”),
 - y10 – average level of qualification (1 to 4, 1 – the lowest, 4 – the highest),
 - y11 – type of organizational structure (1 to 4, 1 – the worst, 4 – the best),
 - y12 – dominant pay system (1 to 4, 1 – the worst, 4 – the best),
 - y13 – cultural differences (from 0 to 3, 0 – no difference, 3 – the largest),
 - knowledge related indicators:
 - ❖ y15.1 to y15.4 – the importance of knowledge (from 1 to 4, where 1 – the lowest, 4 – the largest),
 - ❖ y16.1 to y16.4 – type of knowledge (1 – “explicit” knowledge, 2 – “tacit” knowledge, ‘tacit’ < ‘explicit’).

In addition, the variable y1 is the number of the successive company, and y2 includes information about takeover of steelworks (“a” – acquiring steelworks, “b” – acquired steelworks). During work some of the variables were considered as qualitative variables, but ultimately the ordering was ascribed to them as described above. For the order variables, only the dependence measures can be calculated (Spearman’s rank correlation and Kendal coefficient), scattering measures (Taylor index and extension as Gini coefficient), proximity (distance of Kullback-Leiber

and χ^2) and dependencies (Goodman-Kruskal coefficient) and common information measure. Information about the concentration of variables was depicted by Lorentz charts, which simultaneously illustrate the Gini coefficients.

2. Descriptive statistics

2.1. For all steelworks

The table below lists values of the variables. The last four columns contain the product of variables y14 and y15 denoted as y17.1 to y17.4.

	y1	y2	y3	y4	y5	y6	y7	y8	y9	y10	y11	y12	y13	y14.1
British Steel	1	a	7843	27100	53900	9214	3	0	0	3	2	1	1	3
Europipe	2	b	2350	22500	5600	18268	3	0	0	3	3	5	2	2
Thyssen Stahl	3	a	12102	35000	100000	20451	3	1	1	4	2	2	1	2
Thyssen Krupp	4	b	6051	22000	70000	12782	2	1	1	4	2	2	1	1
CMC	5	a	905	30000	11200	700	3	0	0	2	2	5	2	2
Huta Zawiercie	6	b	70	20000	11164	150	2	0	0	3	3	2	2	1
LNМ Holdings	7	a	6647	21000	75000	6737	3	1	0	2	1	1	3	4
PHS	8	b	132	20000	20000	257	1	0	0	3	2	2	3	1
Celsa Group	9	a	882	25000	17000	1690	3	0	0	3	4	5	3	2
Huta Ostrowiec	10	b	44	15000	2500	88	1	0	0	3	2	2	2	2
ZAO Severstal	11	a	2866	24000	24000	4042	4	0	0	3	1	1	1	2
Lucchini	12	b	450	12000	12000	2400	1	0	0	2	2	1	2	3
Evrax	13	a	4042	20500	38000	2646	4	0	0	2	1	1	1	2
Vitkovice Steel	14	b	1837	20000	4200	110	1	0	0	3	2	1	1	2
MSC	15	a	28662	18000	224000	20651	2	1	1	1	1	1	3	4
Arcelor Mittal	16	b	26383	38000	11000	29985	4	1	1	4	4	5	3	1
Tata Steel	17	a	13228	31000	82700	5879	4	1	1	2	1	1	3	4
Corus Group	18	b	5879	35000	24000	11024	3	1	1	4	3	5	3	2
Salzgitter	19	a	2450	28000	12100	8500	3	1	1	3	1	1	1	2
VPE	20	b	3100	31000	16800	6000	3	1	1	4	3	2	2	2
Eramet	21	a	4874	35000	1500	4500	3	0	0	3	2	2	3	3
Tinfos	22	b	400	48000	500	200	4	0	0	4	4	5	3	1
	y14.2	y14.3	y14.4	y15.1	y15.2	y15.3	y15.4	y16.1	y16.2	y16.3				
British Steel	2	1	4	1	2	2	1	1	2	1				
Europipe	1	5	1	1	1	1	2	1	2	1				
Thyssen Stahl	1	3	4	3	4	1	2	2	2	2				
Thyssen Krupp	2	1	3	1	2	1	1	2	1	2				
CMC	1	3	4	2	1	3	1	1	1	1				
Huta Zawiercie	2	3	2	1	1	1	1	1	1	1				
LNМ Holdings	5	2	4	3	4	2	3	1	1	1				
PHS	1	1	1	1	1	1	1	1	1	1				
Celsa Group	1	1	3	2	3	1	1	1	1	1				
Huta Ostrowiec	1	1	2	1	2	1	1	1	1	1				
ZAO Severstal	4	1	1	1	3	2	1	1	1	1				
Lucchini	1	2	1	4	1	2	1	1	1	1				
Evrax	1	4	1	2	2	1	1	1	1	1				
Vitkovice Steel	3	1	2	1	2	1	1	1	1	1				
MSC	5	6	5	3	3	4	2	1	2	1				
Arcelor Mittal	1	1	1	1	1	1	1	1	1	1				
Tata Steel	3	4	4	4	4	4	1	1	1	2				
Corus Group	1	1	1	1	1	1	1	1	1	1				
Salzgitter	1	2	3	3	2	1	3	1	2	1				
VPE	1	1	1	1	2	1	1	1	1	1				
Eramet	2	1	2	2	3	1	1	1	2	2				
Tinfos	1	1	1	3	1	1	1	1	1	1				
	y16.4	y17.1	y17.2	y17.3	y17.4									
British Steel	1	3	4	2	4									
Europipe	1	2	1	5	2									
Thyssen Stahl	1	6	4	3	8									

Thyssen Krupp	2	1	4	1	3
CMC	1	4	1	9	4
Huta Zawiercie	1	1	2	3	2
LNH Holdings	1	12	20	4	12
PHS	1	1	1	1	1
Celsa Group	1	4	3	1	3
Huta Ostrowiec	1	2	2	1	2
ZAO Severstal	1	2	12	2	1
Lucchini	1	12	1	4	1
Evrar	1	4	2	4	1
Vitkovice Steel	1	2	6	1	2
MSC	2	12	15	24	10
Arcelor Mittal	1	1	1	1	1
Tata Steel	1	16	12	16	4
Corus Group	1	2	1	1	1
Salzgitter	1	6	2	2	9
VPE	1	2	2	1	1
Eramet	1	6	6	1	2
Tinfos	1	3	1	1	1

2.1.1. Number characteristic of the group structure

The following list contains the positional measures of all variables (min., max., Q1, Q2, median) and arithmetic means. Each row has the following meaning:

- Min. – minimal value,
- 1st Qu. – first quartile,
- Median – median,
- Mean – arithmetical mean,
- 3rd Qu. – first quartile,
- Max – maximal value.

y3	y4	y5	y6
Min. : 44.0	Min. :12000	Min. : 500	Min. : 88.0
1st Qu.: 887.8	1st Qu.:20125	1st Qu.: 11041	1st Qu.: 947.5
Median : 2983.0	Median :24500	Median : 16900	Median : 5189.5
Mean : 5963.5	Mean :26277	Mean : 37144	Mean : 7557.9
3rd Qu.: 6498.0	3rd Qu.:31000	3rd Qu.: 49925	3rd Qu.:10571.5
Max. :28662.0	Max. :48000	Max. :224000	Max. :29985.0
y7	y8	y9	y10
Min. :1.000	Min. :0.0000	Min. :0.0000	Min. :1.000
1st Qu.:2.000	1st Qu.:0.0000	1st Qu.:0.0000	1st Qu.:2.250
Median :3.000	Median :0.0000	Median :0.0000	Median :3.000
Mean :2.727	Mean :0.4091	Mean :0.3636	Mean :2.955
3rd Qu.:3.000	3rd Qu.:1.0000	3rd Qu.:1.0000	3rd Qu.:3.750
Max. :4.000	Max. :1.0000	Max. :1.0000	Max. :4.000
y11	y12	y13	y14.1
Min. :1.000	Min. :1.000	Min. :1.000	Min. :1.000
1st Qu.:1.250	1st Qu.:1.000	1st Qu.:1.000	1st Qu.:2.000
Median :2.000	Median :2.000	Median :2.000	Median :2.000
Mean :2.182	Mean :2.409	Mean :2.091	Mean :2.182
3rd Qu.:3.000	3rd Qu.:4.250	3rd Qu.:3.000	3rd Qu.:2.750
Max. :4.000	Max. :5.000	Max. :3.000	Max. :4.000
y14.2	y14.3	y14.4	y15.1
Min. :1.000	Min. :1.000	Min. :1.000	Min. :1.000
1st Qu.:1.000	1st Qu.:1.000	1st Qu.:1.000	1st Qu.:1.000
Median :1.000	Median :1.000	Median :2.000	Median :1.500
Mean :1.864	Mean :2.091	Mean :2.318	Mean :1.909
3rd Qu.:2.000	3rd Qu.:3.000	3rd Qu.:3.750	3rd Qu.:3.000
Max. :5.000	Max. :6.000	Max. :5.000	Max. :4.000
y15.2	y15.3	y15.4	y16.1
Min. :1.000	Min. :1.000	Min. :1.000	Min. :1.000

1st Qu.:1.000	1st Qu.:1.000	1st Qu.:1.000	1st Qu.:1.000
Median :2.000	Median :1.000	Median :1.000	Median :1.000
Mean :2.091	Mean :1.545	Mean :1.318	Mean :1.091
3rd Qu.:3.000	3rd Qu.:2.000	3rd Qu.:1.000	3rd Qu.:1.000
Max. :4.000	Max. :4.000	Max. :3.000	Max. :2.000
y16.2	y16.3	y16.4	y17.1
Min. :1.000	Min. :1.000	Min. :1.000	Min. :1.000
1st Qu.:1.000	1st Qu.:1.000	1st Qu.:1.000	1st Qu.:2.000
Median :1.000	Median :1.000	Median :1.000	Median :3.000
Mean :1.273	Mean :1.182	Mean :1.091	Mean :4.727
3rd Qu.:1.750	3rd Qu.:1.000	3rd Qu.:1.000	3rd Qu.:6.000
Max. :2.000	Max. :2.000	Max. :2.000	Max. :16.000
y17.2	y17.3	y17.4	
Min. :1.000	Min. :1	Min. :1.000	
1st Qu.:1.000	1st Qu.:1	1st Qu.:1.000	
Median :2.000	Median :2	Median :2.000	
Mean :4.682	Mean :4	Mean :3.409	
3rd Qu.:5.500	3rd Qu.:4	3rd Qu.:4.000	
Max. :20.000	Max. :24	Max. :12.000	

Additional statistics include a subsequent breakdown in which the meaning of each column is as follows:

- the first column contains variable names,
- vars – the next number of the variable in the list,
- n – number of correct observations,
- mean – arithmetical mean,
- sd – standard deviation,
- median – median,
- trimmed – arithmetic mean calculated after discarding 10;
- mad – median absolute deviation (from median),
- min – minimal value,
- max – maximal value,
- range – range (empirical area of variation),
- skew – skewness factor (classical measure based on the third central moment),
- kurtosis – concentration factor (kurtosis – classical measure based on the fourth central moment),
- se – standard error,
- entropie – entropy,
- Gini – Genie's coefficient,
- var. coeff. – variation coefficient (expressed in deviation from mean x 100),
- var – variance.

	vars	n	mean	sd	median	trimmed	mad	min
y3	1	22	5.963500e+03	7.893009e+03	2983.0	4.224333e+03	4028.2242	44
y4	2	22	2.627727e+04	8.502153e+03	24500.0	2.583889e+04	7413.0000	12000
y5	3	22	3.714382e+04	5.088708e+04	16900.0	2.728689e+04	17791.2000	500
y6	4	22	7.557909e+03	8.256867e+03	5189.5	6.413333e+03	6984.5286	88

y7	5	22	2.727273e+00	1.031957e+00	3.0	2.777778e+00	1.4826	1
y8	6	22	4.090909e-01	5.032363e-01	0.0	3.888889e-01	0.0000	0
y9	7	22	3.636364e-01	4.923660e-01	0.0	3.333333e-01	0.0000	0
y10	8	22	2.954545e+00	8.438727e-01	3.0	3.000000e+00	1.4826	1
y11	9	22	2.181818e+00	1.006473e+00	2.0	2.111111e+00	1.4826	1
y12	10	22	2.409091e+00	1.680677e+00	2.0	2.277778e+00	1.4826	1
y13	11	22	2.090909e+00	8.678979e-01	2.0	2.111111e+00	1.4826	1
y14.1	12	22	2.181818e+00	9.579921e-01	2.0	2.111111e+00	0.7413	1
y14.2	13	22	1.863636e+00	1.320009e+00	1.0	1.611111e+00	0.0000	1
y14.3	14	22	2.090909e+00	1.508992e+00	1.0	1.833333e+00	0.0000	1
y14.4	15	22	2.318182e+00	1.358794e+00	2.0	2.222222e+00	1.4826	1
y15.1	16	22	1.909091e+00	1.064988e+00	1.5	1.777778e+00	0.7413	1
y15.2	17	22	2.090909e+00	1.064988e+00	2.0	2.000000e+00	1.4826	1
y15.3	18	22	1.545455e+00	9.625004e-01	1.0	1.333333e+00	0.0000	1
y15.4	19	22	1.318182e+00	6.463350e-01	1.0	1.166667e+00	0.0000	1
y16.1	20	22	1.090909e+00	2.942449e-01	1.0	1.000000e+00	0.0000	1
y16.2	21	22	1.272727e+00	4.558423e-01	1.0	1.222222e+00	0.0000	1
y16.3	22	22	1.181818e+00	3.947710e-01	1.0	1.111111e+00	0.0000	1
y16.4	23	22	1.090909e+00	2.942449e-01	1.0	1.000000e+00	0.0000	1
y17.1	24	22	4.727273e+00	4.355422e+00	3.0	4.111111e+00	2.2239	1
y17.2	25	22	4.681818e+00	5.285978e+00	2.0	3.666667e+00	1.4826	1
y17.3	26	22	4.000000e+00	5.665266e+00	2.0	2.555556e+00	1.4826	1
y17.4	27	22	3.409091e+00	3.290087e+00	2.0	2.833333e+00	1.4826	1
	max	range	skew	kurtosis	se	entrop	Gini	
y3	28662	28618	1.7930279	2.28304788	1.682795e+03	0.72210001	0.60659958	
y4	48000	36000	0.5902585	-0.13241905	1.812665e+03	0.04912097	0.17496973	
y5	224000	223500	2.2930774	5.48671039	1.084916e+04	0.65987669	0.59599275	
y6	29985	29897	1.1466776	0.36390454	1.760370e+03	0.65705147	0.56007390	
y7	4	3	-0.4655693	-1.01128190	2.200140e-01	0.08462618	0.19848485	
y8	1	1	0.3448752	-1.96424031	1.072903e-01	1.44159140	0.59090909	
y9	1	1	0.5287339	-1.79597107	1.049728e-01	1.58790924	0.63636364	
y10	4	3	-0.3750700	-0.67733708	1.799143e-01	0.04482466	0.14895105	
y11	4	3	0.4576229	-0.94944741	2.145807e-01	0.10340034	0.24431818	
y12	5	4	0.7534724	-1.25646751	3.583215e-01	0.21446724	0.34734134	
y13	3	2	-0.1620448	-1.71325704	1.850365e-01	0.09282158	0.21936759	
y14.1	4	3	0.5870740	-0.63112148	2.042446e-01	0.09153723	0.22537879	
y14.2	5	4	1.3048287	0.36747411	2.814269e-01	0.19181672	0.33148559	
y14.3	6	5	1.1236729	0.07478118	3.217181e-01	0.21219658	0.35375494	
y14.4	5	4	0.4218113	-1.40534842	2.896958e-01	0.16804186	0.31283422	
y15.1	4	3	0.6213746	-1.13356431	2.270562e-01	0.14215178	0.28787879	
y15.2	4	3	0.5075492	-1.09501760	2.270562e-01	0.12375844	0.27075099	
y15.3	4	3	1.5596447	1.16136690	2.052058e-01	0.14050429	0.27005348	
y15.4	3	2	1.6695529	1.38191457	1.377991e-01	0.08740282	0.19592476	
y16.1	2	1	2.6542231	5.29152893	6.273323e-02	0.02608092	0.07575758	
y16.2	2	1	0.9518298	-1.13972107	9.718591e-02	0.05383960	0.15584416	
y16.3	2	1	1.5387098	0.39152893	8.416546e-02	0.04342893	0.12587413	
y16.4	2	1	2.6542231	5.29152893	6.273323e-02	0.02608092	0.07575758	
y17.1	16	15	1.2391630	0.24267444	9.285790e-01	0.34644552	0.45367133	
y17.2	20	19	1.5479358	1.29026551	1.126974e+00	0.47284053	0.52559576	
y17.3	24	23	2.3893702	5.04075676	1.207839e+00	0.55983729	0.56301653	
y17.4	12	11	1.3611968	0.50875055	7.014490e-01	0.35747898	0.46121212	
	wsp.zmien	var						
y3	132.35531	6.229959e+07						
y4	32.35554	7.228660e+07						
y5	137.00012	2.589494e+09						
y6	109.24803	6.817585e+07						
y7	37.83842	1.064935e+00						
y8	123.01331	2.532468e-01						
y9	135.40064	2.424242e-01						
y10	28.56185	7.121212e-01						
y11	46.12999	1.012987e+00						
y12	69.76395	2.824675e+00						
y13	41.50816	7.532468e-01						
y14.1	43.90797	9.177489e-01						
y14.2	70.82976	1.742424e+00						
y14.3	72.16917	2.277056e+00						
y14.4	58.61463	1.846320e+00						

y15.1	55.78508	1.134199e+00
y15.2	50.93420	1.134199e+00
y15.3	62.27943	9.264069e-01
y15.4	49.03231	4.177489e-01
y16.1	26.97245	8.658009e-02
y16.2	35.81618	2.077922e-01
y16.3	33.40370	1.558442e-01
y16.4	26.97245	8.658009e-02
y17.1	92.13392	1.896970e+01
y17.2	112.90437	2.794156e+01
y17.3	141.63165	3.209524e+01
y17.4	96.50923	1.082468e+01

The values of Pearson's linear correlation coefficients between variables y3, y4, y5, y6 and the group of variables y14.1 to y14.4 are shown below.

	y3	y4	y5	y6	y14.1	y14.2
y3	1.00000000	0.17787927	0.7106340	0.80811342	0.33598411	0.39075488
y4	0.1778793	1.00000000	-0.1625170	0.24098520	-0.22806345	-0.27650975
y5	0.7106340	-0.16251697	1.00000000	0.45960664	0.55635412	0.61862451
y6	0.8081134	0.24098520	0.4596066	1.00000000	0.05443591	0.07297093
y14.1	0.3359841	-0.22806345	0.5563541	0.05443591	1.00000000	0.62304658
y14.2	0.3907549	-0.27650975	0.6186245	0.07297093	0.62304658	1.00000000
y14.3	0.3882014	-0.24182970	0.5933926	0.30862240	0.41624976	0.26949200
y14.4	0.3972594	-0.07312639	0.6919846	0.18318491	0.57533217	0.47667749

	y14.3	y14.4
y3	0.3882014	0.39725938
y4	-0.2418297	-0.07312639
y5	0.5933926	0.69198456
y6	0.3086224	0.18318491
y14.1	0.4162498	0.57533217
y14.2	0.2694920	0.47667749
y14.3	1.0000000	0.38003195
y14.4	0.3800320	1.00000000

For all variables (quantitative and ordering), the Spearman rank correlation coefficients were determined and reported below.

	y3	y4	y5	y6	y7	y8
y3	1.00000000	0.37418746	0.64558037	0.83512140	0.408142256	0.70675008
y4	0.37418746	1.00000000	-0.08607044	0.35890295	0.713517116	0.32871004
y5	0.64558037	-0.08607044	1.00000000	0.51623837	0.106410738	0.55389873
y6	0.83512140	0.35890295	0.51623837	1.00000000	0.296667278	0.70675008
y7	0.40814226	0.71351712	0.10641074	0.29666728	1.00000000	0.17013741
y8	0.70675008	0.32871004	0.55389873	0.70675008	0.170137412	1.00000000
y9	0.64043713	0.38822878	0.45439185	0.68511879	0.158085143	0.90851353
y10	0.00000000	0.56165943	-0.24020970	0.19790586	0.126483807	0.22578522
y11	-0.31703026	0.36366960	-0.53922244	-0.07836703	-0.001575370	-0.17619760
y12	-0.25208235	0.47649883	-0.44563176	0.01323583	0.123244838	-0.08539527
y13	0.05354494	0.21864662	-0.10230574	0.01143094	0.098021154	0.13973771
y14.1	0.43170492	-0.14223387	0.38919233	0.21006798	0.019388537	0.14928187
y14.2	0.40336004	-0.25226467	0.37483623	0.08652518	-0.049971035	0.13956137
y14.3	0.20967528	-0.23067302	0.34584539	0.23627126	0.080092229	0.14365897
y14.4	0.40892325	-0.04857982	0.50065870	0.20682534	-0.125130050	0.31263116
y15.1	0.19503785	0.08463013	0.26703346	0.06582527	0.194723529	0.22021132
y15.2	0.50465384	0.03613865	0.55326628	0.21273464	0.185970225	0.33550661
y15.3	0.34298103	-0.17708577	0.47035981	0.12072932	0.097199576	0.08851417
y15.4	0.31609147	-0.05796909	0.32389247	0.50883017	-0.016365976	0.44766601
y16.1	0.29906687	0.12492904	0.39886846	0.37383359	-0.119037168	0.38005848
y16.2	0.37000643	0.14515442	0.12873424	0.53087880	-0.008537573	0.11322770

y16.3	0.42724663	0.32590812	0.27871781	0.27863911	0.098583407	0.32686023
y16.4	0.37383359	-0.27484388	0.42379773	0.39875583	-0.290979744	0.38005848
y17.1	0.32553306	0.03712599	0.34744820	0.13721764	0.178855852	0.18521013
y17.2	0.49146752	-0.14636715	0.50924632	0.15148764	0.032526308	0.25366906
y17.3	0.26519976	-0.25425156	0.43568092	0.22357648	0.129382379	0.07672748
y17.4	0.37711994	-0.06574066	0.44660813	0.29376885	-0.119712414	0.35349702
	y9	y10	y11	y12	y13	y14.1
y3	0.640437129	0.00000000	-0.31703026	-0.25208235	0.053544939	0.43170492
y4	0.388228776	0.56165943	0.36366960	0.47649883	0.218646616	-0.14223387
y5	0.454391850	-0.24020970	-0.53922244	-0.44563176	-0.102305737	0.38919233
y6	0.685118789	0.19790586	-0.07836703	0.01323583	0.011430942	0.21006798
y7	0.158085143	0.12648381	-0.00157537	0.12324484	0.098021154	0.01938854
y8	0.908513525	0.22578522	-0.17619760	-0.08539527	0.139737709	0.14928187
y9	1.000000000	0.35013386	-0.05480928	0.01586920	0.039672999	0.00000000
y10	0.350133858	1.00000000	0.64899071	0.55448641	-0.085503411	-0.64999443
y11	-0.054809282	0.64899071	1.00000000	0.82992774	0.303948383	-0.56658107
y12	0.015869200	0.55448641	0.82992774	1.00000000	0.394871795	-0.57026488
y13	0.039672999	-0.08550341	0.30394838	0.39487179	1.00000000	0.12067038
y14.1	0.000000000	-0.64999443	-0.56658107	-0.57026488	0.120670384	1.00000000
y14.2	-0.025172218	-0.37969089	-0.52912481	-0.59585347	-0.001694691	0.46446352
y14.3	0.106044343	-0.61465847	-0.41132594	-0.24317610	-0.054698147	0.36483307
y14.4	0.202630898	-0.38076446	-0.42467066	-0.29403537	-0.045333076	0.49703805
y15.1	0.120574868	-0.48064969	-0.39475502	-0.31041579	0.224694274	0.52513992
y15.2	0.194837402	-0.23774099	-0.56322451	-0.49929346	-0.062332979	0.59453398
y15.3	-0.018093672	-0.69708220	-0.55318894	-0.47726574	0.107074167	0.67979026
y15.4	0.254194142	-0.19565724	-0.36477029	-0.21768163	-0.053393606	0.32838654
y16.1	0.418330013	0.42609891	-0.02620385	0.07966275	-0.398313753	-0.24187384
y16.2	0.173591269	-0.04297589	-0.19451689	-0.14569591	-0.179977296	0.36430075
y16.3	0.378620093	0.16872254	-0.18554636	-0.03958474	-0.039584739	0.14021942
y16.4	0.418330013	-0.06657796	-0.22273272	-0.13277125	-0.026554250	0.02687487
y17.1	0.060575727	-0.60982020	-0.52850149	-0.44778558	0.151708775	0.81847011
y17.2	0.099132454	-0.30984908	-0.60732255	-0.63330948	-0.121363782	0.57112438
y17.3	-0.007842145	-0.74340847	-0.53735608	-0.39027071	-0.083312659	0.54246029
y17.4	0.199868876	-0.36872306	-0.43818679	-0.28381699	-0.080735687	0.48900594
	y14.2	y14.3	y14.4	y15.1	y15.2	y15.3
y3	0.403360042	0.20967528	0.40892325	0.19503785	0.50465384	0.34298103
y4	-0.252264670	-0.23067302	-0.04857982	0.08463013	0.03613865	-0.17708577
y5	0.374836227	0.34584539	0.50065870	0.26703346	0.55326628	0.47035981
y6	0.086525182	0.23627126	0.20682534	0.06582527	0.21273464	0.12072932
y7	-0.049971035	0.08009223	-0.12513005	0.19472353	0.18597023	0.09719958
y8	0.139561372	0.14365897	0.31263116	0.22021132	0.33550661	0.08851417
y9	-0.025172218	0.10604434	0.20263090	0.12057487	0.19483740	-0.01809367
y10	-0.379690888	-0.61465847	-0.38076446	-0.48064969	-0.23774099	-0.69708220
y11	-0.529124808	-0.41132594	-0.42467066	-0.39475502	-0.56322451	-0.55318894
y12	-0.595853469	-0.24317610	-0.29403537	-0.31041579	-0.49929346	-0.47726574
y13	-0.001694691	-0.05469815	-0.04533308	0.22469427	-0.06233298	0.10707417
y14.1	0.464463524	0.36483307	0.49703805	0.52513992	0.59453398	0.67979026
y14.2	1.000000000	0.10767086	0.47439790	0.06249316	0.55629395	0.53561842
y14.3	0.107670865	1.00000000	0.35309906	0.50873310	0.12525146	0.40312147
y14.4	0.474397897	0.35309906	1.00000000	0.40727157	0.59369202	0.50539044
y15.1	0.062493161	0.50873310	0.40727157	1.00000000	0.38526551	0.44278079
y15.2	0.556293955	0.12525146	0.59369202	0.38526551	1.00000000	0.30258817
y15.3	0.535618425	0.40312147	0.50539044	0.44278079	0.30258817	1.00000000
y15.4	0.136814350	0.53625178	0.40745023	0.39528471	0.33886950	0.11473176
y16.1	-0.014040392	0.01364970	0.28690229	0.02690138	0.26082027	-0.21193552
y16.2	0.081567308	0.31719041	0.37880720	0.18233004	0.26095607	0.03908680
y16.3	0.219766902	0.07121721	0.35964730	0.26066436	0.49573007	-0.01128339
y16.4	0.393130985	0.15014672	0.36514837	0.02690138	0.16953317	0.19679727
y17.1	0.210887974	0.50437379	0.52604447	0.90232066	0.56389804	0.57193220
y17.2	0.850501233	0.09690215	0.61357566	0.21282261	0.89615932	0.39897243
y17.3	0.276700848	0.91838224	0.42813523	0.52566571	0.19010947	0.70213914
y17.4	0.420645765	0.43639506	0.94732923	0.41807835	0.57065453	0.40715682
	y15.4	y16.1	y16.2	y16.3	y16.4	y17.1
y3	0.31609147	0.29906687	0.370006435	0.427246630	0.37383359	0.32553306
y4	-0.05796909	0.12492904	0.145154425	0.325908124	-0.27484388	0.03712599
y5	0.32389247	0.39886846	0.128734241	0.278717807	0.42379773	0.34744820
y6	0.50883017	0.37383359	0.530878798	0.278639106	0.39875583	0.13721764

y7	-0.01636598	-0.11903717	-0.008537573	0.098583407	-0.29097974	0.17885585
y8	0.44766601	0.38005848	0.113227703	0.326860225	0.38005848	0.18521013
y9	0.25419414	0.41833001	0.173591269	0.378620093	0.41833001	0.06057573
y10	-0.19565724	0.42609891	-0.042975885	0.168722545	-0.06657796	-0.60982020
y11	-0.36477029	-0.02620385	-0.194516885	-0.185546360	-0.22273272	-0.52850149
y12	-0.21768163	0.07966275	-0.145695906	-0.039584739	-0.13277125	-0.44778558
y13	-0.05339361	-0.39831375	-0.179977296	-0.039584739	-0.02655425	0.15170877
y14.1	0.32838654	-0.24187384	0.364300750	0.140219424	0.02687487	0.81847011
y14.2	0.13681435	-0.01404039	0.081567308	0.219766902	0.39313098	0.21088797
y14.3	0.53625178	0.01364970	0.317190410	0.071217210	0.15014672	0.50437379
y14.4	0.40745023	0.28690229	0.378807204	0.359647304	0.36514837	0.52604447
y15.1	0.39528471	0.02690138	0.182330040	0.260664356	0.02690138	0.90232066
y15.2	0.33886950	0.26082027	0.260956074	0.495730067	0.16953317	0.56389804
y15.3	0.11473176	-0.21193552	0.039086798	-0.011283387	0.19679727	0.57193220
y15.4	1.00000000	0.17013926	0.604034317	0.000000000	0.17013926	0.43114386
y16.1	0.17013926	1.00000000	0.161374306	0.670820393	0.45000000	-0.08869226
y16.2	0.60403432	0.16137431	1.000000000	0.240562612	0.16137431	0.34350363
y16.3	0.00000000	0.67082039	0.240562612	1.000000000	0.26087460	0.23609752
y16.4	0.17013926	0.45000000	0.161374306	0.260874597	1.00000000	-0.01267032
y17.1	0.43114386	-0.08869226	0.343503633	0.236097518	-0.01267032	1.00000000
y17.2	0.26446498	0.17864035	0.222387138	0.399451963	0.33176065	0.40976916
y17.3	0.46276510	-0.07873451	0.271055514	0.009780873	0.11810177	0.58978827
y17.4	0.64064666	0.27012833	0.498191676	0.297218801	0.32158134	0.53428323
	y17.2	y17.3	y17.4			
y3	0.49146752	0.265199756	0.37711994			
y4	-0.14636715	-0.254251559	-0.06574066			
y5	0.50924632	0.435680917	0.44660813			
y6	0.15148764	0.223576476	0.29376885			
y7	0.03252631	0.129382379	-0.11971241			
y8	0.25366906	0.076727483	0.35349702			
y9	0.09913245	-0.007842145	0.19986888			
y10	-0.30984908	-0.743408470	-0.36872306			
y11	-0.60732255	-0.537356080	-0.43818679			
y12	-0.63330948	-0.390270707	-0.28381699			
y13	-0.12136378	-0.083312659	-0.08073569			
y14.1	0.57112438	0.542460292	0.48900594			
y14.2	0.85050123	0.276700848	0.42064576			
y14.3	0.09690215	0.918382238	0.43639506			
y14.4	0.61357566	0.428135234	0.94732923			
y15.1	0.21282261	0.525665712	0.41807835			
y15.2	0.89615932	0.190109468	0.57065453			
y15.3	0.39897243	0.702139141	0.40715682			
y15.4	0.26446498	0.462765096	0.64064666			
y16.1	0.17864035	-0.078734512	0.27012833			
y16.2	0.22238714	0.271055514	0.49819168			
y16.3	0.39945196	0.009780873	0.29721880			
y16.4	0.33176065	0.118101768	0.32158134			
y17.1	0.40976916	0.589788275	0.53428323			
y17.2	1.00000000	0.208237443	0.57029604			
y17.3	0.20823744	1.000000000	0.47048328			
y17.4	0.57029604	0.470483277	1.00000000			

Kendal correlation coefficients were placed below.

	y3	y4	y5	y6	y7	y8
y3	1.00000000	0.29893648	0.52928541	0.653679654	0.310574368	0.59002826
y4	0.29893648	1.00000000	-0.05727372	0.272559730	0.589416931	0.27796849
y5	0.52928541	-0.05727372	1.00000000	0.407810070	0.081639029	0.46329407
y6	0.65367965	0.27255973	0.40781007	1.000000000	0.188381174	0.59002826
y7	0.31057437	0.58941693	0.08163903	0.188381174	1.000000000	0.15738796
y8	0.59002826	0.27796849	0.46329407	0.590028260	0.157387963	1.00000000
y9	0.53466709	0.32829958	0.38006415	0.571969441	0.146238845	0.90851353
y10	0.01555616	0.44232587	-0.19747255	0.150376188	0.109774466	0.21129642
y11	-0.24654264	0.28613169	-0.41347750	-0.055346306	0.017752722	-0.16260611
y12	-0.18262637	0.38151351	-0.34512900	0.015653689	0.122736348	-0.08064941

y13	0.01565369	0.17486036	-0.09412609	0.005217896	0.085915444	0.13197176
y14.1	0.35370641	-0.10036207	0.30234590	0.176853205	0.012235220	0.13886752
y14.2	0.32237549	-0.21639967	0.29569627	0.060103906	-0.051410017	0.13051847
y14.3	0.16750024	-0.17541284	0.25179597	0.188437775	0.067718278	0.13238873
y14.4	0.32732684	-0.02014557	0.38768085	0.158703920	-0.081660769	0.28571602
y15.1	0.15131899	0.07948198	0.19348141	0.057396860	0.171830888	0.20528941
y15.2	0.40518744	0.03555912	0.43113321	0.155071737	0.164731535	0.30926922
y15.3	0.28347737	-0.12249899	0.38684998	0.090471499	0.085123511	0.08474881
y15.4	0.25519669	-0.04902903	0.25575086	0.393140848	-0.008111872	0.43611285
y16.1	0.24967511	0.10564428	0.33362306	0.312093892	-0.110116976	0.38005848
y16.2	0.30889880	0.12274756	0.10767638	0.443202630	-0.007897800	0.11322770
y16.3	0.35668561	0.27559909	0.23312620	0.232621053	0.091195943	0.32686023
y16.4	0.31209389	-0.23241742	0.35447450	0.332900151	-0.269174831	0.38005848
y17.1	0.25123074	0.05197012	0.23312620	0.111658105	0.125850401	0.16343011
y17.2	0.37222351	-0.11483385	0.40608526	0.117792249	0.027707316	0.22509647
y17.3	0.20162824	-0.17978439	0.33513399	0.162286141	0.104108875	0.06910040
y17.4	0.28236777	-0.02430049	0.33094382	0.205793457	-0.078802301	0.31606327
y3	y9	y10	y11	y12	y13	y14.1
y4	0.534667086	0.01555616	-0.24654264	-0.18262637	0.015653689	0.35370641
y5	0.328299577	0.44232587	0.28613169	0.38151351	0.174860360	-0.10036207
y6	0.380064150	-0.19747255	-0.41347750	-0.34512900	-0.094126091	0.30234590
y7	0.571969441	0.15037619	-0.05534631	0.01565369	0.005217896	0.17685321
y8	0.146238845	0.10977447	0.01775272	0.12273635	0.085915444	0.01223522
y9	0.908513525	0.21129642	-0.16260611	-0.08064941	0.131971761	0.13886752
y10	1.000000000	0.32766551	-0.05058141	0.01498727	0.037468166	0.00000000
y11	0.327665508	1.00000000	0.57857577	0.50000977	-0.081251587	-0.59190318
y12	-0.050581415	0.57857577	1.00000000	0.77627098	0.297166236	-0.50783338
y13	0.014987266	0.50000977	0.77627098	1.00000000	0.364779874	-0.49530024
y14.1	0.037468166	-0.08125159	0.29716624	0.36477987	1.00000000	0.10658360
y14.2	0.000000000	-0.59190318	-0.50783338	-0.49530024	0.106583596	1.00000000
y14.3	-0.023541181	-0.34687974	-0.48264914	-0.55321854	-0.013171870	0.40704994
y14.4	0.097725027	-0.54547867	-0.35285916	-0.21451211	-0.044164258	0.31447163
y15.1	0.185185937	-0.34455513	-0.37467867	-0.26302545	-0.047822810	0.42905817
y15.2	0.112404497	-0.42500830	-0.33355394	-0.26415094	0.194968553	0.46395212
y15.3	0.179600667	-0.20971624	-0.49419440	-0.44015055	-0.084412434	0.53494233
y15.4	-0.017323973	-0.65021366	-0.49772197	-0.43619352	0.101778488	0.62325386
y16.1	0.247634016	-0.17349448	-0.32867381	-0.19952255	-0.049880637	0.29834709
y16.2	0.418330013	0.39875583	-0.02418254	0.07523548	-0.376177397	-0.22500000
y16.3	0.173591269	-0.04021809	-0.17951228	-0.13759883	-0.169975026	0.33888604
y16.4	0.378620093	0.15789549	-0.17123372	-0.03738481	-0.037384810	0.13043730
y17.1	0.418330013	-0.06230560	-0.20555160	-0.12539247	-0.025078493	0.02500000
y17.2	0.053452248	-0.51269596	-0.42718308	-0.36450190	0.117762152	0.74349260
y17.3	0.087966444	-0.26525746	-0.52024539	-0.56223688	-0.141979009	0.49820190
y17.4	-0.007062598	-0.66563935	-0.45154654	-0.34379766	-0.041492821	0.46681047
	0.178703655	-0.32102894	-0.38937591	-0.24228126	-0.080760420	0.41403934
	y14.2	y14.3	y14.4	y15.1	y15.2	y15.3
y3	0.32237549	0.16750024	0.32732684	0.15131899	0.40518744	0.28347737
y4	-0.21639967	-0.17541284	-0.02014557	0.07948198	0.03555912	-0.12249899
y5	0.29569627	0.25179597	0.38768085	0.19348141	0.43113321	0.38684998
y6	0.06010391	0.18843777	0.15870392	0.05739686	0.15507174	0.09047150
y7	-0.05141002	0.06771828	-0.08166077	0.17183089	0.16473153	0.08512351
y8	0.13051847	0.13238873	0.28571602	0.20528941	0.30926922	0.08474881
y9	-0.02354118	0.09772503	0.18518594	0.11240450	0.17960067	-0.01732397
y10	-0.34687974	-0.54547867	-0.34455513	-0.42500830	-0.20971624	-0.65021366
y11	-0.48264914	-0.35285916	-0.37467867	-0.33355394	-0.49419440	-0.49772197
y12	-0.55321854	-0.21451211	-0.26302545	-0.26415094	-0.44015055	-0.43619352
y13	-0.01317187	-0.04416426	-0.04782281	0.19496855	-0.08441243	0.10177849
y14.1	0.40704994	0.31447163	0.42905817	0.46395212	0.53494233	0.62325386
y14.2	1.00000000	0.09249441	0.41940583	0.03951561	0.49879264	0.47960430
y14.3	0.09249441	1.00000000	0.31782715	0.42902422	0.09677616	0.37922881
y14.4	0.41940583	0.31782715	1.00000000	0.36464893	0.52150924	0.44223199
y15.1	0.03951561	0.42902422	0.36464893	1.00000000	0.35573811	0.39257417
y15.2	0.49879264	0.09677616	0.52150924	0.35573811	1.00000000	0.26484213
y15.3	0.47960430	0.37922881	0.44223199	0.39257417	0.26484213	1.00000000
y15.4	0.12187744	0.45868385	0.34767675	0.35747790	0.30285856	0.10570572
y16.1	-0.01313064	0.01257887	0.26220221	0.02507849	0.24042352	-0.20291986
y16.2	0.07628214	0.29230641	0.34619482	0.16997503	0.24054871	0.03742406

y16.3	0.20552708	0.06563013	0.32868444	0.24300127	0.45696283	-0.01080340
y16.4	0.36765801	0.13836752	0.33371191	0.02507849	0.15627529	0.18842559
y17.1	0.15854946	0.40503164	0.42107141	0.81872734	0.48921903	0.49911687
y17.2	0.79095237	0.07406235	0.53439398	0.17605397	0.81123356	0.33479533
y17.3	0.23587020	0.83247841	0.36621026	0.43863839	0.15343138	0.65091399
y17.4	0.36244019	0.34142284	0.88823479	0.36342189	0.48666344	0.33340002
	y15.4	y16.1	y16.2	y16.3	y16.4	y17.1
y3	0.255196690	0.24967511	0.30889880	0.356685614	0.31209389	0.25123074
y4	-0.049029034	0.10564428	0.12274756	0.275599095	-0.23241742	0.05197012
y5	0.255750864	0.33362306	0.10767638	0.233126202	0.35447450	0.23312620
y6	0.393140848	0.31209389	0.44320263	0.232621053	0.33290015	0.11165811
y7	-0.008111872	-0.11011698	-0.00789780	0.091195943	-0.26917483	0.12585040
y8	0.436112853	0.38005848	0.11322770	0.326860225	0.38005848	0.16343011
y9	0.247634016	0.41833001	0.17359127	0.378620093	0.41833001	0.05345225
y10	-0.173494480	0.39875583	-0.04021809	0.157895494	-0.06230560	-0.51269596
y11	-0.328673815	-0.02418254	-0.17951228	-0.171233722	-0.20555160	-0.42718308
y12	-0.199522548	0.07523548	-0.13759883	-0.037384810	-0.12539247	-0.36450190
y13	-0.049880637	-0.37617740	-0.16997503	-0.037384810	-0.02507849	0.11776215
y14.1	0.298347095	-0.22500000	0.33888604	0.130437299	0.02500000	0.74349260
y14.2	0.121877444	-0.01313064	0.07628214	0.205527077	0.36765801	0.15854946
y14.3	0.458683851	0.01257887	0.29230641	0.065630128	0.13836752	0.40503164
y14.4	0.347676748	0.26220221	0.34619482	0.328684438	0.33371191	0.42107141
y15.1	0.357477899	0.02507849	0.16997503	0.243001267	0.02507849	0.81872734
y15.2	0.302858557	0.24042352	0.24054871	0.456962831	0.15627529	0.48921903
y15.3	0.105705725	-0.20291986	0.03742406	-0.010803395	0.18842559	0.49911687
y15.4	1.000000000	0.16574839	0.58844568	0.000000000	0.16574839	0.37062466
y16.1	0.165748386	1.00000000	0.16137431	0.670820393	0.45000000	-0.07826238
y16.2	0.588445677	0.16137431	1.00000000	0.240562612	0.16137431	0.30310889
y16.3	0.000000000	0.67082039	0.24056261	1.000000000	0.26087460	0.20833333
y16.4	0.165748386	0.45000000	0.16137431	0.260874597	1.00000000	-0.01118034
y17.1	0.370624658	-0.07826238	0.30310889	0.208333333	-0.01118034	1.00000000
y17.2	0.232714633	0.15851878	0.19733805	0.354458778	0.29439203	0.32914029
y17.3	0.391762437	-0.07090792	0.24411128	0.008808607	0.10636188	0.48623511
y17.4	0.571886264	0.24152295	0.44543540	0.265744658	0.28752732	0.43719282
	y17.2	y17.3	y17.4			
y3	0.37222351	0.201628236	0.28236777			
y4	-0.11483385	-0.179784388	-0.02430049			
y5	0.40608526	0.335133992	0.33094382			
y6	0.11779225	0.162286141	0.20579346			
y7	0.02770732	0.104108875	-0.07880230			
y8	0.22509647	0.069100399	0.31606327			
y9	0.08796644	-0.007062598	0.17870365			
y10	-0.26525746	-0.665639353	-0.32102894			
y11	-0.52024539	-0.451546542	-0.38937591			
y12	-0.56223688	-0.343797660	-0.24228126			
y13	-0.14197901	-0.041492821	-0.08076042			
y14.1	0.49820190	0.466810466	0.41403934			
y14.2	0.79095237	0.235870203	0.36244019			
y14.3	0.07406235	0.832478405	0.34142284			
y14.4	0.53439398	0.366210260	0.88823479			
y15.1	0.17605397	0.438638393	0.36342189			
y15.2	0.81123356	0.153431382	0.48666344			
y15.3	0.33479533	0.650913995	0.33340002			
y15.4	0.23271463	0.391762437	0.57188626			
y16.1	0.15851878	-0.070907919	0.24152295			
y16.2	0.19733805	0.244111279	0.44543540			
y16.3	0.35445878	0.008808607	0.26574466			
y16.4	0.29439203	0.106361878	0.28752732			
y17.1	0.32914029	0.486235109	0.43719282			
y17.2	1.00000000	0.155222322	0.47922517			
y17.3	0.15522232	1.000000000	0.38057532			
y17.4	0.47922517	0.380575321	1.00000000			

2.1.2. Bar charts and empirical probability density functions

Charts containing bar charts and empirical probability density functions are presented in figures 1-6.

Figure 1. Bar chart for continuous variables

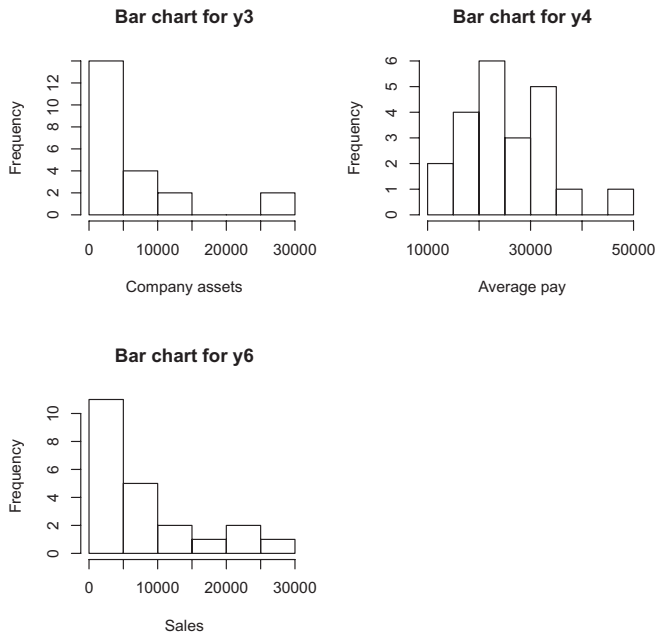


Figure 2. Estimated function of probability density for continuous variables

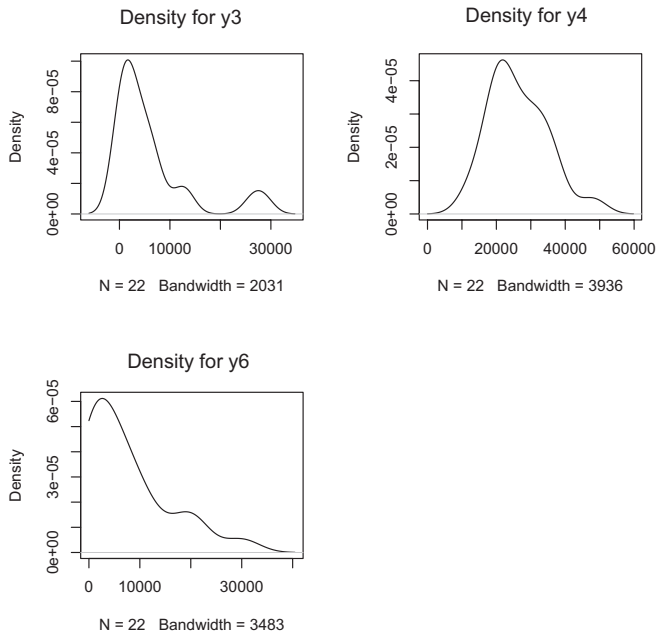


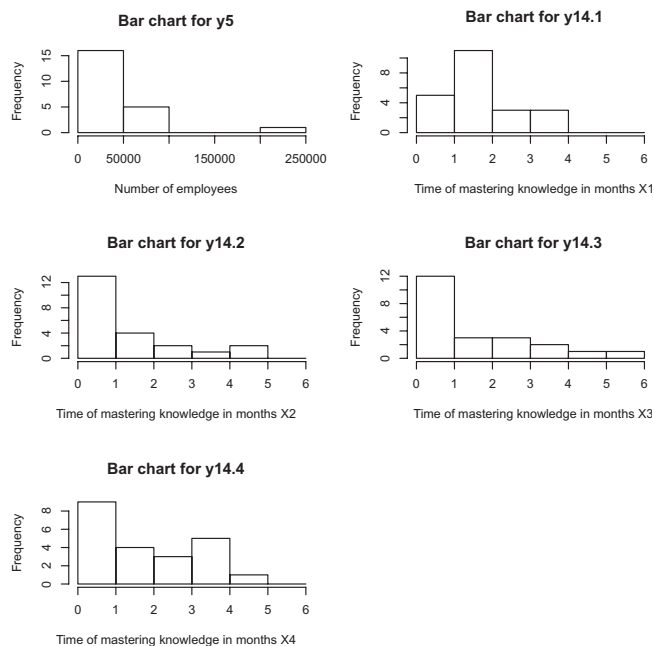
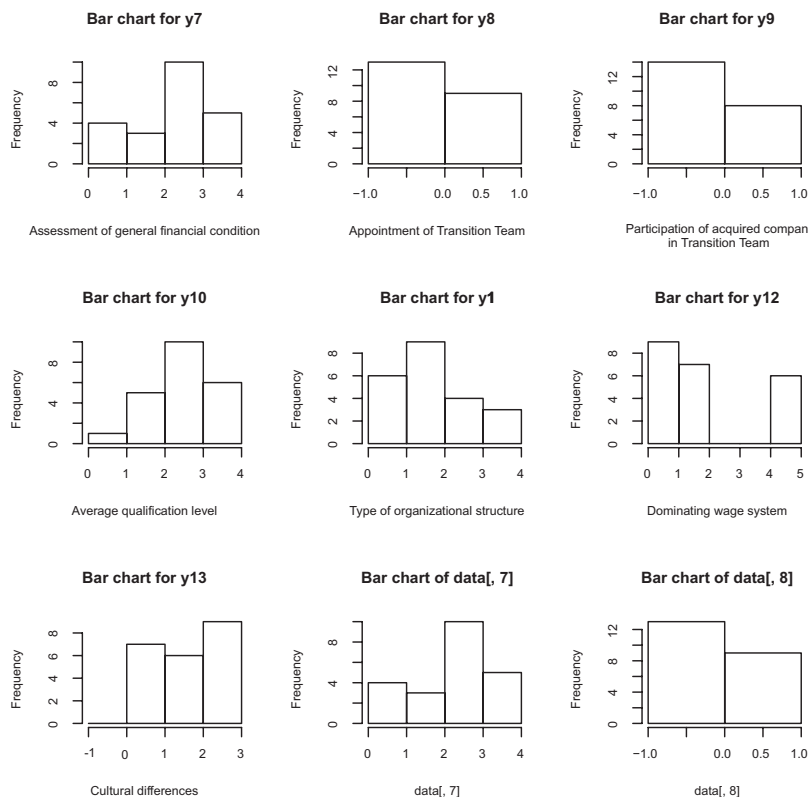
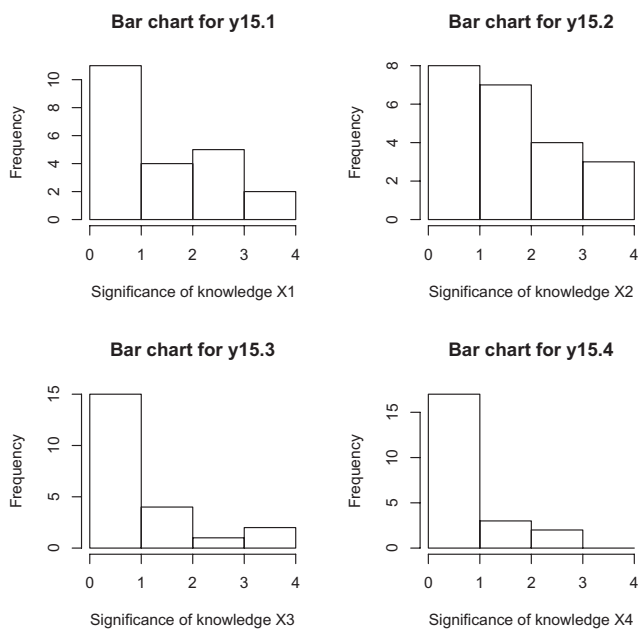
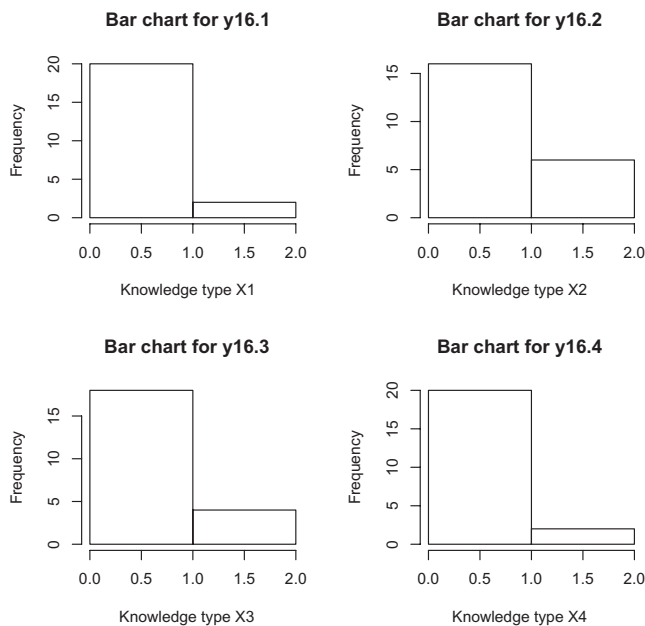
Figure 3. Bar chart for discrete variables**Figure 4.** Bar chart for ordinate variables

Figure 5. Bar chart for variables knowledge significance**Figure 6.** Bar chart for variable types of knowledge

2.1.3. Box-plots

Box plots are contained in figures 7-11.

Figure 7. Boxplot for continuous variables

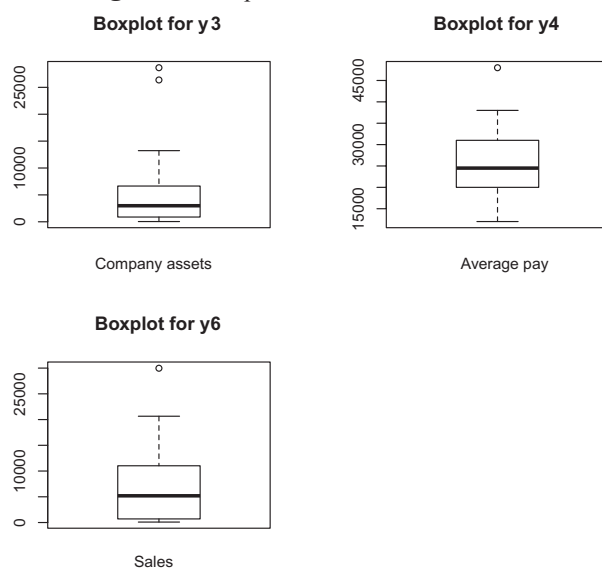


Figure 8. Boxplot for discrete variables

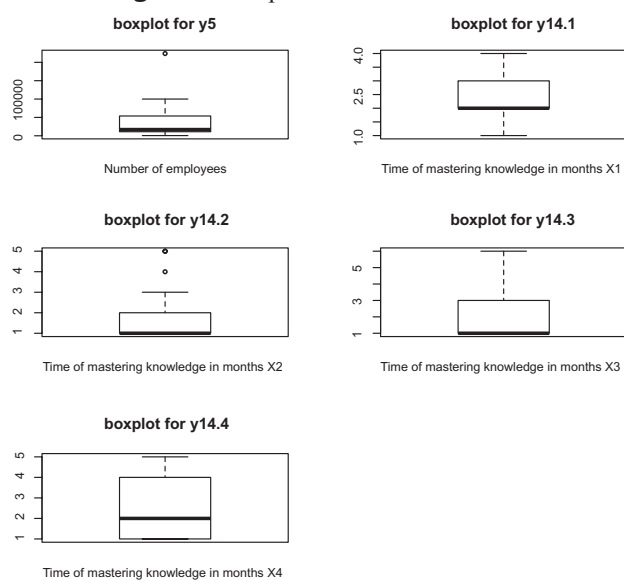


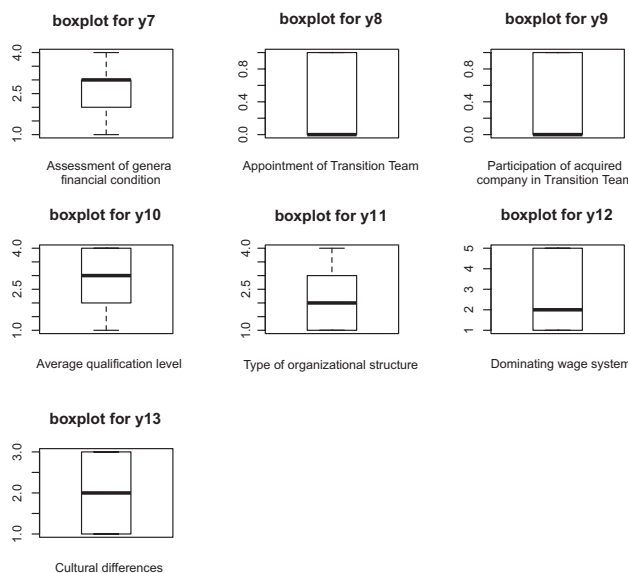
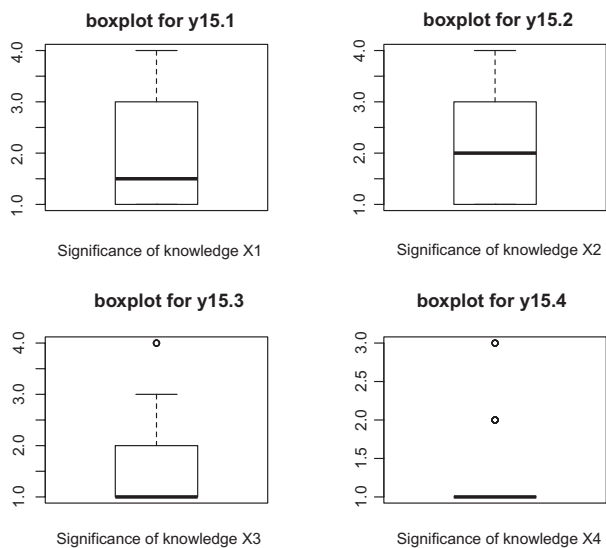
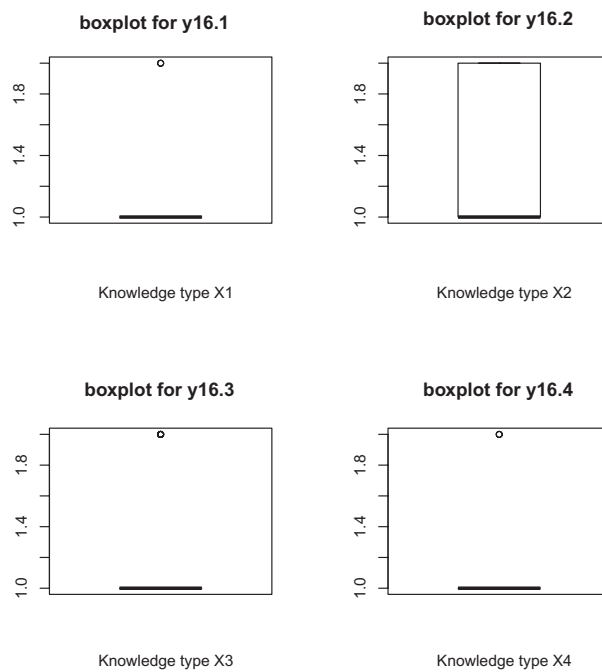
Figure 9. Boxplot for ordinate variables**Figure 10.** Boxplot for variables knowledge significance

Figure 11. Boxplot for variables knowledge type

2.1.4. Lorenz curves

Lorenz curves depict concentration of variables and were placed in Figures 12-16.

Figure 12. Lorenz curves for continuous variables

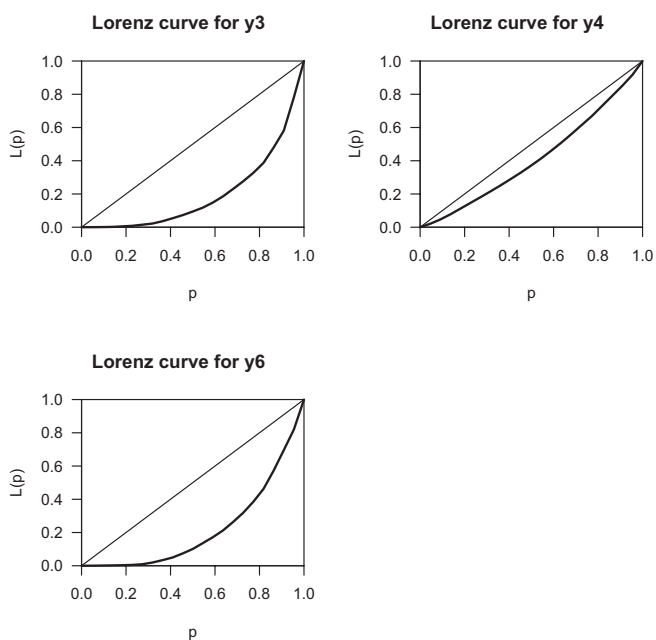


Figure 13. Lorenz curves for discrete variables

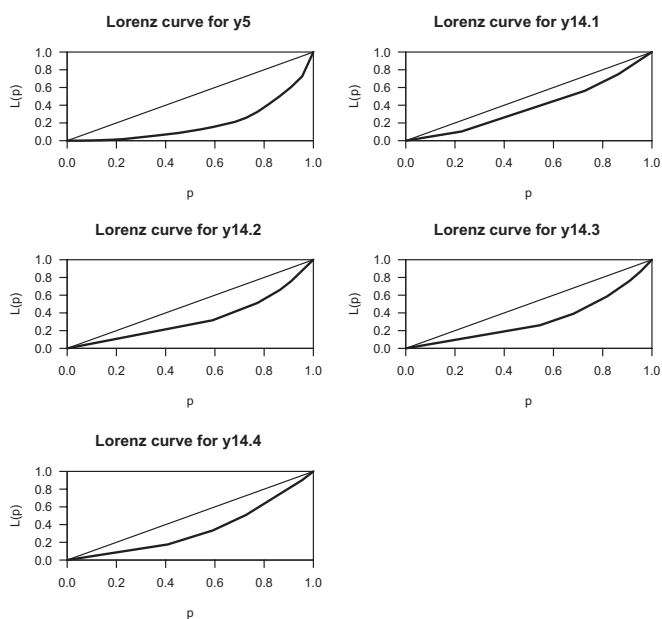


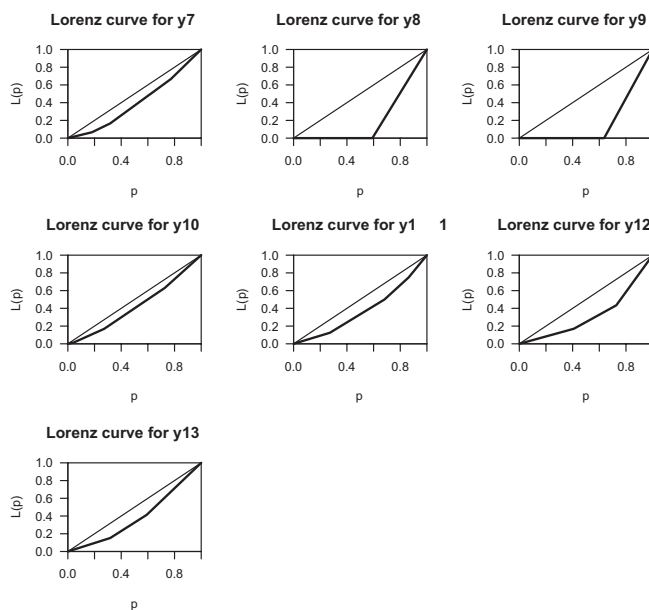
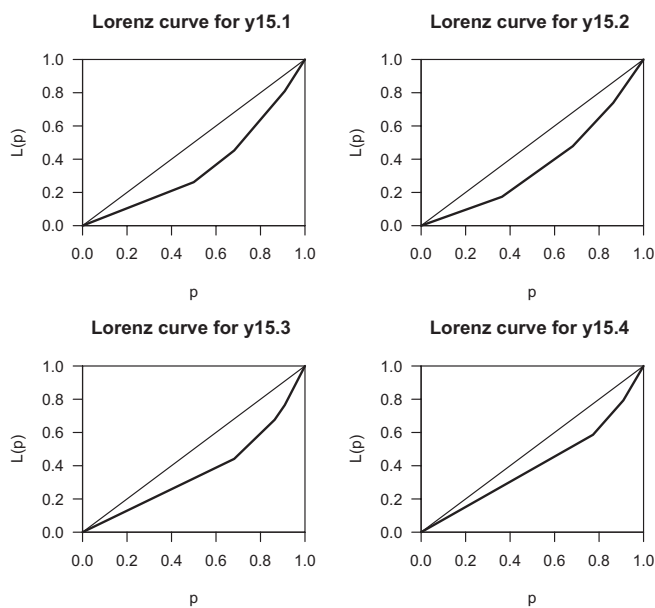
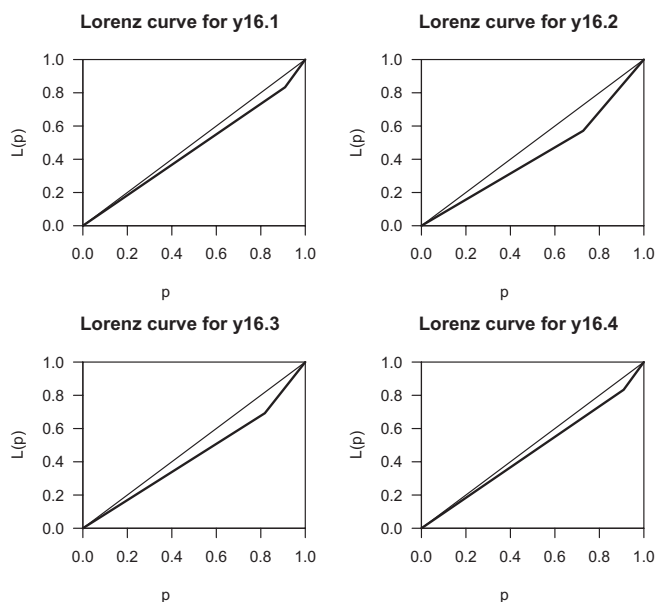
Figure 14. Lorenz curves for serial variables**Figure 15.** Lorenz curves for variables knowledge significance

Figure 16. Lorenz curves for variables knowledge type

2.1.5. Dominants

The dominant values for continuous variables were read as maximal values from empirical density function graphs; they are respectively: $y_3 = 1697$, $y_4 = 21770$ and $y_6 = 2611$. For the remaining variables dominant were read from bar charts and recorded below.

y_5	y_7	y_8	y_9	y_{10}	y_{11}	y_{12}	y_{13}	$y_{14.1}$	$y_{14.2}$	$y_{14.3}$	$y_{14.4}$	$y_{15.1}$
50000	3	0	0	3	2	1	3	2	1	1	1	1
$y_{15.2}$	$y_{15.3}$	$y_{15.4}$	$y_{16.1}$	$y_{16.2}$	$y_{16.3}$	$y_{16.4}$						
1	1	1	1	1	1	1						

2.2. For acquiring steelworks

The table below lists values of the variables for the acquiring steelworks.

	y1	y2	y3	y4	y5	y6	y7	y8	y9	y10	y11	y12	y13	y14.1
British Steel	1	a	7843	27100	53900	9214	3	0	0	3	2	1	1	3
Thyssen Stahl	3	a	12102	35000	100000	20451	3	1	1	4	2	2	1	2
CMC	5	a	905	30000	11200	700	3	0	0	2	2	5	2	2
LNM Holdings	7	a	6647	21000	75000	6737	3	1	0	2	1	1	3	4
Celsa Group	9	a	882	25000	17000	1690	3	0	0	3	4	5	3	2
ZAO Severstal	11	a	2866	24000	24000	4042	4	0	0	3	1	1	1	2
Evrast	13	a	4042	20500	38000	2646	4	0	0	2	1	1	1	2
MSC	15	a	28662	18000	224000	20651	2	1	1	1	1	1	3	4
Tata Steel	17	a	13228	31000	82700	5879	4	1	1	2	1	1	3	4
Salzgitter	19	a	2450	28000	12100	8500	3	1	1	3	1	1	1	2
Eramet	21	a	4874	35000	1500	4500	3	0	0	3	2	2	3	3
	y14.2	y14.3	y14.4	y15.1	y15.2	y15.3	y15.4	y16.1	y16.2	y16.3	y16.4			
British Steel	2	1	4	1	2	2	1	1	2	1	1	1	1	

Thyssen Stahl	1	3	4	3	4	1	2	2	2	2	1
CMC	1	3	4	2	1	3	1	1	1	1	1
LNH Holdings	5	2	4	3	4	2	3	1	1	1	1
Celsa Group	1	1	3	2	3	1	1	1	1	1	1
ZAO Severstal	4	1	1	1	3	2	1	1	1	1	1
Evráz	1	4	1	2	2	1	1	1	1	1	1
MSC	5	6	5	3	3	4	2	1	2	1	2
Tata Steel	3	4	4	4	4	4	1	1	1	2	1
Salzgitter	1	2	3	3	2	1	3	1	2	1	1
Eramet	2	1	2	2	3	1	1	1	2	2	1
	y17.1	y17.2	y17.3	y17.4							
British Steel	3	4	2	4							
Thyssen Stahl	6	4	3	8							
CMC	4	1	9	4							
LNH Holdings	12	20	4	12							
Celsa Group	4	3	1	3							
ZAO Severstal	2	12	2	1							
Evráz	4	2	4	1							
MSC	12	15	24	10							
Tata Steel	16	12	16	4							
Salzgitter	6	2	2	9							
Eramet	6	6	1	2							

2.2.1. Number characteristic of the group structure

The following list contains the positional measures of all variables (min., max., Q1, Q2, median) and arithmetic means.

y3	y4	y5	y6	
Min. : 882	Min. :18000	Min. : 1500	Min. : 700	
1st Qu.: 2658	1st Qu.:22500	1st Qu.: 14550	1st Qu.: 3344	
Median : 4874	Median :27100	Median : 38000	Median : 5879	
Mean : 7682	Mean :26782	Mean : 58127	Mean : 7728	
3rd Qu.: 9972	3rd Qu.:30500	3rd Qu.: 78850	3rd Qu.: 8857	
Max. :28662	Max. :35000	Max. :224000	Max. :20651	
y7	y8	y9	y10	
Min. :2.000	Min. :0.0000	Min. :0.0000	Min. :1.000	
1st Qu.:3.000	1st Qu.:0.0000	1st Qu.:0.0000	1st Qu.:2.000	
Median :3.000	Median :0.0000	Median :0.0000	Median :3.000	
Mean :3.182	Mean :0.4545	Mean :0.3636	Mean :2.545	
3rd Qu.:3.500	3rd Qu.:1.0000	3rd Qu.:1.0000	3rd Qu.:3.000	
Max. :4.000	Max. :1.0000	Max. :1.0000	Max. :4.000	
y11	y12	y13	y14.1	y14.2
Min. :1.000	Min. :1.000	Min. :1	Min. :2.000	Min. :1.000
1st Qu.:1.000	1st Qu.:1.000	1st Qu.:1	1st Qu.:2.000	1st Qu.:1.000
Median :1.000	Median :1.000	Median :2	Median :2.000	Median :2.000
Mean :1.636	Mean :1.909	Mean :2	Mean :2.727	Mean :2.364
3rd Qu.:2.000	3rd Qu.:2.000	3rd Qu.:3	3rd Qu.:3.500	3rd Qu.:3.500
Max. :4.000	Max. :5.000	Max. :3	Max. :4.000	Max. :5.000
y14.3	y14.4	y15.1	y15.2	y15.3
Min. :1.000	Min. :1.000	Min. :1.000	Min. :1.000	Min. :1.0
1st Qu.:1.000	1st Qu.:2.500	1st Qu.:2.000	1st Qu.:2.000	1st Qu.:1.0
Median :2.000	Median :4.000	Median :2.000	Median :3.000	Median :2.0
Mean :2.545	Mean :3.182	Mean :2.364	Mean :2.818	Mean :2.0
3rd Qu.:3.500	3rd Qu.:4.000	3rd Qu.:3.000	3rd Qu.:3.500	3rd Qu.:2.5
Max. :6.000	Max. :5.000	Max. :4.000	Max. :4.000	Max. :4.0
y15.4	y16.1	y16.2	y16.3	
Min. :1.000	Min. :1.000	Min. :1.000	Min. :1.000	
1st Qu.:1.000	1st Qu.:1.000	1st Qu.:1.000	1st Qu.:1.000	
Median :1.000	Median :1.000	Median :1.000	Median :1.000	
Mean :1.545	Mean :1.091	Mean :1.455	Mean :1.273	
3rd Qu.:2.000	3rd Qu.:1.000	3rd Qu.:2.000	3rd Qu.:1.500	
Max. :3.000	Max. :2.000	Max. :2.000	Max. :2.000	
y16.4	y17.1	y17.2	y17.3	

Min. :1.000	Min. : 2.000	Min. : 1.000	Min. : 1.000
1st Qu.:1.000	1st Qu.: 4.000	1st Qu.: 2.500	1st Qu.: 2.000
Median :1.000	Median : 6.000	Median : 4.000	Median : 3.000
Mean :1.091	Mean : 6.818	Mean : 7.364	Mean : 6.182
3rd Qu.:1.000	3rd Qu.: 9.000	3rd Qu.:12.000	3rd Qu.: 6.500
Max. :2.000	Max. :16.000	Max. :20.000	Max. :24.000

y17.4

Min. : 1.000
1st Qu.: 2.500
Median : 4.000
Mean : 5.273
3rd Qu.: 8.500
Max. :12.000

Additional statistics are included in the further list.

	vars	n	mean	sd	median	trimmed	mad	min
y3	1	11	7.681909e+03	8.095813e+03	4874	6.106333e+03	4401.8394	882
y4	2	11	2.678182e+04	5.707332e+03	27100	2.684444e+04	5782.1400	18000
y5	3	11	5.812727e+04	6.400158e+04	38000	4.598889e+04	39733.6800	1500
y6	4	11	7.728182e+03	6.868532e+03	5879	7.073222e+03	4793.2458	700
y7	5	11	3.181818e+00	6.030227e-01	3	3.222222e+00	0.0000	2
y8	6	11	4.545455e-01	5.222330e-01	0	4.444444e-01	0.0000	0
y9	7	11	3.636364e-01	5.045250e-01	0	3.333333e-01	0.0000	0
y10	8	11	2.545455e+00	8.201995e-01	3	2.555556e+00	1.4826	1
y11	9	11	1.636364e+00	9.244163e-01	1	1.444444e+00	0.0000	1
y12	10	11	1.909091e+00	1.578261e+00	1	1.666667e+00	0.0000	1
y13	11	11	2.000000e+00	1.000000e+00	2	2.000000e+00	1.4826	1
y14.1	12	11	2.727273e+00	9.045340e-01	2	2.666667e+00	0.0000	2
y14.2	13	11	2.363636e+00	1.629278e+00	2	2.222222e+00	1.4826	1
y14.3	14	11	2.545455e+00	1.634848e+00	2	2.333333e+00	1.4826	1
y14.4	15	11	3.181818e+00	1.328020e+00	4	3.222222e+00	1.4826	1
y15.1	16	11	2.363636e+00	9.244163e-01	2	2.333333e+00	1.4826	1
y15.2	17	11	2.818182e+00	9.816498e-01	3	2.888889e+00	1.4826	1
y15.3	18	11	2.000000e+00	1.183216e+00	2	1.888889e+00	1.4826	1
y15.4	19	11	1.545455e+00	8.201995e-01	1	1.444444e+00	0.0000	1
y16.1	20	11	1.090909e+00	3.015113e-01	1	1.000000e+00	0.0000	1
y16.2	21	11	1.454545e+00	5.222330e-01	1	1.444444e+00	0.0000	1
y16.3	22	11	1.272727e+00	4.670994e-01	1	1.222222e+00	0.0000	1
y16.4	23	11	1.090909e+00	3.015113e-01	1	1.000000e+00	0.0000	1
y17.1	24	11	6.818182e+00	4.490394e+00	6	6.333333e+00	2.9652	2
y17.2	25	11	7.363636e+00	6.344647e+00	4	6.666667e+00	2.9652	1
y17.3	26	11	6.181818e+00	7.400246e+00	3	4.777778e+00	1.4826	1
y17.4	27	11	5.272727e+00	3.823373e+00	4	5.000000e+00	4.4478	1
	max	range	skew	kurtosis	se	entrop	Gini	
y3	28662	27780	1.46306419	1.2503807	2.440980e+03	0.42939430	0.49425343	
y4	35000	17000	0.03652798	-1.4371112	1.720825e+03	0.02107719	0.11602790	
y5	224000	222500	1.44145499	1.2506324	1.929720e+04	0.50397342	0.51906617	
y6	20651	19951	0.96277072	-0.5966863	2.070940e+03	0.34620187	0.43985413	
y7	4	2	-0.02055759	-0.7293388	1.818182e-01	0.01688923	0.08831169	
y8	1	1	0.15825241	-2.1460055	1.574592e-01	1.30320055	0.54545455	
y9	1	1	0.49142043	-1.9079103	1.521200e-01	1.58790924	0.63636364	
y10	4	3	-0.13071777	-0.8409166	2.472995e-01	0.05306471	0.16233766	
y11	4	3	1.36385545	1.0168133	2.787220e-01	0.11779852	0.25252525	
y12	5	4	1.24413101	-0.2552992	4.758637e-01	0.23636811	0.35497835	
y13	3	2	0.00000000	-2.0909091	3.015113e-01	0.12390609	0.24793388	
y14.1	4	2	0.48119992	-1.7015611	2.727273e-01	0.04767594	0.16363636	
y14.2	5	4	0.59931589	-1.4354282	4.912457e-01	0.20788667	0.34965035	
y14.3	6	5	0.67574451	-0.7799081	4.929252e-01	0.18413985	0.33116883	
y14.4	5	4	-0.53121302	-1.2334041	4.004130e-01	0.10336332	0.21298701	
y15.1	4	3	0.01711952	-1.1561157	2.787220e-01	0.07721997	0.20279720	
y15.2	4	3	-0.25733401	-1.2251559	2.959786e-01	0.06397453	0.18181818	
y15.3	4	3	0.65856176	-1.2374768	3.567530e-01	0.14956149	0.29752066	
y15.4	3	2	0.85783536	-1.0600547	2.472995e-01	0.11181611	0.24598930	
y16.1	2	1	2.46691100	4.5206612	9.090909e-02	0.02608092	0.07575758	

y16.2	2	1	0.15825241	-2.1460055	1.574592e-01	0.05892477	0.17045455
y16.3	2	1	0.88465789	-1.3126722	1.408358e-01	0.05383960	0.15584416
y16.4	2	1	2.46691100	4.5206612	9.090909e-02	0.02608092	0.07575758
y17.1	16	14	0.81935211	-0.8777148	1.353905e+00	0.18102355	0.32969697
y17.2	20	19	0.68851851	-1.1071863	1.912983e+00	0.34390155	0.44219978
y17.3	24	23	1.36279688	0.4150451	2.231258e+00	0.50836855	0.54010695
y17.4	12	11	0.44433030	-1.4635038	1.152790e+00	0.26249864	0.38244514
wsp.zmien			var				
y3	105.38804		6.554219e+07				
y4	21.31047		3.257364e+07				
y5	110.10594		4.096202e+09				
y6	88.87642		4.717673e+07				
y7	18.95214		3.636364e-01				
y8	114.89125		2.727273e-01				
y9	138.74437		2.545455e-01				
y10	32.22212		6.727273e-01				
y11	56.49211		8.545455e-01				
y12	82.67084		2.490909e+00				
y13	50.00000		1.000000e+00				
y14.1	33.16625		8.181818e-01				
y14.2	68.93097		2.654545e+00				
y14.3	64.22616		2.672727e+00				
y14.4	41.73776		1.763636e+00				
y15.1	39.10992		8.545455e-01				
y15.2	34.83274		9.636364e-01				
y15.3	59.16080		1.400000e+00				
y15.4	53.07173		6.727273e-01				
y16.1	27.63854		9.090909e-02				
y16.2	35.90352		2.727273e-01				
y16.3	36.70066		2.181818e-01				
y16.4	27.63854		9.090909e-02				
y17.1	65.85911		2.016364e+01				
y17.2	86.16187		4.025455e+01				
y17.3	119.70986		5.476364e+01				
y17.4	72.51225		1.461818e+01				

The values of Pearson's linear correlation coefficients between variables y3, y4, y5, y6 and the group of variables y14.1 to y14.4 are shown below.

	y3	y4	y5	y6	y14.1	y14.2
y3	1.0000000	-0.26267249	0.9685245	0.8062624	0.6600592	0.5593369
y4	-0.2626725	1.0000000	-0.4067049	-0.0147776	-0.2354402	-0.5336939
y5	0.9685245	-0.4067049	1.0000000	0.8101408	0.6111107	0.5915924
y6	0.8062624	-0.0147776	0.8101408	1.0000000	0.2965247	0.2790455
y14.1	0.6600592	-0.2354402	0.6111107	0.2965247	1.0000000	0.7525704
y14.2	0.5593369	-0.53369386	0.5915924	0.2790455	0.7525704	1.0000000
y14.3	0.7528173	-0.34071598	0.7678625	0.4897132	0.3811507	0.2559742
y14.4	0.5952265	0.03346369	0.6224404	0.5585746	0.5448919	0.2436889
	y14.3	y14.4				
y3	0.7528173	0.59522651				
y4	-0.3407160	0.03346369				
y5	0.7678625	0.62244040				
y6	0.4897132	0.55857462				
y14.1	0.3811507	0.54489193				
y14.2	0.2559742	0.24368887				
y14.3	1.0000000	0.41034727				
y14.4	0.4103473	1.00000000				

For all variables (quantitative and ordering), the Spearman rank correlation coefficients were determined and reported below.

	y3	y4	y5	y6	y7	y8
y3	1.00000000	-0.00455582	0.81818182	0.77272727	-0.15990054	0.57735027
y4	-0.00455582	1.00000000	-0.30523997	-0.02277910	0.05342173	0.02893335
y5	0.81818182	-0.30523997	1.00000000	0.68181818	-0.10660036	0.63508530
y6	0.77272727	-0.02277910	0.68181818	1.00000000	-0.47970161	0.69282032
y7	-0.15990054	0.05342173	-0.10660036	-0.47970161	1.00000000	-0.27080128
y8	0.57735027	0.02893335	0.63508530	0.69282032	-0.27080128	1.00000000
y9	0.53785287	0.20964201	0.53785287	0.65737574	-0.21022947	0.82807867
y10	-0.25434031	0.56376613	-0.26901379	0.08314972	0.05735393	-0.18637822
y11	-0.33127067	0.48526897	-0.35675303	-0.25482360	-0.32868787	-0.48550416
y12	-0.47673129	0.49905486	-0.46084025	-0.47673129	-0.27329720	-0.37004615
y13	0.18090681	-0.03021989	0.06030227	-0.09045340	-0.31819805	0.19148542
y14.1	0.73367761	-0.14606282	0.49246853	0.47236777	-0.24748737	0.44679932
y14.2	0.57495957	-0.39618616	0.45517633	0.38330638	-0.08989331	0.30429031
y14.3	0.49203136	-0.21604817	0.56700757	0.23898666	-0.02747419	0.53568323
y14.4	0.59891622	0.01440677	0.61329021	0.57016824	-0.61801654	0.57815159
y15.1	0.47792761	0.14849543	0.49226544	0.43013485	-0.16812594	0.91057439
y15.2	0.54077652	0.14501138	0.57398210	0.36051768	0.06118670	0.57239869
y15.3	0.45866432	-0.22259657	0.42486800	0.14966941	-0.06227524	0.24529766
y15.4	0.24366266	-0.16192737	0.36019698	0.63564173	-0.49690399	0.80737343
y16.1	0.30000000	0.45102623	0.40000000	0.40000000	-0.11726039	0.34641016
y16.2	0.40414519	0.28933346	0.11547005	0.75055535	-0.60930288	0.26666667
y16.3	0.45184806	0.77636314	0.12909944	0.19364917	0.15138252	0.26087460
y16.4	0.50000000	-0.50114025	0.50000000	0.50000000	-0.58630197	0.34641016
y17.1	0.58481429	0.12095117	0.45021418	0.44557279	-0.26124021	0.82534879
y17.2	0.65447766	-0.25458983	0.56751909	0.47598376	-0.09123449	0.43599560
y17.3	0.53000457	-0.28870285	0.60374433	0.21661056	-0.02702111	0.49757981
y17.4	0.41841845	-0.06912736	0.48279051	0.66671071	-0.65777992	0.81763508
	y9	y10	y11	y12	y13	y14.1
y3	0.53785287	-0.25434031	-0.33127067	-0.47673129	0.18090681	0.73367761
y4	0.20964201	0.56376613	0.48526897	0.49905486	-0.03021989	-0.14606282
y5	0.53785287	-0.26901379	-0.35675303	-0.46084025	0.06030227	0.49246853
y6	0.65737574	0.08314972	-0.25482360	-0.47673129	-0.09045340	0.47236777
y7	-0.21022947	0.05735393	-0.32868787	-0.27329720	-0.31819805	-0.24748737
y8	0.82807867	-0.18637822	-0.48550416	-0.37004615	0.19148542	0.44679932
y9	1.00000000	-0.03215330	-0.33502970	-0.24374901	0.00000000	0.1982062
y10	-0.03215330	1.00000000	0.52098807	0.32204320	-0.47044212	-0.5299233
y11	-0.33502970	0.52098807	1.00000000	0.84632727	0.08451543	-0.3239758
y12	-0.24374901	0.32204320	0.84632727	1.00000000	0.22838672	-0.4333492
y13	0.00000000	-0.47044212	0.08451543	0.22838672	1.00000000	0.6500000
y14.1	0.19820624	-0.52992331	-0.32397580	-0.43334916	0.65000000	1.0000000
y14.2	0.03149704	-0.44081536	-0.51035454	-0.56114611	0.44494921	0.7998492
y14.3	0.58528953	-0.67064033	-0.48600142	-0.24027578	0.10879223	0.2486679
y14.4	0.47245559	-0.36863507	0.04029115	-0.01395886	0.34960295	0.5773746
y15.1	0.78544504	-0.31113727	-0.38850127	-0.16708490	0.39627664	0.4332625
y15.2	0.34301991	0.08677536	-0.14626418	-0.09950372	0.44052174	0.4746097
y15.3	0.19043040	-0.67797926	-0.35186578	-0.30382181	0.35228194	0.6084870
y15.4	0.52231931	-0.03704922	-0.38604402	-0.29320988	0.00000000	0.1932503
y16.1	0.41833001	0.53802759	0.28030596	0.29133579	-0.33166248	-0.2763854
y16.2	0.44854261	0.37275645	0.16183472	-0.06728112	-0.19148542	0.1276569
y16.3	0.38575837	0.31256578	0.18093672	0.22566773	0.21408721	0.2140872
y16.4	0.41833001	-0.53802759	-0.28030596	-0.23306863	0.33166248	0.4422166
y17.1	0.64073787	-0.41703110	-0.36428206	-0.18389934	0.61574907	0.6773240
y17.2	0.15043277	-0.24624268	-0.41052640	-0.46134810	0.48574139	0.7766802
y17.3	0.42415391	-0.79348057	-0.52966095	-0.32224550	0.18342535	0.4305401
y17.4	0.54407103	-0.23996379	-0.20621570	-0.18753888	0.24399771	0.4727456
	y14.2	y14.3	y14.4	y15.1	y15.2	y15.3
y3	0.57495957	0.49203136	0.59891622	0.47792761	0.54077652	0.45866432
y4	-0.39618616	-0.21604817	0.01440677	0.14849543	0.14501138	-0.22259657
y5	0.45517633	0.56700757	0.61329021	0.49226544	0.57398210	0.42486800
y6	0.38330638	0.23898666	0.57016824	0.43013485	0.36051768	0.14966941
y7	-0.08989331	-0.02747419	-0.61801654	-0.16812594	0.06118670	-0.06227524
y8	0.30429031	0.53568323	0.57815159	0.91057439	0.57239869	0.24529766
y9	0.03149704	0.58528953	0.47245559	0.78544504	0.34301991	0.19043040
y10	-0.44081536	-0.67064033	-0.36863507	-0.31113727	0.08677536	-0.67797926
y11	-0.51035454	-0.48600142	0.04029115	-0.38850127	-0.14626418	-0.35186578
y12	-0.56114611	-0.24027578	-0.01395886	-0.16708490	-0.09950372	-0.30382181

y13	0.44494921	0.10879223	0.34960295	0.39627664	0.44052174	0.35228194
y14.1	0.79984917	0.24866795	0.57737457	0.43326246	0.47460973	0.60848698
y14.2	1.00000000	0.05680415	0.32323232	0.14609618	0.48002400	0.63869545
y14.3	0.05680415	1.00000000	0.45937270	0.64790904	0.09047131	0.42556278
y14.4	0.32323232	0.45937270	1.00000000	0.50881774	0.24001200	0.63615085
y15.1	0.14609618	0.64790904	0.50881774	1.00000000	0.55363145	0.21574716
y15.2	0.48002400	0.09047131	0.24001200	0.55363145	1.00000000	0.09825205
y15.3	0.63869545	0.42556278	0.63615085	0.21574716	0.09825205	1.00000000
y15.4	0.18425693	0.24846700	0.38805627	0.61264464	0.29574716	-0.07032912
y16.1	-0.31622777	0.15463843	0.21081851	0.26286019	0.41744152	-0.31865100
y16.2	-0.03042903	-0.05952036	0.27386128	0.09105744	-0.06025249	-0.21463545
y16.3	-0.03402069	0.09981868	0.06804138	0.40722125	0.57259686	-0.10284417
y16.4	0.47434165	0.51546143	0.52704628	0.26286019	0.05218019	0.47797650
y17.1	0.36204112	0.56701161	0.53327678	0.93210664	0.59820501	0.29333132
y17.2	0.93350900	0.03774635	0.31599400	0.29113805	0.74749586	0.45453197
y17.3	0.33034629	0.89798637	0.61697027	0.54273096	0.11062296	0.73918434
y17.4	0.29080336	0.34603375	0.79486253	0.67199963	0.28551048	0.31256723
	y15.4	y16.1	y16.2	y16.3	y16.4	y17.1
y3	0.24366266	0.30000000	0.40414519	0.45184806	0.50000000	0.5848143
y4	-0.16192737	0.45102623	0.28933346	0.77636314	-0.50114025	0.1209512
y5	0.36019698	0.40000000	0.11547005	0.12909944	0.50000000	0.4502142
y6	0.63564173	0.40000000	0.75055535	0.19364917	0.50000000	0.4455728
y7	-0.49690399	-0.11726039	-0.60930288	0.15138252	-0.58630197	-0.2612402
y8	0.80737343	0.34641016	0.26666667	0.26087460	0.34641016	0.8253488
y9	0.52231931	0.41833001	0.44854261	0.38575837	0.41833001	0.6407379
y10	-0.03704922	0.53802759	0.37275645	0.31256578	-0.53802759	-0.4170311
y11	-0.38604402	0.28030596	0.16183472	0.18093672	-0.28030596	-0.3642821
y12	-0.29320988	0.29133579	-0.06728112	0.22566773	-0.23306863	-0.1838993
y13	0.00000000	-0.33166248	-0.19148542	0.21408721	0.33166248	0.6157491
y14.1	0.19325030	-0.27638540	0.12765695	0.21408721	0.44221664	0.6773240
y14.2	0.18425693	-0.31622777	-0.03042903	-0.03402069	0.47434165	0.3620411
y14.3	0.24846700	0.15463843	-0.05952036	0.09981868	0.51546143	0.5670116
y14.4	0.38805627	0.21081851	0.27386128	0.06804138	0.52704628	0.5332768
y15.1	0.61264464	0.26286019	0.09105744	0.40722125	0.26286019	0.9321066
y15.2	0.29574716	0.41744152	-0.06025249	0.57259686	0.05218019	0.5982050
y15.3	-0.07032912	-0.31865100	-0.21463545	-0.10284417	0.47797650	0.2933313
y15.4	1.00000000	0.29133579	0.37004615	-0.11283387	0.29133579	0.5354716
y16.1	0.29133579	1.00000000	0.34641016	0.51639778	-0.10000000	0.1021104
y16.2	0.37004615	0.34641016	1.00000000	0.26087460	0.34641016	0.1473837
y16.3	-0.11283387	0.51639778	0.26087460	1.00000000	-0.19364917	0.4613840
y16.4	0.29133579	-0.10000000	0.34641016	-0.19364917	1.00000000	0.3573865
y17.1	0.53547162	0.10211043	0.14738371	0.46138400	0.35738651	1.0000000
y17.2	0.27200870	-0.05034444	0.02906637	0.19498316	0.40275549	0.4813557
y17.3	0.20677419	0.00000000	-0.20488581	-0.03272418	0.50696089	0.5106010
y17.4	0.84660407	0.20231222	0.35041504	-0.06529599	0.40462443	0.6479159
	y17.2	y17.3	y17.4			
y3	0.65447766	0.53000457	0.41841845			
y4	-0.25458983	-0.28870285	-0.06912736			
y5	0.56751909	0.60374433	0.48279051			
y6	0.47598376	0.21661056	0.66671071			
y7	-0.09123449	-0.02702111	-0.65777992			
y8	0.43599560	0.49757981	0.81763508			
y9	0.15043277	0.42415391	0.54407103			
y10	-0.24624268	-0.79348057	-0.23996379			
y11	-0.41052640	-0.52966095	-0.20621570			
y12	-0.46134810	-0.32224550	-0.18753888			
y13	0.48574139	0.18342535	0.24399771			
y14.1	0.77668025	0.43054006	0.47274557			
y14.2	0.93350900	0.33034629	0.29080336			
y14.3	0.03774635	0.89798637	0.34603375			
y14.4	0.31599400	0.61697027	0.79486253			
y15.1	0.29113805	0.54273096	0.67199963			
y15.2	0.74749586	0.11062296	0.28551048			
y15.3	0.45453197	0.73918434	0.31256723			
y15.4	0.27200870	0.20677419	0.84660407			
y16.1	-0.05034444	0.00000000	0.20231222			
y16.2	0.02906637	-0.20488581	0.35041504			

y16.3	0.19498316	-0.03272418	-0.06529599
y16.4	0.40275549	0.50696089	0.40462443
y17.1	0.48135571	0.51060096	0.64791589
y17.2	1.00000000	0.22970394	0.32407755
y17.3	0.22970394	1.00000000	0.43123660
y17.4	0.32407755	0.43123660	1.00000000

Kendal correlation coefficients were placed below.

	y3	y4	y5	y6	y7	y8
y3	1.00000000	-0.03669879	0.67272727	0.63636364	-0.12108987	0.4923660
y4	-0.03669879	1.00000000	-0.29359034	-0.03669879	0.02444119	0.0248452
y5	0.67272727	-0.29359034	1.00000000	0.52727273	-0.07265392	0.5416026
y6	0.63636364	-0.03669879	0.52727273	1.00000000	-0.41170556	0.5908392
y7	-0.12108987	0.02444119	-0.07265392	-0.41170556	1.00000000	-0.2623303
y8	0.49236596	0.02484520	0.54160256	0.59083916	-0.26233033	1.0000000
y9	0.45868247	0.18002057	0.45868247	0.56061191	-0.20365327	0.8280787
y10	-0.19432508	0.47939500	-0.23750843	0.10795838	0.02875987	-0.1754116
y11	-0.27749837	0.37340802	-0.27749837	-0.18499892	-0.30802055	-0.4696682
y12	-0.38138504	0.38490018	-0.33371191	-0.38138504	-0.25400025	-0.3550235
y13	0.11396058	0.00000000	0.02279212	-0.06837635	-0.30358837	0.1851640
y14.1	0.62925320	-0.11340230	0.40451992	0.40451992	-0.23947374	0.4260064
y14.2	0.47294677	-0.33203883	0.34956935	0.30844355	-0.05477910	0.2784230
y14.3	0.39762139	-0.14045016	0.43738352	0.19881069	0.00000000	0.4845437
y14.4	0.47294677	0.04150485	0.47294677	0.47294677	-0.57518059	0.5290037
y15.1	0.37451267	0.10499013	0.33290015	0.29128763	-0.16628220	0.8451543
y15.2	0.43182096	0.04150485	0.43182096	0.30844355	0.05477910	0.5290037
y15.3	0.35799392	-0.14876790	0.35799392	0.10529233	-0.05609927	0.2281064
y15.4	0.19069252	-0.12028131	0.28603878	0.47673129	-0.44450044	0.7745967
y16.1	0.25584086	0.38729833	0.34112115	0.34112115	-0.11359237	0.3464102
y16.2	0.34465617	0.24845200	0.09847319	0.64007575	-0.59024325	0.2666667
y16.3	0.38533732	0.66666667	0.11009638	0.16514456	0.14664712	0.2608746
y16.4	0.42640143	-0.43033148	0.42640143	0.42640143	-0.56796183	0.3464102
y17.1	0.46709937	0.11785113	0.27247463	0.31139958	-0.25923792	0.7378648
y17.2	0.48617243	-0.20758412	0.44877456	0.37397880	-0.04981355	0.3797773
y17.3	0.41952354	-0.21169510	0.49580055	0.15255401	0.00000000	0.4389381
y17.4	0.32098334	0.00000000	0.35874608	0.47203432	-0.57844477	0.7158340
	y9	y10	y11	y12	y13	y14.1
y3	0.45868247	-0.19432508	-0.27749837	-0.38138504	0.11396058	0.6292532
y4	0.18002057	0.47939500	0.37340802	0.38490018	0.00000000	-0.1134023
y5	0.45868247	-0.23750843	-0.27749837	-0.33371191	0.02279212	0.4045199
y6	0.56061191	0.10795838	-0.18499892	-0.38138504	-0.06837635	0.4045199
y7	-0.20365327	0.02875987	-0.30802055	-0.25400025	-0.30358837	-0.2394737
y8	0.82807867	-0.17541160	-0.46966822	-0.35502347	0.18516402	0.4260064
y9	1.00000000	-0.03026138	-0.32410186	-0.23385359	0.00000000	0.1889822
y10	-0.03026138	1.00000000	0.46684978	0.28306926	-0.43306557	-0.4803845
y11	-0.32410186	0.46684978	1.00000000	0.81855773	0.08696566	-0.3144141
y12	-0.23385359	0.28306926	0.81855773	1.00000000	0.20916501	-0.4124790
y13	0.00000000	-0.43306557	0.08696566	0.20916501	1.00000000	0.5916080
y14.1	0.18898224	-0.48038446	-0.31441407	-0.41247896	0.59160798	1.0000000
y14.2	0.02881952	-0.39070903	-0.47075920	-0.51220567	0.38665445	0.7624929
y14.3	0.52941430	-0.59024021	-0.42986348	-0.20851441	0.09968896	0.1965893
y14.4	0.43229281	-0.31745109	0.02615329	0.00000000	0.30932356	0.5083286
y15.1	0.72901480	-0.27179142	-0.34401648	-0.16366342	0.36514837	0.3600411
y15.2	0.31701473	0.09767726	-0.13076645	-0.08087458	0.36087748	0.4320793
y15.3	0.17708440	-0.62519540	-0.32140295	-0.27607882	0.34317639	0.5466082
y15.4	0.50111483	-0.02830693	-0.36380344	-0.28125000	0.00000000	0.1767767
y16.1	0.41833001	0.50636968	0.27116307	0.27950850	-0.32071349	-0.2635231
y16.2	0.44854261	0.35082321	0.15655607	-0.06454972	-0.18516402	0.1217161
y16.3	0.38575837	0.29417420	0.17503501	0.21650635	0.20701967	0.2041241
y16.4	0.41833001	-0.50636968	-0.27116307	-0.22360680	0.32071349	0.4216370
y17.1	0.57282196	-0.32357511	-0.32179795	-0.20412415	0.53674504	0.5773503
y17.2	0.13103560	-0.17764624	-0.38052120	-0.41674679	0.37504578	0.6933752
y17.3	0.37416574	-0.65672068	-0.46081769	-0.27500000	0.19123658	0.3299832
y17.4	0.47633051	-0.17937941	-0.19211684	-0.14852213	0.18935243	0.3967460

	y14.2	y14.3	y14.4	y15.1	y15.2	y15.3
y3	0.47294677	0.39762139	0.47294677	0.37451267	0.43182096	0.35799392
y4	-0.33203883	-0.14045016	0.04150485	0.10499013	0.04150485	-0.14876790
y5	0.34956935	0.43738352	0.47294677	0.33290015	0.43182096	0.35799392
y6	0.30844355	0.19881069	0.47294677	0.29128763	0.30844355	0.10529233
y7	-0.05477910	0.00000000	-0.57518059	-0.16628220	0.05477910	-0.05609927
y8	0.27842302	0.48454371	0.52900374	0.84515425	0.52900374	0.22810638
y9	0.02881952	0.52941430	0.43229281	0.72901480	0.31701473	0.17708440
y10	-0.39070903	-0.59024021	-0.31745109	-0.27179142	0.09767726	-0.62519540
y11	-0.47075920	-0.42986348	0.02615329	-0.34401648	-0.13076645	-0.32140295
y12	-0.51220567	-0.20851441	0.00000000	-0.16366342	-0.08087458	-0.27607882
y13	0.38665445	0.09968896	0.30932356	0.36514837	0.36087748	0.34317639
y14.1	0.76249285	0.19658927	0.50832857	0.36004115	0.43207928	0.54660817
y14.2	1.00000000	0.04496938	0.25581395	0.07059312	0.41860465	0.54777433
y14.3	0.04496938	1.00000000	0.42720906	0.54601891	0.06745406	0.36842504
y14.4	0.25581395	0.42720906	1.00000000	0.44708977	0.18604651	0.54777433
y15.1	0.07059312	0.54601891	0.44708977	1.00000000	0.47062081	0.16868694
y15.2	0.41860465	0.06745406	0.18604651	0.47062081	1.00000000	0.07144883
y15.3	0.54777433	0.36842504	0.54777433	0.16868694	0.07144883	1.00000000
y15.4	0.16174916	0.18245011	0.32349832	0.54554473	0.26958193	-0.05521576
y16.1	-0.28934569	0.13987572	0.19289713	0.24397502	0.38579426	-0.29631888
y16.2	-0.02784230	-0.05383819	0.25058072	0.08451543	-0.05568460	-0.19959308
y16.3	-0.03112864	0.09028939	0.06225728	0.37796447	0.52918689	-0.09563651
y16.4	0.43401854	0.46625240	0.48224282	0.24397502	0.04822428	0.44447832
y17.1	0.24212400	0.44690968	0.44022545	0.89087081	0.48424800	0.22541741
y17.2	0.86705762	0.02044652	0.23262521	0.19258222	0.65558015	0.36817587
y17.3	0.25879866	0.81320621	0.51759731	0.41461399	0.04313311	0.66258916
y17.4	0.19218664	0.24775204	0.70468435	0.51856298	0.23489478	0.24055571
	y15.4	y16.1	y16.2	y16.3	y16.4	y17.1
y3	0.19069252	0.25584086	0.34465617	0.38533732	0.42640143	0.46709937
y4	-0.12028131	0.38729833	0.24845200	0.66666667	-0.43033148	0.11785113
y5	0.28603878	0.34112115	0.09847319	0.11009638	0.42640143	0.27247463
y6	0.47673129	0.34112115	0.64007575	0.16514456	0.42640143	0.31139958
y7	-0.44450044	-0.11359237	-0.59024325	0.14664712	-0.56796183	-0.25923792
y8	0.77459667	0.34641016	0.26666667	0.26087460	0.34641016	0.73786479
y9	0.50111483	0.41833001	0.44854261	0.38575837	0.41833001	0.57282196
y10	-0.02830693	0.50636968	0.35082321	0.29417420	-0.50636968	-0.32357511
y11	-0.36380344	0.27116307	0.15655607	0.17503501	-0.27116307	-0.32179795
y12	-0.28125000	0.27950850	-0.06454972	0.21650635	-0.22360680	-0.20412415
y13	0.00000000	-0.32071349	-0.18516402	0.20701967	0.32071349	0.53674504
y14.1	0.17677670	-0.26352314	0.12171612	0.20412415	0.42163702	0.57735027
y14.2	0.16174916	-0.28934569	-0.02784230	-0.03112864	0.43401854	0.24212400
y14.3	0.18245011	0.13987572	-0.05383819	0.09028939	0.46625240	0.44690968
y14.4	0.32349832	0.19289713	0.25058072	0.06225728	0.48224282	0.44022545
y15.1	0.54554473	0.24397502	0.08451543	0.37796447	0.24397502	0.89087081
y15.2	0.26958193	0.38579426	-0.05568460	0.52918689	0.04822428	0.48424800
y15.3	-0.05521576	-0.29631888	-0.19959308	-0.09563651	0.44447832	0.22541741
y15.4	1.00000000	0.27950850	0.35502347	-0.10825318	0.27950850	0.45927933
y16.1	0.27950850	1.00000000	0.34641016	0.51639778	-0.10000000	0.09128709
y16.2	0.35502347	0.34641016	1.00000000	0.26087460	0.34641016	0.13176157
y16.3	-0.10825318	0.51639778	0.26087460	1.00000000	-0.19364917	0.41247896
y16.4	0.27950850	-0.10000000	0.34641016	-0.19364917	1.00000000	0.31950483
y17.1	0.45927933	0.09128709	0.13176157	0.41247896	0.31950483	1.00000000
y17.2	0.24514517	-0.04385290	0.02531848	0.16984156	0.35082321	0.34027233
y17.3	0.17500000	0.00000000	-0.18073922	-0.02886751	0.44721360	0.38783588
y17.4	0.74261066	0.17712298	0.30678600	-0.05716620	0.35424595	0.52549385
	y17.2	y17.3	y17.4			
y3	0.48617243	0.41952354	0.3209833			
y4	-0.20758412	-0.21169510	0.00000000			
y5	0.44877456	0.49580055	0.3587461			
y6	0.37397880	0.15255401	0.4720343			
y7	-0.04981355	0.00000000	-0.5784448			
y8	0.37977726	0.43893811	0.7158340			
y9	0.13103560	0.37416574	0.4763305			
y10	-0.17764624	-0.65672068	-0.1793794			
y11	-0.38052120	-0.46081769	-0.1921168			
y12	-0.41674679	-0.27500000	-0.1485221			

y13	0.37504578	0.19123658	0.1893524
y14.1	0.69337525	0.32998316	0.3967460
y14.2	0.86705762	0.25879866	0.1921866
y14.3	0.02044652	0.81320621	0.2477520
y14.4	0.23262521	0.51759731	0.7046843
y15.1	0.19258222	0.41461399	0.5185630
y15.2	0.65558015	0.04313311	0.2348948
y15.3	0.36817587	0.66258916	0.2405557
y15.4	0.24514517	0.17500000	0.7426107
y16.1	-0.04385290	0.00000000	0.1771230
y16.2	0.02531848	-0.18073922	0.3067860
y16.3	0.16984156	-0.02886751	-0.0571662
y16.4	0.35082321	0.44721360	0.3542460
y17.1	0.34027233	0.38783588	0.5254939
y17.2	1.00000000	0.13728129	0.2330207
y17.3	0.13728129	1.00000000	0.3168472
y17.4	0.23302069	0.31684721	1.0000000

2.2.2. Bar charts and empirical probability density functions

Charts containing bar charts and empirical probability density functions are presented in figures 17-22.

Figure 17. Bar chart for continuous variables

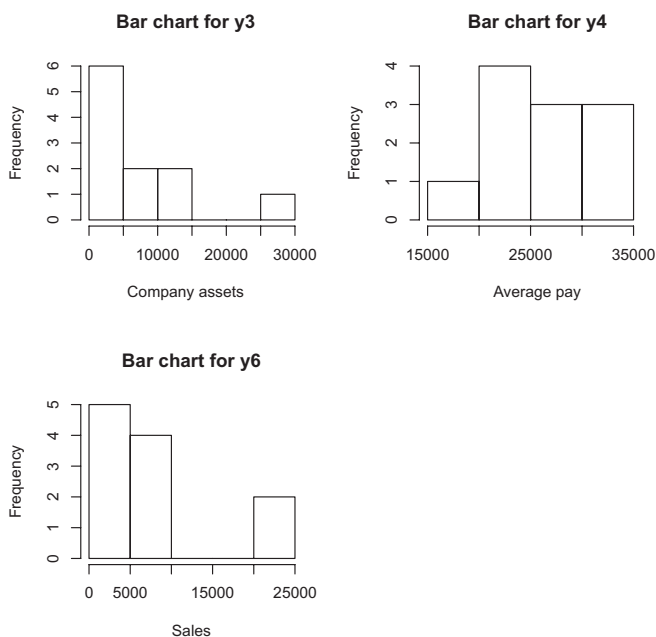


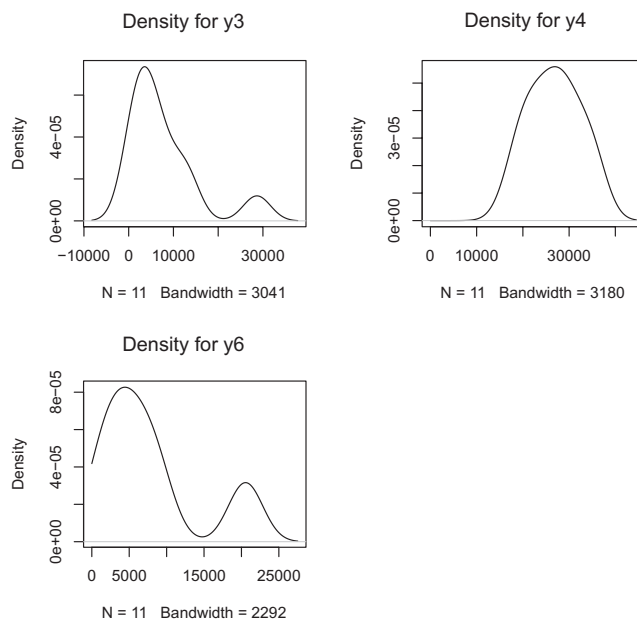
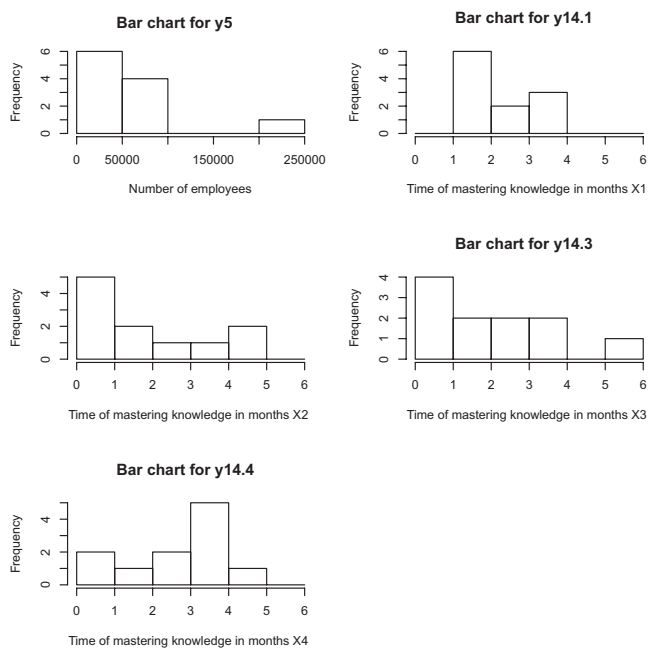
Figure 18. Estimated function of probability density for continuous variables**Figure 19.** Bar chart for discrete variables

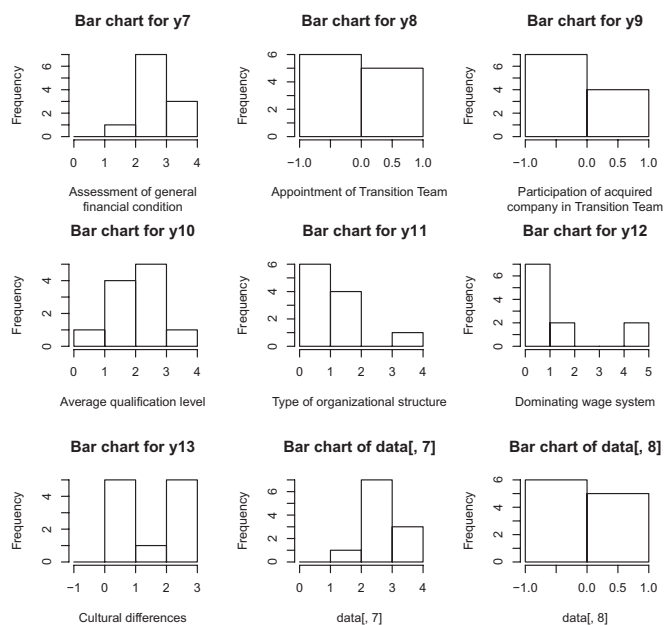
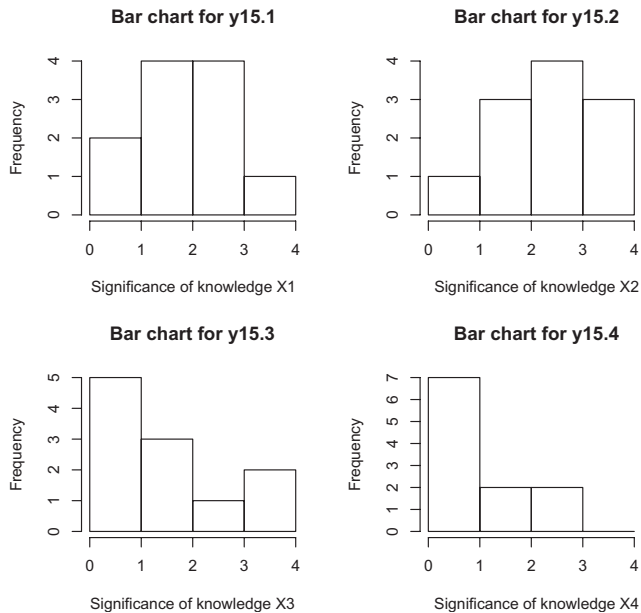
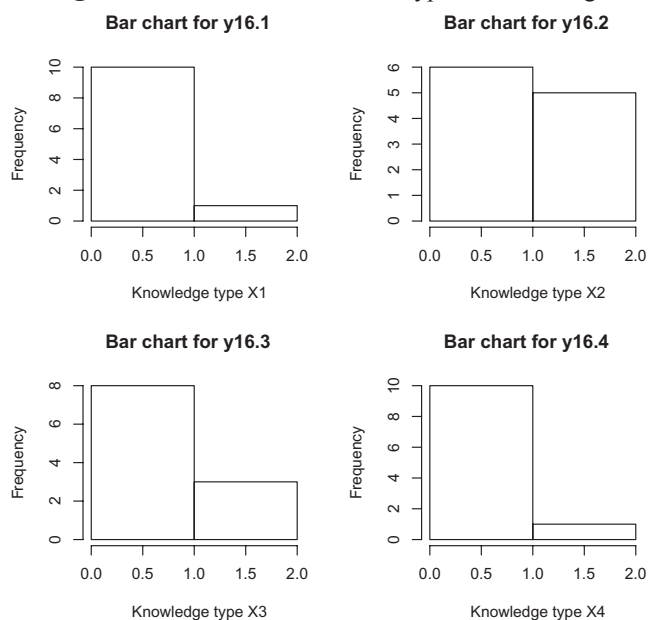
Figure 20. Bar chart for ordinate variables**Figure 21.** Bar chart for variables knowledge significance

Figure 22. Bar chart for variable types of knowledge

2.2.3. Box-plots

Box plots are contained in figures 23-27.

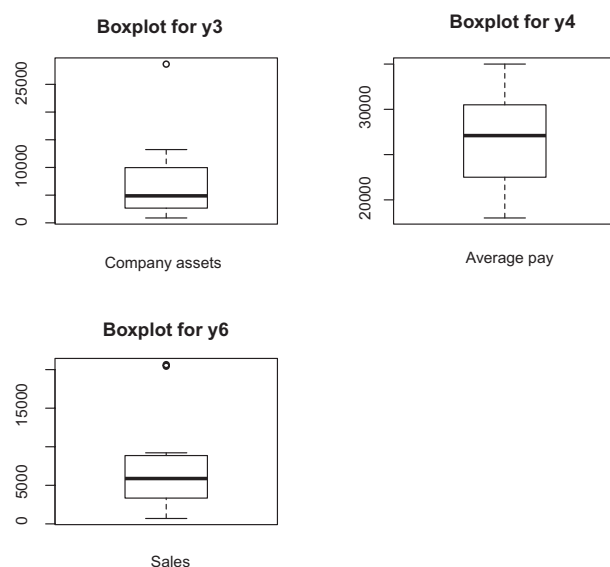
Figure 23. Boxplot for continuous variables

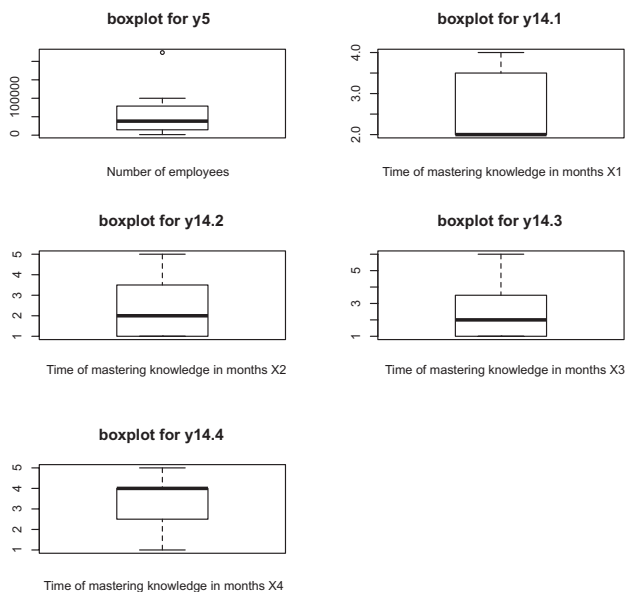
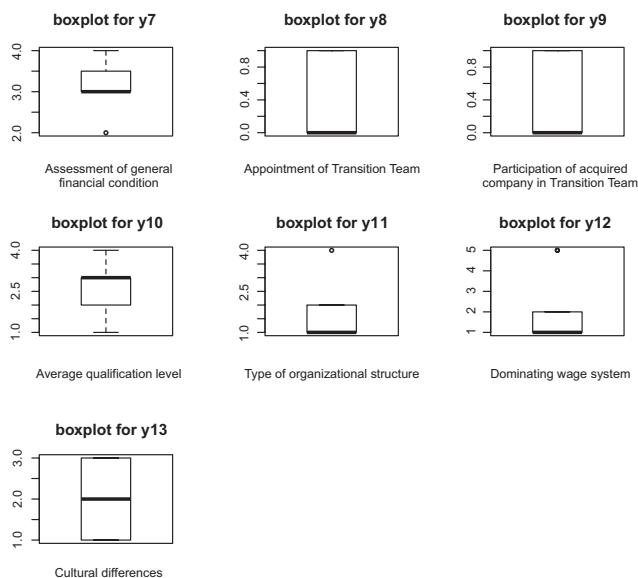
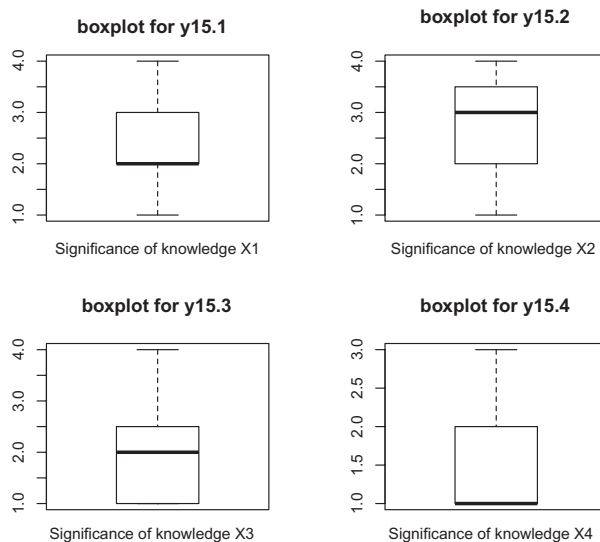
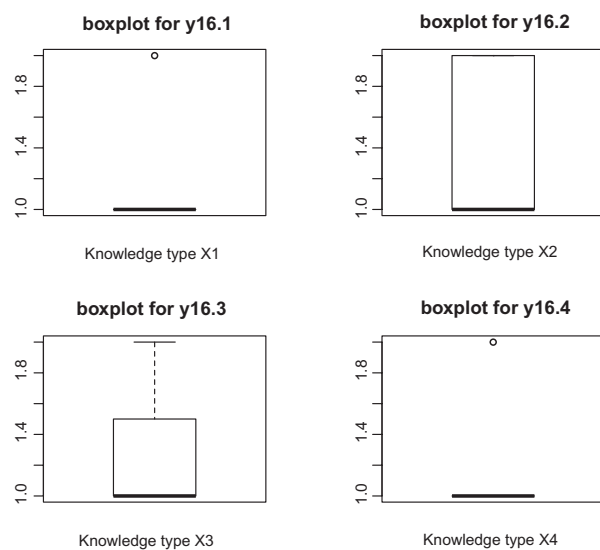
Figure 24. Boxplot for discrete variables**Figure 25.** Boxplot for ordinate variables

Figure 26. Boxplot for variables knowledge significance**Figure 27.** Boxplot for variables knowledge type

2.2.4. Lorenz curves

Lorenz curves depict concentration of variables and were placed in Figures 28-32.

Figure 28. Lorenz curves for continuous variables

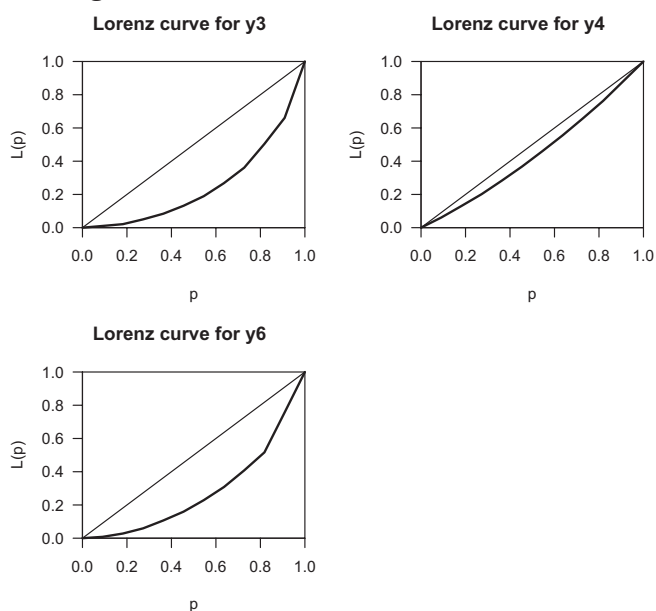


Figure 29. Lorenz curves for discrete variables

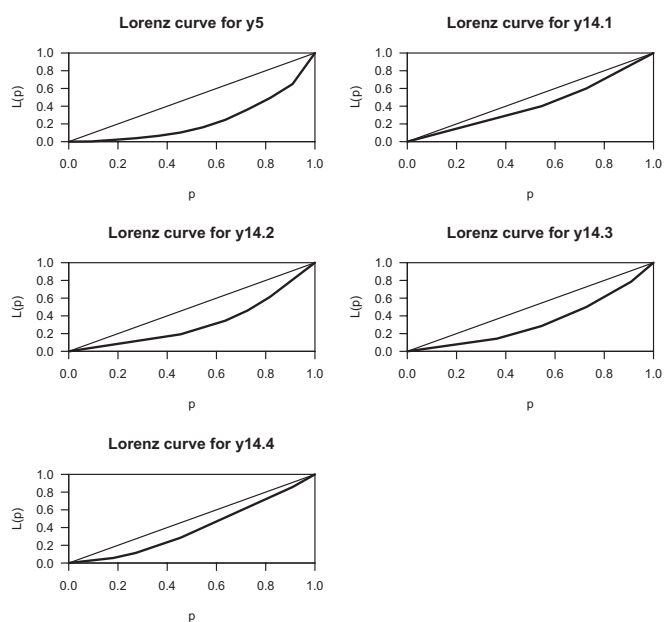


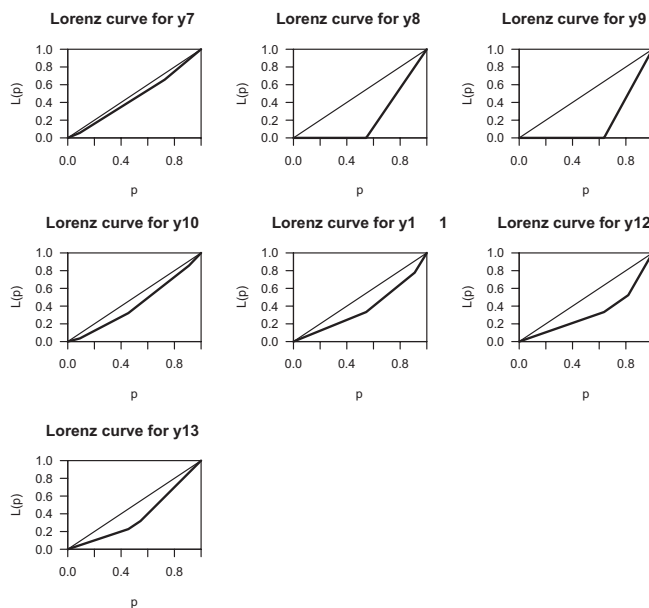
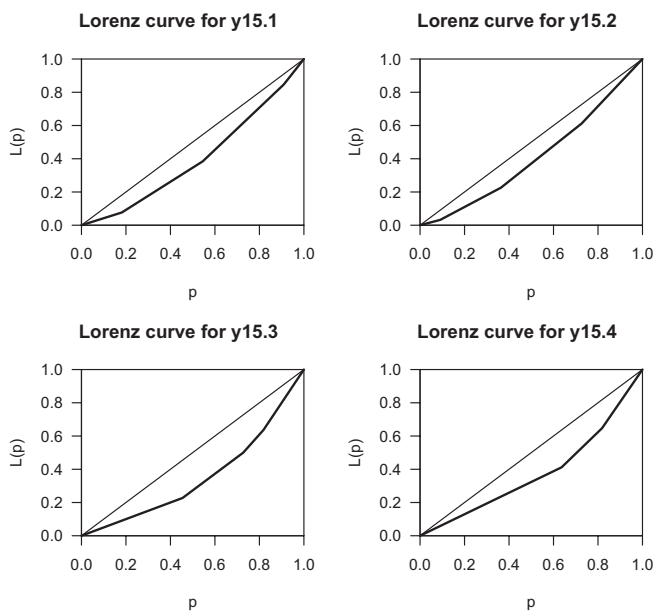
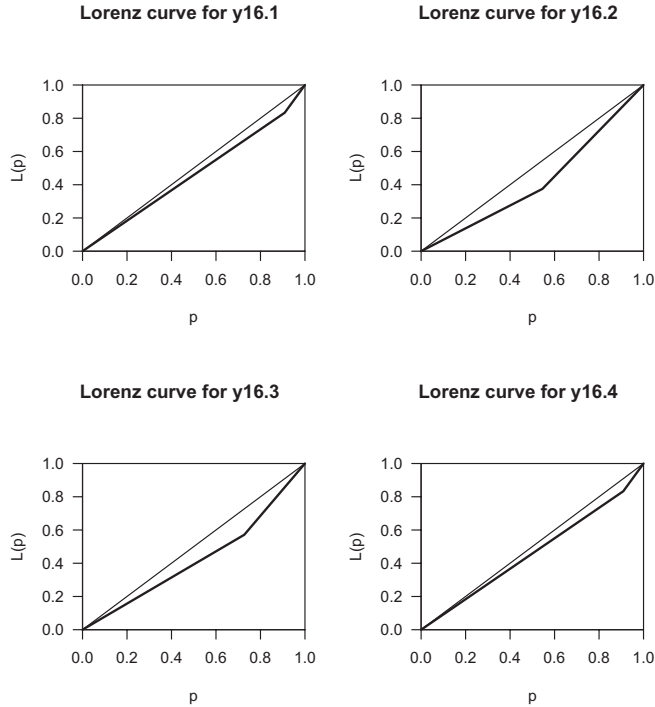
Figure 30. Lorenz curves for serial variables**Figure 31.** Lorenz curves for variables knowledge significance

Figure 32. Lorenz curves for variables knowledge type



2.2.5. Dominants

The dominant values for continuous variables were read as maximal values from empirical density function graphs and they are respectively: $y_3 = 3558$, $y_4 = 26846$ and $y_6 = 4417$. For the remaining variables dominant were read from bar charts and recorded below.

y5	y7	y8	y9	y10	y11	y12	y13	y14.1	y14.2	y14.3	y14.4	y15.1
50000	3	0	0	3	1	1	1	2	1	1	4	2
y15.2	y15.3	y15.4	y16.1	y16.2	y16.3	y16.4						
3	1	1	1	1	1	1						

2.3. DFor acquired steelworks

The table below lists values of the variables for the acquired steelworks.

	y1	y2	y3	y4	y5	y6	y7	y8	y9	y10	y11	y12	y13	y14.1
Europipe	2	b	2350	22500	5600	18268	3	0	0	3	3	5	2	2
Thyssen Krupp	4	b	6051	22000	70000	12782	2	1	1	4	2	2	1	1
Huta Zawiercie	6	b	70	20000	11164	150	2	0	0	3	3	2	2	1
PHS	8	b	132	20000	20000	257	1	0	0	3	2	2	3	1
Huta Ostrowiec	10	b	44	15000	2500	88	1	0	0	3	2	2	2	2
Lucchini	12	b	450	12000	12000	2400	1	0	0	2	2	1	2	3
Vitkovice Steel	14	b	1837	20000	4200	110	1	0	0	3	2	1	1	2
Arcelor Mittal	16	b	26383	38000	11000	29985	4	1	1	4	4	5	3	1

Corus Group	18	b	5879	35000	24000	11024	3	1	1	4	3	5	3	2
VPE	20	b	3100	31000	16800	6000	3	1	1	4	3	2	2	2
Tinfos	22	b	400	48000	500	200	4	0	0	4	4	5	3	1
	y14.2	y14.3	y14.4	y15.1	y15.2	y15.3	y15.4	y16.1	y16.2	y16.3				
Europipe	1	5	1	1	1	1	2	1	2	1				
Thyssen Krupp	2	1	3	1	2	1	1	2	1	2				
Huta Zawiercie	2	3	2	1	1	1	1	1	1	1				
PHS	1	1	1	1	1	1	1	1	1	1				
Huta Ostrowiec	1	1	2	1	2	1	1	1	1	1				
Lucchini	1	2	1	4	1	2	1	1	1	1				
Vitkovice Steel	3	1	2	1	2	1	1	1	1	1				
Arcelor Mittal	1	1	1	1	1	1	1	1	1	1				
Corus Group	1	1	1	1	1	1	1	1	1	1				
VPE	1	1	1	1	2	1	1	1	1	1				
Tinfos	1	1	1	3	1	1	1	1	1	1				
	y16.4	y17.1	y17.2	y17.3	y17.4									
Europipe	1	2	1	5	2									
Thyssen Krupp	2	1	4	1	3									
Huta Zawiercie	1	1	2	3	2									
PHS	1	1	1	1	1									
Huta Ostrowiec	1	2	2	1	2									
Lucchini	1	12	1	4	1									
Vitkovice Steel	1	2	6	1	2									
Arcelor Mittal	1	1	1	1	1									
Corus Group	1	2	1	1	1									
VPE	1	2	2	1	1									
Tinfos	1	3	1	1	1									

2.3.1. Number characteristic of the group structure

The following list contains the positional measures of all variables (min., max., Q1, Q2, median) and arithmetic means.

y3	y4	y5	y6
Min. : 44	Min. :12000	Min. : 500	Min. : 88
1st Qu.: 266	1st Qu.:20000	1st Qu.: 4900	1st Qu.: 175
Median : 1837	Median :22000	Median :11164	Median : 2400
Mean : 4245	Mean :25773	Mean :16160	Mean : 7388
3rd Qu.: 4490	3rd Qu.:33000	3rd Qu.:18400	3rd Qu.:11903
Max. :26383	Max. :48000	Max. :70000	Max. :29985
y7	y8	y9	y10
Min. :1.000	Min. :0.0000	Min. :0.0000	Min. :2.000
1st Qu.:1.000	1st Qu.:0.0000	1st Qu.:0.0000	1st Qu.:3.000
Median :2.000	Median :0.0000	Median :0.0000	Median :3.000
Mean :2.273	Mean :0.3636	Mean :0.3636	Mean :3.364
3rd Qu.:3.000	3rd Qu.:1.0000	3rd Qu.:1.0000	3rd Qu.:4.000
Max. :4.000	Max. :1.0000	Max. :1.0000	Max. :4.000
y11	y12	y13	y14.1
Min. :2.000	Min. :1.000	Min. :1.000	Min. :1.000
1st Qu.:2.000	1st Qu.:2.000	1st Qu.:2.000	1st Qu.:1.000
Median :3.000	Median :2.000	Median :2.000	Median :2.000
Mean :2.727	Mean :2.909	Mean :2.182	Mean :1.636
3rd Qu.:3.000	3rd Qu.:5.000	3rd Qu.:3.000	3rd Qu.:2.000
Max. :4.000	Max. :5.000	Max. :3.000	Max. :3.000
y14.2	y14.3	y14.4	y15.1
Min. :1.000	Min. :1.000	Min. :1.000	Min. :1.000
1st Qu.:1.000	1st Qu.:1.000	1st Qu.:1.000	1st Qu.:1.000
Median :1.000	Median :1.000	Median :1.000	Median :1.000
Mean :1.364	Mean :1.636	Mean :1.455	Mean :1.455
3rd Qu.:1.500	3rd Qu.:1.500	3rd Qu.:2.000	3rd Qu.:1.000
Max. :3.000	Max. :5.000	Max. :3.000	Max. :4.000
y15.2	y15.3	y15.4	y16.1
Min. :1.000	Min. :1.000	Min. :1.000	Min. :1.000
1st Qu.:1.000	1st Qu.:1.000	1st Qu.:1.000	1st Qu.:1.000

Median :1.000	Median :1.000	Median :1.000	Median :1.000
Mean :1.364	Mean :1.091	Mean :1.091	Mean :1.091
3rd Qu.:2.000	3rd Qu.:1.000	3rd Qu.:1.000	3rd Qu.:1.000
Max. :2.000	Max. :2.000	Max. :2.000	Max. :2.000
y16.2	y16.3	y16.4	
Min. :1.000	Min. :1.000	Min. :1.000	
1st Qu.:1.000	1st Qu.:1.000	1st Qu.:1.000	
Median :1.000	Median :1.000	Median :1.000	
Mean :1.091	Mean :1.091	Mean :1.091	
3rd Qu.:1.000	3rd Qu.:1.000	3rd Qu.:1.000	
Max. :2.000	Max. :2.000	Max. :2.000	

Additional statistics are included in the further list.

	vars	n	mean	sd	median	trimmed	mad	min
y3	1	11	4.245091e+03	7.667496e+03	1837	2.252111e+03	2527.8330	44
y4	2	11	2.577273e+04	1.089349e+04	22000	2.483333e+04	10378.2000	12000
y5	3	11	1.616036e+04	1.931488e+04	11164	1.191822e+04	10324.8264	500
y6	4	11	7.387636e+03	9.794323e+03	2400	5.687889e+03	3427.7712	88
y7	5	11	2.272727e+00	1.190874e+00	2	2.222222e+00	1.4826	1
y8	6	11	3.636364e-01	5.045250e-01	0	3.333333e-01	0.0000	0
y9	7	11	3.636364e-01	5.045250e-01	0	3.333333e-01	0.0000	0
y10	8	11	3.636364e+00	6.741999e-01	3	3.444444e+00	1.4826	2
y11	9	11	2.727273e+00	7.862454e-01	3	2.666667e+00	1.4826	2
y12	10	11	2.909091e+00	1.700267e+00	2	2.888889e+00	1.4826	1
y13	11	11	2.181818e+00	7.507572e-01	2	2.222222e+00	1.4826	1
y14.1	12	11	1.636364e+00	6.741999e-01	2	1.555556e+00	1.4826	1
y14.2	13	11	1.363636e+00	6.741999e-01	1	1.222222e+00	0.0000	1
y14.3	14	11	1.636364e+00	1.286291e+00	1	1.333333e+00	0.0000	1
y14.4	15	11	1.454545e+00	6.875517e-01	1	1.333333e+00	0.0000	1
y15.1	16	11	1.454545e+00	1.035725e+00	1	1.222222e+00	0.0000	1
y15.2	17	11	1.363636e+00	5.045250e-01	1	1.333333e+00	0.0000	1
y15.3	18	11	1.090909e+00	3.015113e-01	1	1.000000e+00	0.0000	1
y15.4	19	11	1.090909e+00	3.015113e-01	1	1.000000e+00	0.0000	1
y16.1	20	11	1.090909e+00	3.015113e-01	1	1.000000e+00	0.0000	1
y16.2	21	11	1.090909e+00	3.015113e-01	1	1.000000e+00	0.0000	1
y16.3	22	11	1.090909e+00	3.015113e-01	1	1.000000e+00	0.0000	1
y16.4	23	11	1.090909e+00	3.015113e-01	1	1.000000e+00	0.0000	1
	max range	skew	kurtosis	se	entrop	Gini		
y3	26383 26339	2.1194700	3.3540695	2.311837e+03	1.03301459	0.70148115		
y4	48000 36000	0.6476422	-0.8855650	3.284512e+03	0.07734074	0.21901555		
y5	70000 69500	1.8544864	2.5756280	5.823654e+03	0.50270549	0.51580134		
y6	29985 29897	1.0660777	-0.1345655	2.953100e+03	0.97455581	0.64303102		
y7	4	3	0.1708265	-1.6824947	3.590621e-01	0.13472598	0.27636364	
y8	1	1	0.4914204	-1.9079103	1.521200e-01	1.58790924	0.63636364	
y9	1	1	0.4914204	-1.9079103	1.521200e-01	1.58790924	0.63636364	
y10	4	2	-0.4412945	-1.0793388	2.032789e-01	0.01978234	0.09828010	
y11	4	2	0.4266352	-1.4135949	2.370619e-01	0.03669096	0.14545455	
y12	5	4	0.3494190	-1.8422201	5.126499e-01	0.15911667	0.28977273	
y13	3	2	-0.2450206	-1.3690371	2.263618e-01	0.06125175	0.17424242	
y14.1	3	2	0.4412945	-1.0793388	2.032789e-01	0.07622030	0.20202020	
y14.2	3	2	1.3385932	0.3606612	2.032789e-01	0.08867248	0.20606061	
y14.3	5	4	1.6479147	1.4099257	3.878314e-01	0.19583621	0.31313131	
y14.4	3	2	0.9847263	-0.4497530	2.073046e-01	0.08798332	0.21590909	
y15.1	4	3	1.5823546	0.7975931	3.122830e-01	0.16114224	0.26136364	
y15.2	2	1	0.4914204	-1.9079103	1.521200e-01	0.05866093	0.16969697	
y15.3	2	1	2.4669110	4.5206612	9.090909e-02	0.02608092	0.07575758	
y15.4	2	1	2.4669110	4.5206612	9.090909e-02	0.02608092	0.07575758	
y16.1	2	1	2.4669110	4.5206612	9.090909e-02	0.02608092	0.07575758	
y16.2	2	1	2.4669110	4.5206612	9.090909e-02	0.02608092	0.07575758	
y16.3	2	1	2.4669110	4.5206612	9.090909e-02	0.02608092	0.07575758	
y16.4	2	1	2.4669110	4.5206612	9.090909e-02	0.02608092	0.07575758	
	wsp.zmien	var						
y3	180.62031	5.879050e+07						
y4	42.26752	1.186682e+08						

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y5      119.52005 3.730644e+08
y6      132.57722 9.592877e+07
y7       52.39847 1.418182e+00
y8      138.74437 2.545455e-01
y9      138.74437 2.545455e-01
y10     20.04378 4.545455e-01
y11     28.82900 6.181818e-01
y12     58.44669 2.890909e+00
y13     34.40970 5.636364e-01
y14.1   41.20110 4.545455e-01
y14.2   49.44132 4.545455e-01
y14.3   78.60669 1.654545e+00
y14.4   47.26918 4.727273e-01
y15.1   71.20613 1.072727e+00
y15.2   36.99850 2.545455e-01
y15.3   27.63854 9.090909e-02
y15.4   27.63854 9.090909e-02
y16.1   27.63854 9.090909e-02
y16.2   27.63854 9.090909e-02
y16.3   27.63854 9.090909e-02
y16.4   27.63854 9.090909e-02

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The values of Pearson's linear correlation coefficients between variables y3, y4, y5, y6 and the group of variables y14.1 to y14.4 are shown below.

	y3	y4	y5	y6	y14.1	y14.2
y3	1.0000000	0.4225912	0.1231233	0.867154760	-0.3018834	-0.13899735
y4	0.4225912	1.0000000	-0.1064051	0.336633539	-0.4480847	-0.28717028
y5	0.1231233	-0.1064051	1.0000000	0.219579823	-0.2766265	0.19138673
y6	0.8671548	0.3366335	0.2195798	1.000000000	-0.1729953	-0.24833746
y14.1	-0.3018834	-0.4480847	-0.2766265	-0.172995326	1.0000000	-0.12000000
y14.2	-0.1389973	-0.2871703	0.1913867	-0.248337463	-0.1200000	1.00000000
y14.3	-0.2000037	-0.2741117	-0.2269895	0.190965796	0.1782084	-0.06289709
y14.4	-0.1360532	-0.3987220	0.5802886	-0.163736458	-0.2549510	0.68640647
y17.3	-0.2421969	-0.4116096	-0.2277838	0.097754560	0.4308483	-0.12833779
y17.4	-0.1720009	-0.4424176	0.5007677	-0.002165369	-0.1765045	0.60796002
	y14.3	y14.4	y17.3	y17.4		
y3	-0.20000373	-0.1360532	-0.24219686	-0.172000947		
y4	-0.27411167	-0.3987220	-0.41160956	-0.442417578		
y5	-0.22698954	0.5802886	-0.22778375	0.500767673		
y6	0.19096580	-0.1637365	0.09775456	-0.002165369		
y14.1	0.17820842	-0.2549510	0.43084829	-0.176504522		
y14.2	-0.06289709	0.6864065	-0.12833779	0.607960019		
y14.3	1.00000000	-0.1336306	0.91291308	0.246702685		
y14.4	-0.13363062	1.0000000	-0.20674627	0.903846154		
y17.3	0.91291308	-0.2067463	1.00000000	0.107867620		
y17.4	0.24670268	0.9038462	0.10786762	1.000000000		

For all variables (quantitative and ordering), the Spearman rank correlation coefficients were determined and reported below.

	y3	y4	y5	y6	y7	y8
y3	1.000000000	0.57800598	0.44545455	0.84545455	0.53811912	0.83666003
y4	0.578005977	1.00000000	-0.03669879	0.5321325	0.94324222	0.54281015
y5	0.445454545	-0.03669879	1.00000000	0.4636364	-0.10384755	0.59761430
y6	0.845454545	0.53213249	0.46363636	1.00000000	0.59004290	0.65737574
y7	0.538119125	0.94324222	-0.10384755	0.5900429	1.00000000	0.49648625
y8	0.836660027	0.54281015	0.59761430	0.6573757	0.49648625	1.00000000
y9	0.836660027	0.54281015	0.59761430	0.6573757	0.49648625	1.00000000
y10	0.633173824	0.86215588	0.22110832	0.4522670	0.76190622	0.79282497
y11	0.308957190	0.84632727	-0.26482045	0.3972307	0.93961596	0.29014423

y12	0.343285767	0.82158085	-0.10788981	0.5345450	0.84539973	0.32238248
y13	-0.004904082	0.51472535	-0.02452041	0.2108755	0.48635948	0.09671474
y14.1	-0.030151134	-0.40572041	-0.07035265	-0.1005038	-0.34442336	-0.13213749
y14.2	0.000000000	-0.26937921	0.06382847	-0.3017346	-0.33443446	-0.07628962
y14.3	-0.231248645	-0.31506302	-0.09828067	0.1098431	-0.06604016	-0.45605174
y14.4	-0.181220609	-0.43033148	0.00000000	-0.4157414	-0.45387763	-0.07007649
y15.1	-0.215743956	-0.06804138	-0.25619595	-0.1348400	0.02100420	-0.35456210
y15.2	0.059761430	-0.24124895	0.00000000	-0.2988072	-0.34133430	0.21428571
y15.3	-0.100000000	-0.50460839	0.10000000	0.0000000	-0.36346643	-0.23904572
y15.4	0.100000000	0.10092168	-0.20000000	0.4000000	0.20769510	-0.23904572
y16.1	0.400000000	0.00000000	0.50000000	0.3000000	-0.05192378	0.41833001
y16.2	0.100000000	0.10092168	-0.20000000	0.4000000	0.20769510	-0.23904572
y16.3	0.400000000	0.00000000	0.50000000	0.3000000	-0.05192378	0.41833001
y16.4	0.400000000	0.00000000	0.50000000	0.3000000	-0.05192378	0.41833001
y3	0.83666003	0.6331738	0.30895719	0.34328577	-0.004904082	-0.03015113
y4	0.54281015	0.8621559	0.84632727	0.82158085	0.514725355	-0.40572041
y5	0.59761430	0.2211083	-0.26482045	-0.10788981	-0.024520412	-0.07035265
y6	0.65737574	0.4522670	0.39723067	0.53454498	0.210875543	-0.10050378
y7	0.49648625	0.7619062	0.93961596	0.84539973	0.486359480	-0.34442336
y8	1.00000000	0.7928250	0.29014423	0.32238248	0.096714743	-0.13213749
y9	1.00000000	0.7928250	0.29014423	0.32238248	0.096714743	-0.13213749
y10	0.79282497	1.00000000	0.58554004	0.60722671	0.303613356	-0.44444444
y11	0.29014423	0.5855400	1.00000000	0.79365079	0.579365079	-0.34156503
y12	0.32238248	0.6072267	0.79365079	1.00000000	0.656084656	-0.36325169
y13	0.09671474	0.3036134	0.57936508	0.65608466	1.000000000	-0.30361336
y14.1	-0.13213749	-0.4444444	-0.34156503	-0.36325169	-0.303613356	1.00000000
y14.2	-0.07628962	-0.1026400	-0.33806170	-0.49144155	-0.710555614	-0.21811010
y14.3	-0.45605174	-0.5943979	0.05613609	-0.03742406	-0.205832327	0.24287225
y14.4	-0.07007649	-0.1060660	-0.50029753	-0.45429316	-0.736069930	-0.18856181
y15.1	-0.35456210	-0.2236068	0.06546537	-0.13820466	0.167300383	0.22360680
y15.2	0.21428571	0.1321375	-0.48357371	-0.48357371	-0.709241448	0.19820624
y15.3	-0.23904572	-0.5527708	-0.32366944	-0.48550416	-0.107889812	0.55277080
y15.4	-0.23904572	-0.2211083	0.16183472	0.37761434	-0.107889812	0.22110832
y16.1	0.41833001	0.3316625	-0.32366944	-0.10788981	-0.485504156	-0.33166248
y16.2	-0.23904572	-0.2211083	0.16183472	0.37761434	-0.107889812	0.22110832
y16.3	0.41833001	0.3316625	-0.32366944	-0.10788981	-0.485504156	-0.33166248
y16.4	0.41833001	0.3316625	-0.32366944	-0.10788981	-0.485504156	-0.33166248
y3	0.00000000	-0.23124865	-0.18122061	-0.21574396	0.05976143	-0.10000000
y4	-0.26937921	-0.31506302	-0.43033148	-0.06804138	-0.24124895	-0.50460804
y5	0.06382847	-0.09828067	0.00000000	-0.25619595	0.00000000	0.10000000
y6	-0.30173460	0.10984311	-0.41574140	-0.13483997	-0.29880715	0.00000000
y7	-0.33443446	-0.06604016	-0.45387763	0.02100420	-0.34133430	-0.3634664
y8	-0.07628962	-0.45605174	-0.07007649	-0.35456210	0.21428571	-0.2390457
y9	-0.07628962	-0.45605174	-0.07007649	-0.35456210	0.21428571	-0.2390457
y10	-0.10264005	-0.59439787	-0.10606602	-0.22360680	0.13213749	-0.5527708
y11	-0.33806170	0.05613609	-0.50029753	0.06546537	-0.48357371	-0.3236694
y12	-0.49144155	-0.03742406	-0.45429316	-0.13820466	-0.48357371	-0.4855042
y13	-0.71055561	-0.20583233	-0.73606993	0.16730038	-0.70924145	-0.1078898
y14.1	-0.21811010	0.24287225	-0.18856181	0.22360680	0.19820624	0.5527708
y14.2	1.00000000	0.04059068	0.80969244	-0.28401878	0.41959290	-0.1914854
y14.3	0.04059068	1.00000000	-0.07456984	0.18007351	-0.45605174	0.3815603
y14.4	0.80969244	-0.07456984	1.00000000	-0.34785054	0.63068840	-0.2345208
y15.1	-0.28401878	0.18007351	-0.34785054	1.00000000	-0.35456210	0.7416198
y15.2	0.41959290	-0.45605174	0.63068840	-0.35456210	1.00000000	-0.2390457
y15.3	-0.19148542	0.38156026	-0.23452079	0.74161985	-0.23904572	1.0000000
y15.4	-0.19148542	0.63593377	-0.23452079	-0.14832397	-0.23904572	-0.1000000
y16.1	0.44679932	-0.19078013	0.58630197	-0.14832397	0.41833001	-0.1000000
y16.2	-0.19148542	0.63593377	-0.23452079	-0.14832397	-0.23904572	-0.1000000
y16.3	0.44679932	-0.19078013	0.58630197	-0.14832397	0.41833001	-0.1000000
y16.4	0.44679932	-0.19078013	0.58630197	-0.14832397	0.41833001	-0.1000000
y3	0.10000000	0.40000000	0.10000000	0.40000000	0.40000000	0.40000000
y4	0.1009217	0.00000000	0.1009217	0.00000000	0.00000000	0.00000000
y5	-0.2000000	0.50000000	-0.2000000	0.50000000	0.50000000	0.50000000
y6	0.4000000	0.30000000	0.4000000	0.30000000	0.30000000	0.30000000

y7	0.2076951	-0.05192378	0.2076951	-0.05192378	-0.05192378
y8	-0.2390457	0.41833001	-0.2390457	0.41833001	0.41833001
y9	-0.2390457	0.41833001	-0.2390457	0.41833001	0.41833001
y10	-0.2211083	0.33166248	-0.2211083	0.33166248	0.33166248
y11	0.1618347	-0.32366944	0.1618347	-0.32366944	-0.32366944
y12	0.3776143	-0.10788981	0.3776143	-0.10788981	-0.10788981
y13	-0.1078898	-0.48550416	-0.1078898	-0.48550416	-0.48550416
y14.1	0.2211083	-0.33166248	0.2211083	-0.33166248	-0.33166248
y14.2	-0.1914854	0.44679932	-0.1914854	0.44679932	0.44679932
y14.3	0.6359338	-0.19078013	0.6359338	-0.19078013	-0.19078013
y14.4	-0.2345208	0.58630197	-0.2345208	0.58630197	0.58630197
y15.1	-0.1483240	-0.14832397	-0.1483240	-0.14832397	-0.14832397
y15.2	-0.2390457	0.41833001	-0.2390457	0.41833001	0.41833001
y15.3	-0.1000000	-0.10000000	-0.1000000	-0.10000000	-0.10000000
y15.4	1.0000000	-0.10000000	1.0000000	-0.10000000	-0.10000000
y16.1	1.0000000	1.00000000	-0.1000000	1.00000000	1.00000000
y16.2	1.0000000	-0.10000000	1.0000000	-0.10000000	-0.10000000
y16.3	-0.1000000	1.00000000	-0.1000000	1.00000000	1.00000000
y16.4	-0.1000000	1.00000000	-0.1000000	1.00000000	1.00000000

Kendal correlation coefficients were placed below.

	y3	y4	y5	y6	y7	y8
y3	1.00000000	0.48617243	0.38181818	0.70909091	0.40655781	0.71350607
y4	0.48617243	1.00000000	0.00000000	0.41137668	0.87805411	0.47172818
y5	0.38181818	0.00000000	1.00000000	0.38181818	-0.08131156	0.50964719
y6	0.70909091	0.41137668	0.38181818	1.00000000	0.48786938	0.56061191
y7	0.40655781	0.87805411	-0.08131156	0.48786938	1.00000000	0.45584231
y8	0.71350607	0.47172818	0.50964719	0.56061191	0.45584231	1.00000000
y9	0.71350607	0.47172818	0.50964719	0.56061191	0.45584231	1.00000000
y10	0.52421865	0.77353193	0.15954481	0.34188173	0.68802371	0.76665188
y11	0.26248718	0.76486616	-0.21873932	0.34998291	0.90486458	0.27591270
y12	0.26248718	0.71987403	-0.08749573	0.43747864	0.78258558	0.30656967
y13	0.00000000	0.42742521	0.00000000	0.17499146	0.44020439	0.09197090
y14.1	-0.06837635	-0.35160542	-0.06837635	-0.11396058	-0.30578831	-0.12777531
y14.2	0.00000000	-0.24476773	0.05288859	-0.26444294	-0.32522182	-0.07412493
y14.3	-0.18164975	-0.24019223	-0.12974982	0.07784989	-0.02901294	-0.43643578
y14.4	-0.16952582	-0.32378806	-0.02421797	-0.36326961	-0.37907125	-0.06788442
y15.1	-0.15467206	-0.03181424	-0.21654088	-0.09280323	0.03458572	-0.34684399
y15.2	0.05096472	-0.20965697	0.00000000	-0.25482360	-0.31339159	0.21428571
y15.3	-0.08528029	-0.43852901	0.08528029	0.00000000	-0.33371191	-0.23904572
y15.4	0.08528029	0.08770580	-0.17056057	0.34112115	0.19069252	-0.23904572
y16.1	0.34112115	0.00000000	0.42640143	0.25584086	-0.04767313	0.41833001
y16.2	0.08528029	0.08770580	-0.17056057	0.34112115	0.19069252	-0.23904572
y16.3	0.34112115	0.00000000	0.42640143	0.25584086	-0.04767313	0.41833001
y16.4	0.34112115	0.00000000	0.42640143	0.25584086	-0.04767313	0.41833001
	y9	y10	y11	y12	y13	y14.1
y3	0.71350607	0.52421865	0.26248718	0.26248718	0.00000000	-0.06837635
y4	0.47172818	0.77353193	0.76486616	0.71987403	0.4274252	-0.35160542
y5	0.50964719	0.15954481	-0.21873932	-0.08749573	0.00000000	-0.06837635
y6	0.56061191	0.34188173	0.34998291	0.43747864	0.1749915	-0.11396058
y7	0.45584231	0.68802371	0.90486458	0.78258558	0.4402044	-0.30578831
y8	1.00000000	0.76665188	0.27591270	0.30656967	0.0919709	0.12777531
y9	1.00000000	0.76665188	0.27591270	0.30656967	0.0919709	-0.12777531
y10	0.76665188	1.00000000	0.54840850	0.57582892	0.2742042	-0.42857143
y11	0.27591270	0.54840850	1.00000000	0.73684211	0.5526316	-0.32904510
y12	0.30656967	0.57582892	0.73684211	1.00000000	0.6052632	-0.32904510
y13	0.09197090	0.27420425	0.55263158	0.60526316	1.00000000	-0.27420425
y14.1	-0.12777531	-0.42857143	-0.32904510	-0.32904510	-0.2742042	1.00000000
y14.2	-0.07412493	-0.09944903	-0.31814238	-0.47721357	-0.6680990	-0.19889806
y14.3	-0.43643578	-0.52048004	0.06243905	-0.03121953	-0.1873172	0.22771002
y14.4	-0.06788442	-0.09107651	-0.46617324	-0.40790158	-0.6992599	-0.18215302
y15.1	-0.34684399	-0.19389168	0.07443229	-0.11164844	0.1488646	0.19389168
y15.2	0.21428571	0.12777531	-0.45985450	-0.45985450	-0.6744533	0.19166297
y15.3	-0.23904572	-0.53452248	-0.30779351	-0.46169026	-0.1025978	0.53452248

y15.4	-0.23904572	-0.21380899	0.15389675	0.35909242	-0.1025978	0.21380899
y16.1	0.41833001	0.32071349	-0.30779351	-0.10259784	-0.4616903	-0.32071349
y16.2	-0.23904572	-0.21380899	0.15389675	0.35909242	-0.1025978	0.21380899
y16.3	0.41833001	0.32071349	-0.30779351	-0.10259784	-0.4616903	-0.32071349
y16.4	0.41833001	0.32071349	-0.30779351	-0.10259784	-0.4616903	-0.32071349
	y14.2	y14.3	y14.4	y15.1	y15.2	y15.3
y3	0.00000000	-0.18164975	-0.16952582	-0.15467206	0.05096472	-0.08528029
y4	-0.24476773	-0.24019223	-0.32378806	-0.03181424	-0.20965697	-0.43852901
y5	0.05288859	-0.12974982	-0.02421797	-0.21654088	0.00000000	0.08528029
y6	-0.26444294	0.07784989	-0.36326961	-0.09280323	-0.25482360	0.00000000
y7	-0.32522182	-0.02901294	-0.37907125	0.03458572	-0.31339159	-0.33371191
y8	-0.07412493	-0.43643578	-0.06788442	-0.34684399	0.21428571	-0.23904572
y9	-0.07412493	-0.43643578	-0.06788442	-0.34684399	0.21428571	-0.23904572
y10	-0.09944903	-0.52048004	-0.09107651	-0.19389168	0.12777531	-0.53452248
y11	-0.31814238	0.06243905	-0.46617324	0.07443229	-0.45985450	-0.30779351
y12	-0.47721357	-0.03121953	-0.40790158	-0.11164844	-0.45985450	-0.46169026
y13	-0.66809900	-0.18731716	-0.69925986	0.14886459	-0.67445327	-0.10259784
y14.1	-0.19889806	0.22771002	-0.18215302	0.19389168	0.19166297	0.53452248
y14.2	1.00000000	0.03774257	0.73969345	-0.26995276	0.40768712	-0.18605210
y14.3	0.03774257	1.00000000	-0.06913011	0.17660431	-0.43643578	0.36514837
y14.4	0.73969345	-0.06913011	1.00000000	-0.32963426	0.61095981	-0.22718473
y15.1	-0.26995276	0.17660431	-0.32963426	1.00000000	-0.34684399	0.72547625
y15.2	0.40768712	-0.43643578	0.61095981	-0.34684399	1.00000000	-0.23904572
y15.3	-0.18605210	0.36514837	-0.22718473	0.72547625	-0.23904572	1.00000000
y15.4	-0.18605210	0.60858062	-0.22718473	-0.14509525	-0.23904572	-0.10000000
y16.1	0.43412157	-0.18257419	0.56796183	-0.14509525	0.41833001	-0.10000000
y16.2	-0.18605210	0.60858062	-0.22718473	-0.14509525	-0.23904572	-0.10000000
y16.3	0.43412157	-0.18257419	0.56796183	-0.14509525	0.41833001	-0.10000000
y16.4	0.43412157	-0.18257419	0.56796183	-0.14509525	0.41833001	-0.10000000
	y15.4	y16.1	y16.2	y16.3	y16.4	
y3	0.08528029	0.34112115	0.08528029	0.34112115	0.34112115	
y4	0.08770580	0.00000000	0.08770580	0.00000000	0.00000000	
y5	-0.17056057	0.42640143	-0.17056057	0.42640143	0.42640143	
y6	0.34112115	0.25584086	0.34112115	0.25584086	0.25584086	
y7	0.19069252	-0.04767313	0.19069252	-0.04767313	-0.04767313	
y8	-0.23904572	0.41833001	-0.23904572	0.41833001	0.41833001	
y9	-0.23904572	0.41833001	-0.23904572	0.41833001	0.41833001	
y10	-0.21380899	0.32071349	-0.21380899	0.32071349	0.32071349	
y11	0.15389675	-0.30779351	0.15389675	-0.30779351	-0.30779351	
y12	0.35909242	-0.10259784	0.35909242	-0.10259784	-0.10259784	
y13	-0.10259784	-0.46169026	-0.10259784	-0.46169026	-0.46169026	
y14.1	0.21380899	-0.32071349	0.21380899	-0.32071349	-0.32071349	
y14.2	-0.18605210	0.43412157	-0.18605210	0.43412157	0.43412157	
y14.3	0.60858062	-0.18257419	0.60858062	-0.18257419	-0.18257419	
y14.4	-0.22718473	0.56796183	-0.22718473	0.56796183	0.56796183	
y15.1	-0.14509525	-0.14509525	-0.14509525	-0.14509525	-0.14509525	
y15.2	-0.23904572	0.41833001	-0.23904572	0.41833001	0.41833001	
y15.3	-0.10000000	-0.10000000	-0.10000000	-0.10000000	-0.10000000	
y15.4	1.00000000	-0.10000000	1.00000000	-0.10000000	-0.10000000	
y16.1	-0.10000000	1.00000000	-0.10000000	1.00000000	1.00000000	
y16.2	1.00000000	-0.10000000	1.00000000	-0.10000000	-0.10000000	
y16.3	-0.10000000	1.00000000	-0.10000000	1.00000000	1.00000000	
y16.4	-0.10000000	1.00000000	-0.10000000	1.00000000	1.00000000	

2.3.2. Bar charts and empirical probability density functions

Charts containing bar charts and empirical probability density functions are presented in figures 33-38.

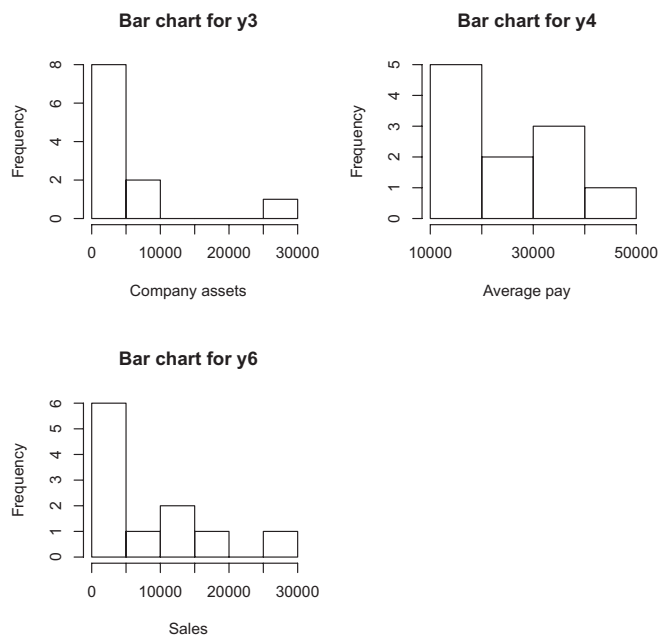
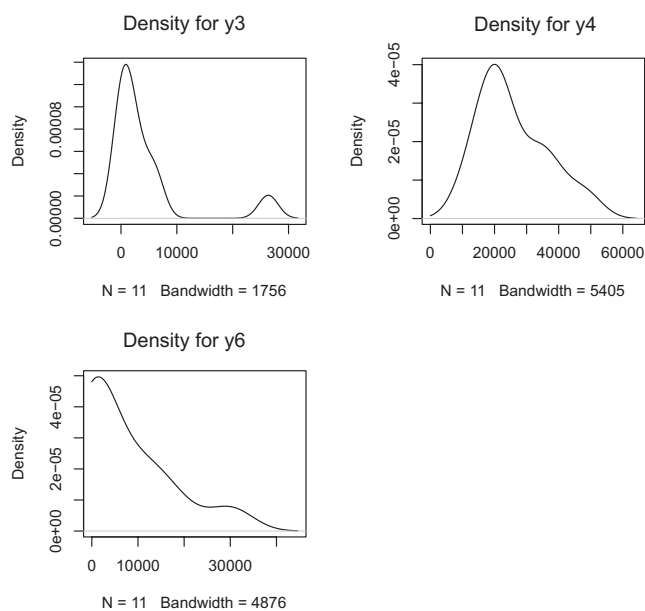
Figure 33. Bar chart for continuous variables**Figure 34.** Estimated function of probability density for continuous variables

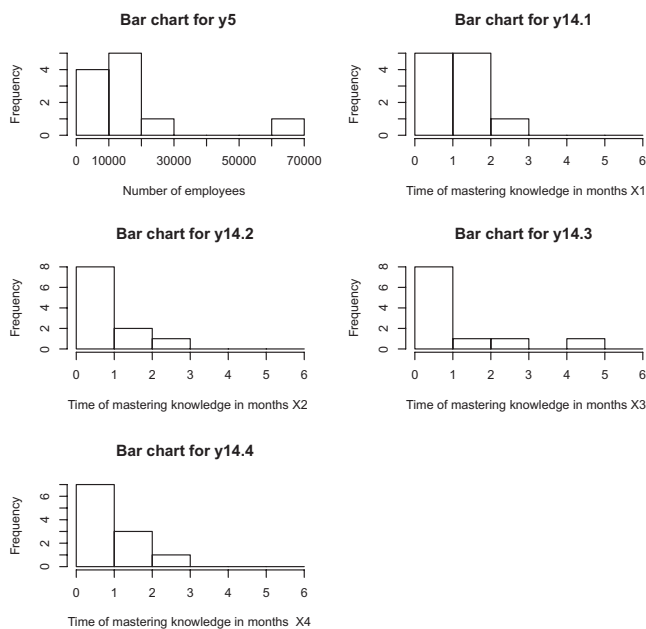
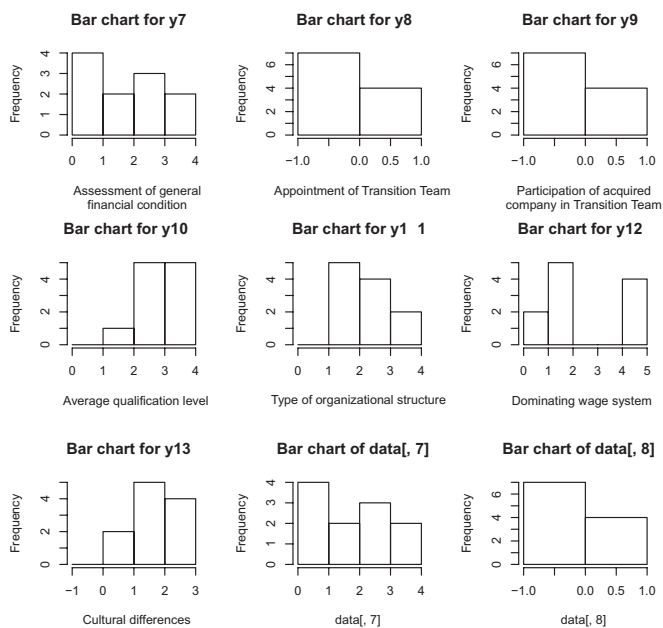
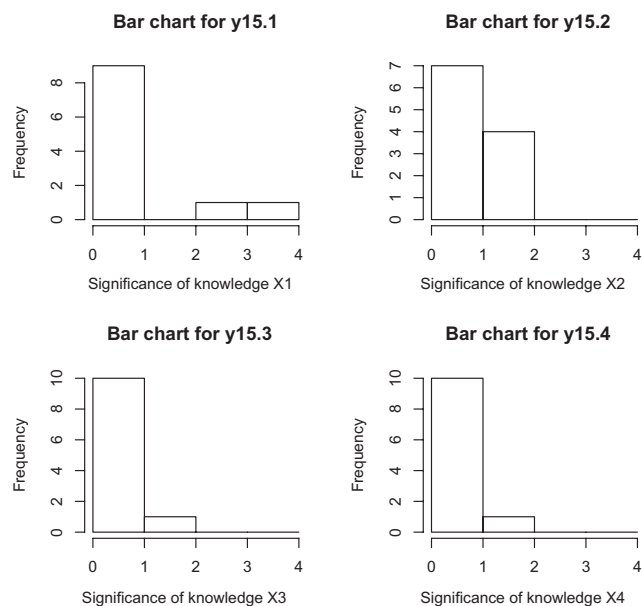
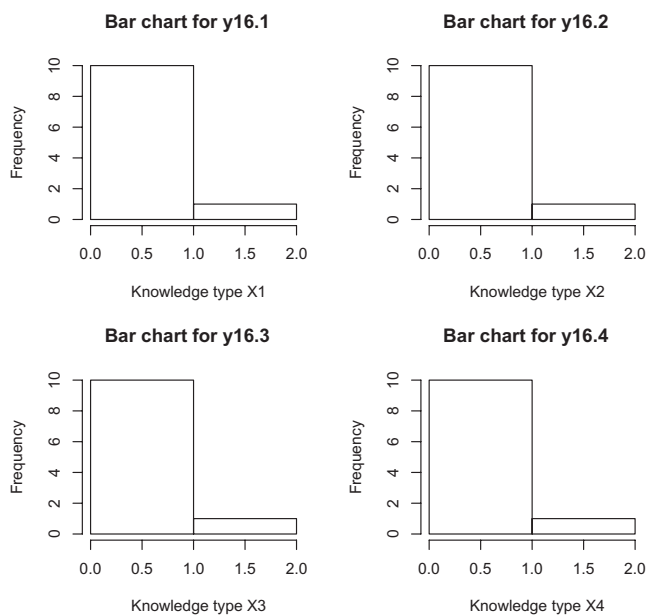
Figure 35. Bar chart for discrete variables**Figure 36.** Bar chart for ordinate variables

Figure 37. Bar chart for variables knowledge significance**Figure 38.** Bar chart for variable types of knowledge

2.3.3. Box-plots

Box plots are contained in figures 39-43.

Figure 39. Boxplot for continuous variables

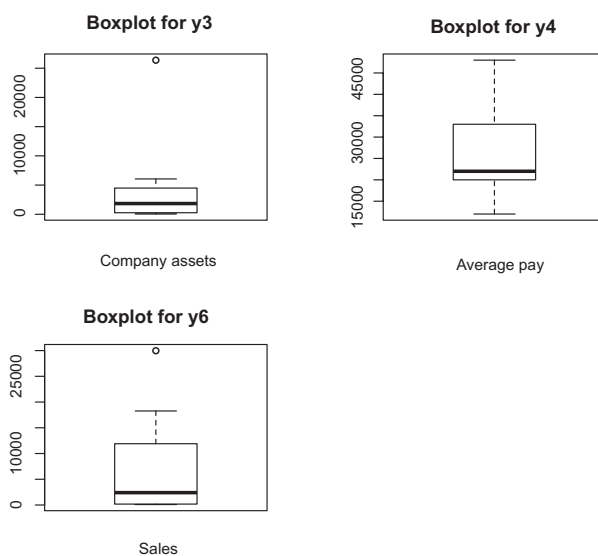


Figure 40. Boxplot for discrete variables

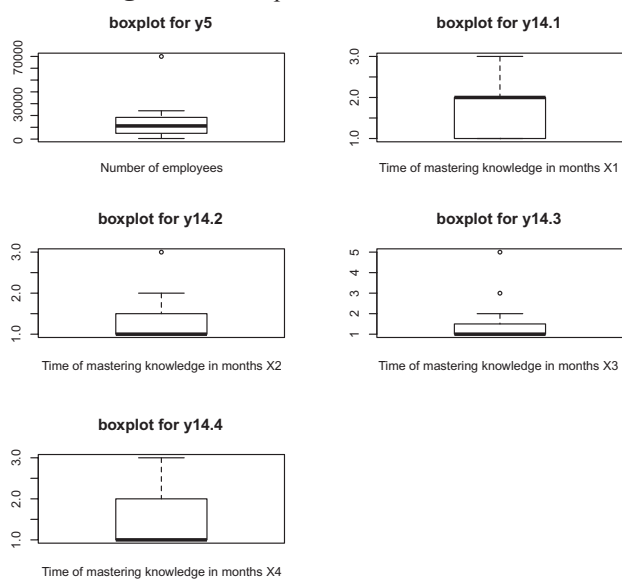


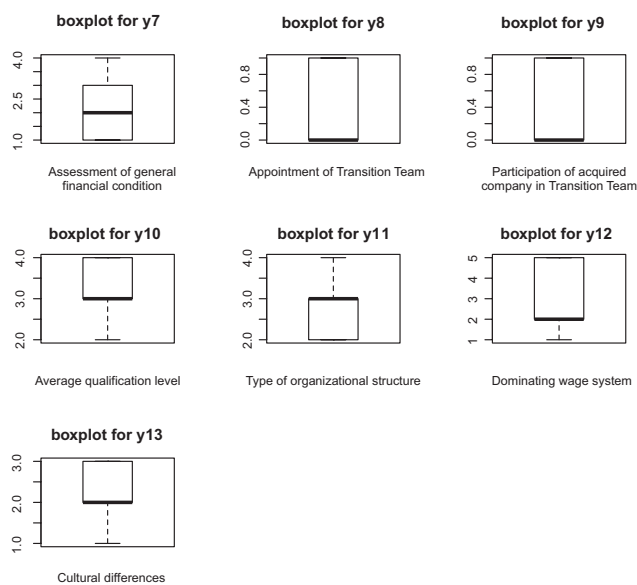
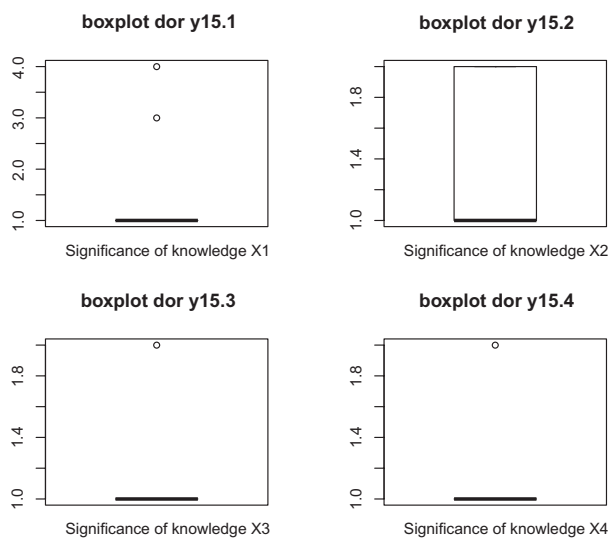
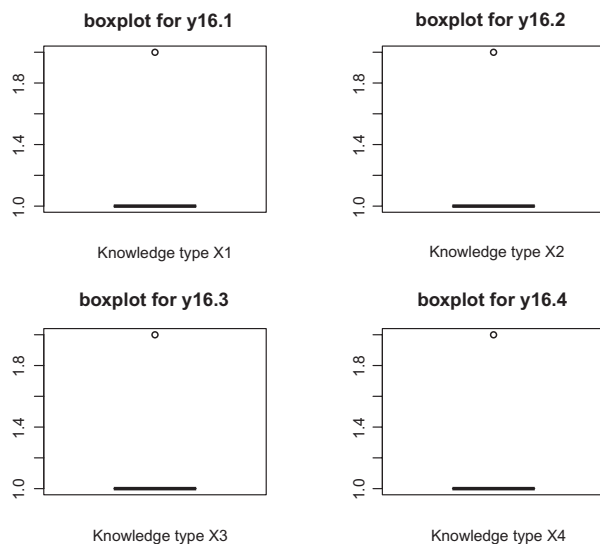
Figure 41. Boxplot for ordinate variables**Figure 42.** Boxplot for variables knowledge significance

Figure 43. Boxplot for variables knowledge type

2.3.4. Lorenz curves

Lorenz curves depict concentration of variables and were placed in Figures 44-48.

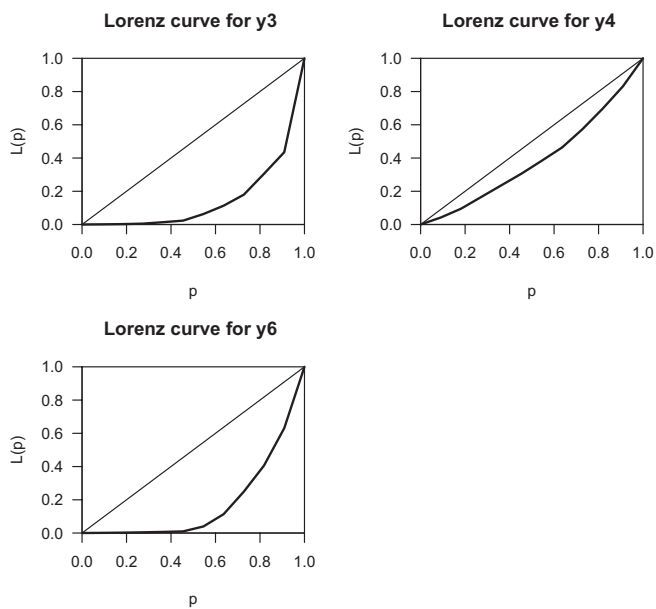
Figure 44. Lorenz curves for continuous variables

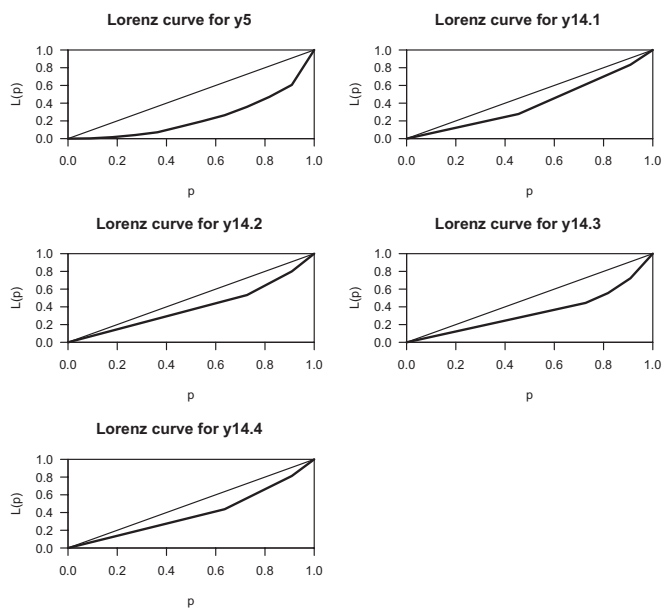
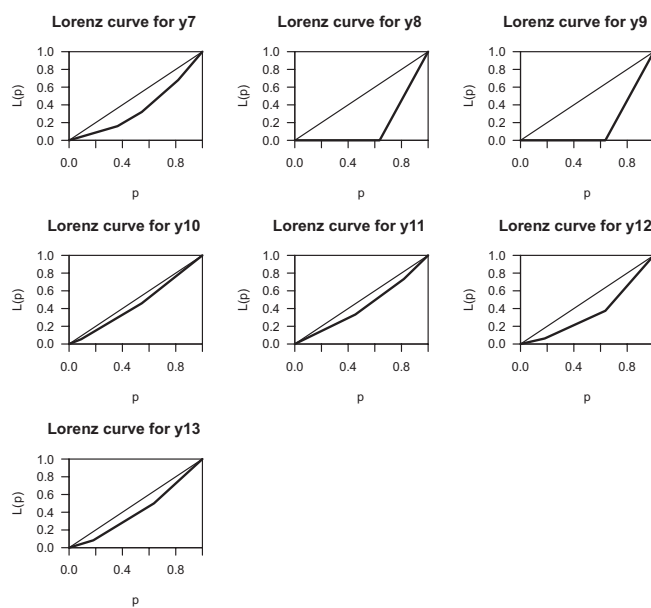
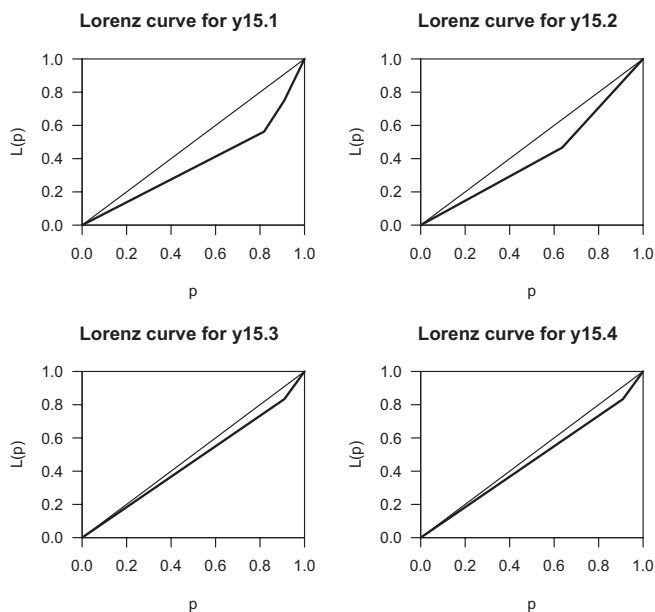
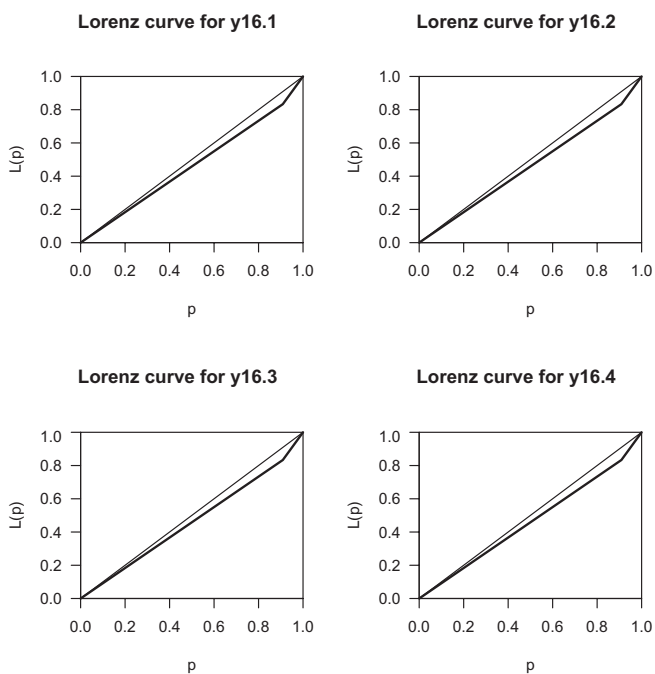
Figure 45. Lorenz curves for discrete variables**Figure 46.** Lorenz curves for serial variables

Figure 47. Lorenz curves for variables knowledge significance**Figure 48.** Lorenz curves for variables knowledge type

2.3.5. Dominants

The dominant values for continuous variables were read as maximal values from empirical density function graphs and they are respectively: y3=910, y4=19981 and y6=1397. For the remaining variables dominant were read from bar charts and recorded below.

y5	y7	y8	y9	y10	y11	y12	y13	y14.1	y14.2	y14.3	y14.4	y15.1
20000	1	0	0	3	2	2	2	1	1	1	1	1
y15.2	y15.3	y15.4	y16.1	y16.2	y16.3	y16.4						
1	1	1	1	1	1	1						

3. Taxonomical calculations

3.1. For all variables

The distance matrix, calculated for variables y3 to y16.4 and applied for building dendrites, is given below.

	British Steel	Europipe	Thyssen Stahl	Thyssen Krupp	CMC
Europipe	49660.830				
Thyssen Stahl	48291.089	95746.943			
Thyssen Krupp	17354.017	64741.051	34123.719		
CMC	44185.111	19958.273	91792.782	60777.431	
Huta Zawiercie	44937.193	19252.751	93132.887	60506.319	10049.928
LNM Holdings	22135.627	70498.498	32230.899	7930.781	64968.115
PHS	36596.549	23300.766	84711.738	51922.155	13350.424
Celsa Group	38354.741	20327.202	86411.015	54477.069	7721.441
Huta Ostrowiec	54152.362	20042.207	102304.922	69299.868	17372.561
ZAO Severstal	30905.341	23312.130	79066.801	46973.736	14657.917
Lucchini	45658.593	20164.659	93459.123	60026.304	18103.510
Evrax	18813.725	36064.800	66605.042	33660.431	28672.595
Vitkovice Steel	51375.625	18389.839	99608.065	67171.254	12256.295
MSC	171991.441	220038.201	126250.836	155901.182	215861.839
Arcelor Mittal	52291.358	31373.288	90690.927	66680.833	39633.064
Tata Steel	29745.092	79299.926	22997.850	18478.387	72745.642
Corus Group	31041.157	23658.812	76834.850	47834.299	17893.174
Salzgitter	42162.119	12958.544	89506.410	58478.310	8248.458
VPE	37741.832	18675.020	85018.277	54460.481	8078.865
Eramet	53284.208	19209.072	100044.632	70222.695	12218.142
Tinfos	58523.675	31725.623	103035.382	75475.099	20952.209
	Huta Zawiercie	LNM Holdings	PHS	Celsa Group	
Europipe					
Thyssen Stahl					
Thyssen Krupp					
CMC					
Huta Zawiercie					
LNM Holdings	64518.838				
PHS	8836.866	55771.280			
Celsa Group	7879.712	58640.494	6051.117		
Huta Ostrowiec	10003.471	73348.884	18201.272	17706.458	
ZAO Severstal	14273.339	51298.723	7334.917	7711.563	
Lucchini	8360.970	64087.537	11519.270	13953.163	
Evrax	27247.527	37319.865	18580.782	21729.003	
Vitkovice Steel	7184.789	71278.982	15892.408	13865.369	
MSC	215733.531	151288.663	207002.116	209831.475	
Arcelor Mittal	43663.808	72903.904	44473.239	40692.850	
Tata Steel	73785.864	14259.584	65233.444	67249.249	

Corus Group	23275.551	53065.698	19747.312	16158.390
Salzgitter	11843.269	63451.816	14132.594	9046.810
VPE	14005.995	59163.878	13154.128	7715.934
Eramet	18984.041	74875.882	24652.376	19080.938
Tinfos	29963.850	79755.924	34122.208	28349.646
	Huta Ostrowiec	ZAO Severstal	Lucchini	Evrax

Europipe				
Thyssen Stahl				
Thyssen Krupp				
CMC				
Huta Zawiercie				
LMN Holdings				
PHS				
Celsa Group				
Huta Ostrowiec				
ZAO Severstal	23808.566			
Lucchini	10235.243	17220.141		
Evrax	36235.720	14545.852	27590.089	
Vitkovice Steel	5577.216	20604.841	11489.469	33970.330
MSC	224305.767	202428.488	214730.100	188500.861
Arcelor Mittal	46784.865	39888.452	45939.664	47768.099
Tata Steel	83038.507	60045.280	74396.712	46937.990
Corus Group	31873.082	13372.604	27871.983	21904.691
Salzgitter	18376.904	13328.798	17240.070	27638.086
VPE	22467.329	10233.696	20100.312	23912.898
Eramet	21066.434	25129.501	25753.287	39327.211
Tinfos	33062.657	33898.262	37856.209	46709.176
	Vitkovice Steel		MSC Arcelor Mittal Tata Steel	

Europipe				
Thyssen Stahl				
Thyssen Krupp				
CMC				
Huta Zawiercie				
LMN Holdings				
PHS				
Celsa Group				
Huta Ostrowiec				
ZAO Severstal				
Lucchini				
Evrax				
Vitkovice Steel				
MSC	222390.542			
Arcelor Mittal	43188.677	214152.557		
Tata Steel	80288.768	143496.029	77097.622	
Corus Group	27431.609	202239.324	30950.501	59516.123
Salzgitter	14042.005	214094.198	33698.720	71528.980
VPE	17777.719	209687.643	34641.281	66673.841
Eramet	16148.854	224993.275	34804.775	81738.186
Tinfos	28280.083	228186.840	42101.218	85103.753
	Corus Group Salzgitter		VPE	Eramet

Europipe	
Thyssen Stahl	
Thyssen Krupp	
CMC	
Huta Zawiercie	
LMN Holdings	
PHS	
Celsa Group	
Huta Ostrowiec	
ZAO Severstal	
Lucchini	
Evrax	
Vitkovice Steel	
MSC	
Arcelor Mittal	
Tata Steel	
Corus Group	

```

Salzgitter      14447.791
VPE             10040.091   6145.122
Eramet          23448.297   13536.462   15983.963
Tinfos          29469.110   24650.609   24405.328   14439.761

```

K-means clustering with 2 clusters of sizes 5, 17

Cluster means:

```

      y3      y4      y5      y6      y7      y8      y9      y10
1 13338.000 25400.00 110340.00 13300.000 2.800000 1.0000000 0.8000000 2.600000
2 3794.529 26535.29 15615.53 5869.059 2.705882 0.2352941 0.2352941 3.058824
      y11      y12      y13      y14.1      y14.2      y14.3      y14.4      y15.1
1 1.400000 1.400000 2.200000 3.000000 3.200000 3.200000 4.000000 2.800000
2 2.411765 2.705882 2.058824 1.941176 1.470588 1.764706 1.823529 1.647059
      y15.2      y15.3      y15.4      y16.1      y16.2      y16.3      y16.4
1 3.400000 2.400000 1.800000 1.4 1.400000 1.600000 1.4
2 1.705882 1.294118 1.176471 1.0 1.235294 1.058824 1.0

```

Clustering vector:

```

British Steel      Europipe      Thyssen Stahl      Thyssen Krupp      CMC
2                  2                  1                  1                  2
Huta Zawiercie    LNM Holdings          PHS          Celsa Group      Huta Ostrowiec
2                  1                  2                  2                  2
ZAO Severstal      Lucchini          Evraz      Vitkovice Steel      MSC
2                  2                  2                  2                  1
Arcelor Mittal      Tata Steel      Corus Group          Salzgitter      VPE
2                  1                  2                  2                  2
      Eramet          Tinfos
2                  2

```

Within cluster sum of squares by cluster:

```

[1] 17412733238 5987088694
(between_SS / total_SS = 60.1 %)

```

Available components:

```

[1] "cluster"      "centers"      "totss"      "withinss"      "tot.withinss"
[6] "betweenss"    "size"      "iter"      "ifault"

```

Centroids of individual classes:

```

      y3      y4      y5      y6      y7      y8      y9      y10
1 13338.000 25400.00 110340.00 13300.000 2.800000 1.0000000 0.8000000 2.600000
2 3794.529 26535.29 15615.53 5869.059 2.705882 0.2352941 0.2352941 3.058824
      y11      y12      y13      y14.1      y14.2      y14.3      y14.4      y15.1
1 1.400000 1.400000 2.200000 3.000000 3.200000 3.200000 4.000000 2.800000
2 2.411765 2.705882 2.058824 1.941176 1.470588 1.764706 1.823529 1.647059
      y15.2      y15.3      y15.4      y16.1      y16.2      y16.3      y16.4
1 3.400000 2.400000 1.800000 1.4 1.400000 1.600000 1.4
2 1.705882 1.294118 1.176471 1.0 1.235294 1.058824 1.0

```

Assignment to individual classes:

```

British Steel      Europipe      Thyssen Stahl      Thyssen Krupp      CMC
2                  2                  1                  1                  2
Huta Zawiercie    LNM Holdings          PHS          Celsa Group      Huta Ostrowiec
2                  1                  2                  2                  2
ZAO Severstal      Lucchini          Evraz      Vitkovice Steel      MSC
2                  2                  2                  2                  1
Arcelor Mittal      Tata Steel      Corus Group          Salzgitter      VPE
2                  1                  2                  2                  2
      Eramet          Tinfos
2                  2

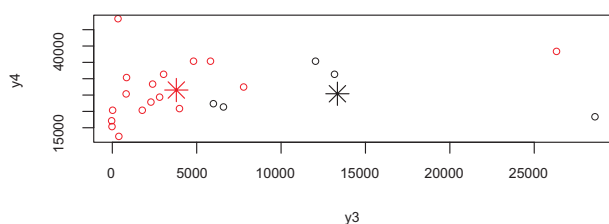
```

First class:

Thyssen Stahl	Thyssen Krupp	LNM Holdings	MSC	Tata Steel
1	1	1	1	1

Second class:

British Steel	Europipe	CMC	Huta Zawiercie	PHS
2	2	2	2	2
Celsa Group	Huta Ostrowiec	ZAO Severstal	Lucchini	Evraz
2	2	2	2	2
Vitkovice Steel	Arcelor Mittal	Corus Group	Salzgitter	VPE
2	2	2	2	2
Eramet	Tinfos			
2	2			



The dendrogram for all variables is shown in Figure 59.

The above dendrites were described in plain text on the following printouts. The first two columns in the dendrogram printout have the following interpretation. The line i (1 to 21) describes clustering in step i . If element j in step i assumes a negative value (preceded by a sign -), then the object $-j$ was included at this stage. If element j is not preceded by any symbol, then the combination of the object in the cluster occurred at earlier stages of the algorithm. Hence negative elements denote single objects, and positive structures not being single objects. The „height” column contains the criterion values assigned to the method used to create the clusters in a specific structure/dendrite.

```
> hs<-hclust(d^2,"ward")
```

```
Call:
```

```
hclust(d = d^2, method = "ward")
```

```
Cluster method : ward
```

```
Distance : euclidean
```

```
Number of objects: 22
```

```
> hs
```

```
Call:
```

```
hclust(d = d^2, method = "ward")
```

```
Cluster method : ward
```

```
Distance : euclidean
```

```
Number of objects: 22
```

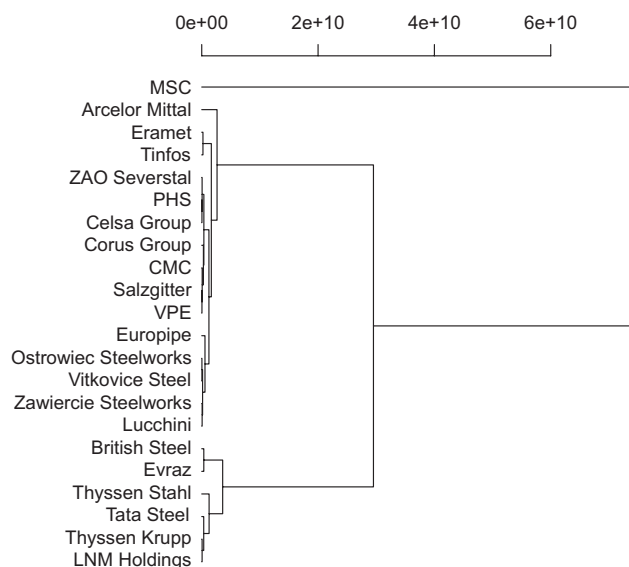
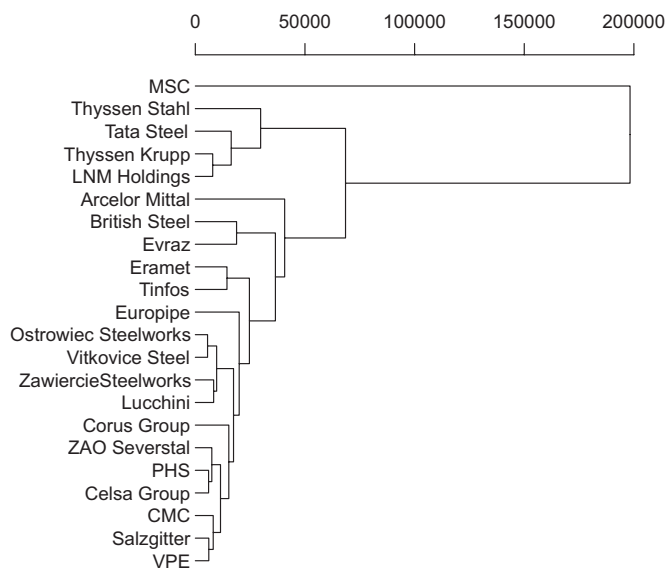
Figure 49. Dendrogram for all variables (Ward)**Figure 50.** Dendrogram (average)

Figure 51. Dendrogram (McQuitty)

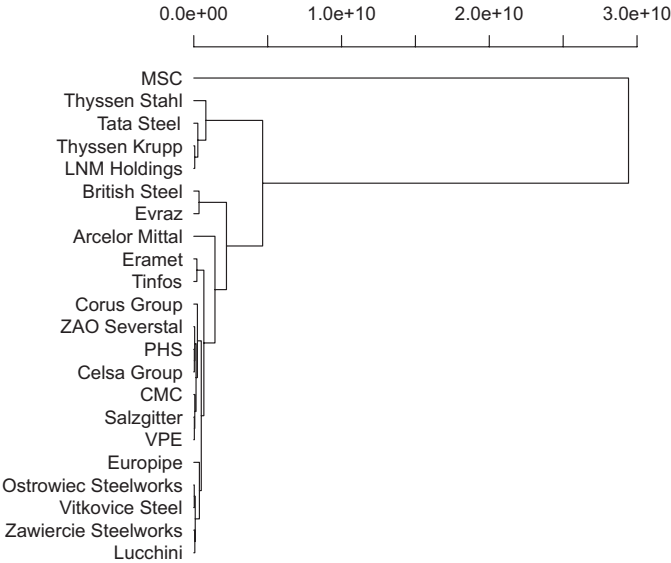


Figure 52. Dendrogram (median)

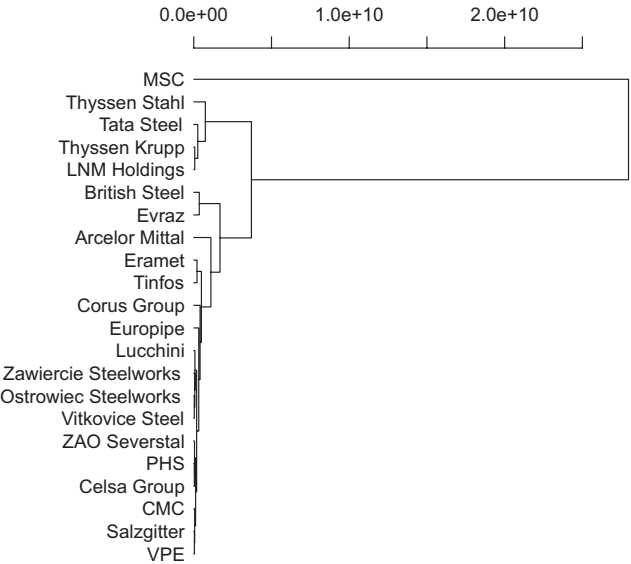
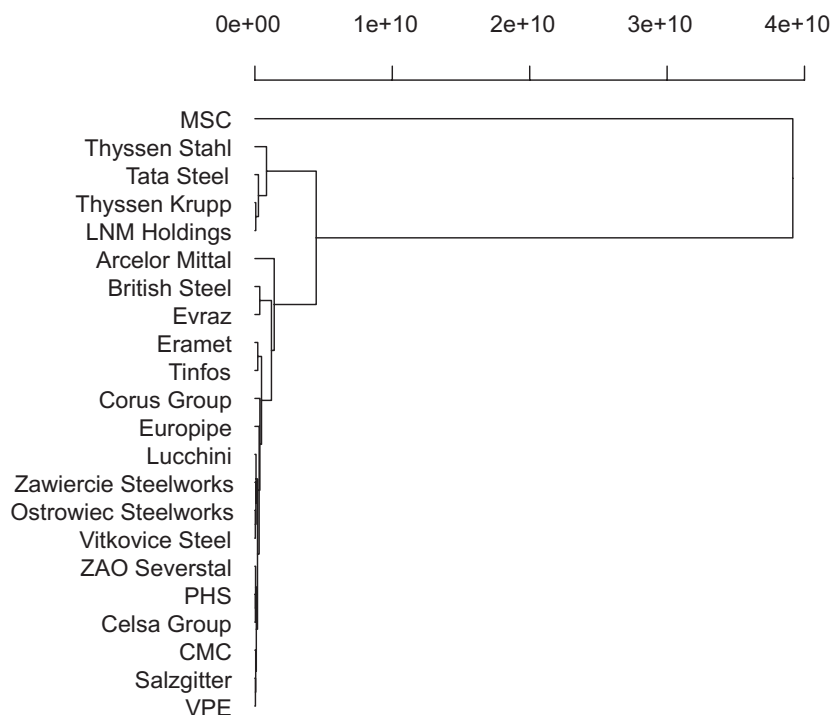


Figure 53. Dendrogram (centroid)

```
> cbind(polaczenia=hs$merge,wysokosc=hs$height)
```

			wysokosc
[1,]	-10	-14	31105339
[2,]	-8	-9	36616016
[3,]	-19	-20	37762521
[4,]	-4	-7	62897289
[5,]	-11	2	63307472
[6,]	-6	-12	69905817
[7,]	-5	3	76282572
[8,]	1	6	143723775
[9,]	-21	-22	208506704
[10,]	-18	7	286342608
[11,]	-17	4	342225264
[12,]	-1	-13	353956251
[13,]	5	10	365338278
[14,]	-2	8	557916276
[15,]	13	14	1235152838
[16,]	-3	11	1264799428
[17,]	9	15	1648857259
[18,]	-16	17	2633070206
[19,]	12	16	3598438900
[20,]	18	19	29520594709
[21,]	-15	20	74737974487

```
> hs<-hclust(d,"ave")
```

```
Call:
hclust(d = d, method = "ave")
```

```
Cluster method : average
```

```
Distance      : euclidean
Number of objects: 22
```

```
> hs
```

```
Call:
hclust(d = d, method = "ave")
```

```
Cluster method : average
Distance       : euclidean
Number of objects: 22
```

```
> cbind(polaczenia=hs$merge,wysokosc=hs$height)
```

			wysokosc
[1,]	-10	-14	5577.216
[2,]	-8	-9	6051.117
[3,]	-19	-20	6145.122
[4,]	-11	2	7523.240
[5,]	-4	-7	7930.781
[6,]	-5	3	8163.661
[7,]	-6	-12	8360.970
[8,]	1	7	9728.243
[9,]	4	6	11482.416
[10,]	-21	-22	14439.761
[11,]	-18	9	15276.560
[12,]	-17	5	16368.986
[13,]	8	11	17423.197
[14,]	-1	-13	18813.725
[15,]	-2	13	20003.655
[16,]	10	15	24664.465
[17,]	-3	12	29784.156
[18,]	14	16	36525.289
[19,]	-16	18	40743.366
[20,]	17	19	68497.517
[21,]	-15	20	198243.091

```
> hs<-hclust(d^2,"mcquitty")
```

```
Call:
hclust(d = d^2, method = "mcquitty")
```

```
Cluster method : mcquitty Distance : euclidean Number of objects: 22
```

```
> hs
```

```
Call:
hclust(d = d^2, method = "mcquitty")
```

```
Cluster method : mcquitty
Distance       : euclidean
Number of objects: 22
```

```
> cbind(polaczenia=hs$merge,wysokosc=hs$height)
```

			wysokosc
[1,]	-10	-14	31105339
[2,]	-8	-9	36616016
[3,]	-19	-20	37762521
[4,]	-11	2	56634608
[5,]	-4	-7	62897289
[6,]	-5	3	66652560
[7,]	-6	-12	69905817
[8,]	1	7	97114676
[9,]	4	6	150877470
[10,]	-21	-22	208506704

```
[11,] -18  9    244822051
[12,] -17  5    272393270
[13,]  -1 -13   353956251
[14,]  -2  8    379289539
[15,]  11 14    505691306
[16,]  10 15    680838627
[17,]  -3 12    815265306
[18,] -16 16    1433049373
[19,]  13 18    2210703473
[20,]  17 19    4659788136
[21,] -15 20    29423666703
```

```
> hs<-hclust(d^2,"median")
```

```
Call:
hclust(d = d^2, method = "median")
```

```
Cluster method : median Distance : euclidean Number of objects: 22
```

```
> hs
```

```
Call:
hclust(d = d^2, method = "median")
```

```
Cluster method : median
Distance       : euclidean
Number of objects: 22
```

```
> cbind(polaczenia=hs$merge,wysokosc=hs$height)
```

```
      wysokosc
[1,] -10 -14    31105339
[2,]  -8  -9    36616016
[3,] -19 -20    37762521
[4,] -11  2    47480604
[5,]  -5  3    57211929
[6,]  -4 -7    62897289
[7,]  -6  1    68068976
[8,] -12  7    73239518
[9,]  4  5    115407020
[10,]  8  9    184228681
[11,] -21 -22   208506704
[12,] -17  6    256668948
[13,]  -2 10    320270806
[14,]  -1 -13   353956251
[15,] -18 13    405369000
[16,]  11 15    490336830
[17,]  -3 12    743235908
[18,] -16 16   1102141725
[19,]  14 18   1687648278
[20,]  17 19   3708510693
[21,] -15 20   27967231272
```

```
> hs<-hclust(d^2,"centroid")
```

```
Call:
hclust(d = d^2, method = "centroid")
```

```
Cluster method : centroid
Distance       : euclidean
Number of objects: 22
```

```
> hs
```

```
Call:
hclust(d = d^2, method = "centroid")
```



```
Cluster method : centroid
Distance       : euclidean
Number of objects: 22
```

```
> cbind(polaczenia=hs$merge,wysokosc=hs$height)
```

```
      wysokosc
[1,] -10 -14 31105339
[2,]  -8  -9 36616016
[3,] -19 -20 37762521
[4,] -11  2 47480604
[5,]  -5  3 57211929
[6,]  -4 -7 62897289
[7,]  -6  1 68068976
[8,] -12  7 81913972
[9,]  4  5 103142578
[10,]  8  9 189250364
[11,] -21 -22 208506704
[12,] -17  6 256668948
[13,]  -2 10 309348075
[14,]  -1 -13 353956251
[15,] -18 13 362437894
[16,] 11 15 480916700
[17,]  -3 12 843199618
[18,] 14 16 1204203763
[19,] -16 18 1404991823
[20,] 17 19 4461372818
[21,] -15 20 39148462826
```

```
> d<-as.matrix(d)
```

	British Steel	Europipe	Thyssen Stahl	Thyssen Krupp	CMC
British Steel	0.00	49660.83	48291.09	17354.017	44185.111
Europipe	49660.83	0.00	95746.94	64741.051	19958.273
Thyssen Stahl	48291.09	95746.94	0.00	34123.719	91792.782
Thyssen Krupp	17354.02	64741.05	34123.72	0.000	60777.431
CMC	44185.11	19958.27	91792.78	60777.431	0.000
Huta Zawiercie	44937.19	19252.75	93132.89	60506.319	10049.928
LNМ Holdings	22135.63	70498.50	32230.90	7930.781	64968.115
PHS	36596.55	23300.77	84711.74	51922.155	13350.424
Celsa Group	38354.74	20327.20	86411.02	54477.069	7721.441
Huta Ostrowiec	54152.36	20042.21	102304.92	69299.868	17372.561
ZAO Severstal	30905.34	23312.13	79066.80	46973.736	14657.917
Lucchini	45658.59	20164.66	93459.12	60026.304	18103.510
Evrax	18813.73	36064.80	66605.04	33660.431	28672.595
Vitkovice Steel	51375.63	18389.84	99608.06	67171.254	12256.295
MSC	171991.44	220038.20	126250.84	155901.182	215861.839
Arcelor Mittal	52291.36	31373.29	90690.93	66680.833	39633.064
Tata Steel	29745.09	79299.93	22997.85	18478.387	72745.642
Corus Group	31041.16	23658.81	76834.85	47834.299	17893.174
Salzgitter	42162.12	12958.54	89506.41	58478.310	8248.458
VPE	37741.83	18675.02	85018.28	54460.481	8078.865
Eramet	53284.21	19209.07	100044.63	70222.695	12218.142
Tinfos	58523.67	31725.62	103035.38	75475.099	20952.209
	Huta Zawiercie	LNМ Holdings	PHS	Celsa Group	
British Steel	44937.193	22135.627	36596.549	38354.741	
Europipe	19252.751	70498.498	23300.766	20327.202	
Thyssen Stahl	93132.887	32230.899	84711.738	86411.015	
Thyssen Krupp	60506.319	7930.781	51922.155	54477.069	
CMC	10049.928	64968.115	13350.424	7721.441	
Huta Zawiercie	0.000	64518.838	8836.866	7879.712	
LNМ Holdings	64518.838	0.000	55771.280	58640.494	
PHS	8836.866	55771.280	0.000	6051.117	
Celsa Group	7879.712	58640.494	6051.117	0.000	
Huta Ostrowiec	10003.471	73348.884	18201.272	17706.458	

ZAO Severstal	14273.339	51298.723	7334.917	7711.563	
Lucchini	8360.970	64087.537	11519.270	13953.163	
Evrast	27247.527	37319.865	18580.782	21729.003	
Vitkovice Steel	7184.789	71278.982	15892.408	13865.369	
MSC	215733.531	151288.663	207002.116	209831.475	
Arcelor Mittal	43663.808	72903.904	44473.239	40692.850	
Tata Steel	73785.864	14259.584	65233.444	67249.249	
Corus Group	23275.551	53065.698	19747.312	16158.390	
Salzgitter	11843.269	63451.816	14132.594	9046.810	
VPE	14005.995	59163.878	13154.128	7715.934	
Eramet	18984.041	74875.882	24652.376	19080.938	
Tinfos	29963.850	79755.924	34122.208	28349.646	
	Huta Ostrowiec	ZAO Severstal	Lucchini	Evrast	
British Steel	54152.362	30905.341	45658.59	18813.73	
Europipe	20042.207	23312.130	20164.66	36064.80	
Thyssen Stahl	102304.922	79066.801	93459.12	66605.04	
Thyssen Krupp	69299.868	46973.736	60026.30	33660.43	
CMC	17372.561	14657.917	18103.51	28672.60	
Huta Zawiercie	10003.471	14273.339	8360.97	27247.53	
LNH Holdings	73348.884	51298.723	64087.54	37319.87	
PHS	18201.272	7334.917	11519.27	18580.78	
Celsa Group	17706.458	7711.563	13953.16	21729.00	
Huta Ostrowiec	0.000	23808.566	10235.24	36235.72	
ZAO Severstal	23808.566	0.000	17220.14	14545.85	
Lucchini	10235.243	17220.141	0.00	27590.09	
Evrast	36235.720	14545.852	27590.09	0.00	
Vitkovice Steel	5577.216	20604.841	11489.47	33970.33	
MSC	224305.767	202428.488	214730.10	188500.86	
Arcelor Mittal	46784.865	39888.452	45939.66	47768.10	
Tata Steel	83038.507	60045.280	74396.71	46937.99	
Corus Group	31873.082	13372.604	27871.98	21904.69	
Salzgitter	18376.904	13328.798	17240.07	27638.09	
VPE	22467.329	10233.696	20100.31	23912.90	
Eramet	21066.434	25129.501	25753.29	39327.21	
Tinfos	33062.657	33898.262	37856.21	46709.18	
	Vitkovice Steel	MSC Arcelor Mittal	Tata Steel	Corus Group	
British Steel	51375.625	171991.4	52291.36	29745.09	31041.16
Europipe	18389.839	220038.2	31373.29	79299.93	23658.81
Thyssen Stahl	99608.065	126250.8	90690.93	22997.85	76834.85
Thyssen Krupp	67171.254	155901.2	66680.83	18478.39	47834.30
CMC	12256.295	215861.8	39633.06	72745.64	17893.17
Huta Zawiercie	7184.789	215733.5	43663.81	73785.86	23275.55
LNH Holdings	71278.982	151288.7	72903.90	14259.58	53065.70
PHS	15892.408	207002.1	44473.24	65233.44	19747.31
Celsa Group	13865.369	209831.5	40692.85	67249.25	16158.39
Huta Ostrowiec	5577.216	224305.8	46784.86	83038.51	31873.08
ZAO Severstal	20604.841	202428.5	39888.45	60045.28	13372.60
Lucchini	11489.469	214730.1	45939.66	74396.71	27871.98
Evrast	33970.330	188500.9	47768.10	46937.99	21904.69
Vitkovice Steel	0.000	222390.5	43188.68	80288.77	27431.61
MSC	222390.542	0.0	214152.56	143496.03	202239.32
Arcelor Mittal	43188.677	214152.6	0.00	77097.62	30950.50
Tata Steel	80288.768	143496.0	77097.62	0.00	59516.12
Corus Group	27431.609	202239.3	30950.50	59516.12	0.00
Salzgitter	14042.005	214094.2	33698.72	71528.98	14447.79
VPE	17777.719	209687.6	34641.28	66673.84	10040.09
Eramet	16148.854	224993.3	34804.77	81738.19	23448.30
Tinfos	28280.083	228186.8	42101.22	85103.75	29469.11
	Salzgitter	VPE	Eramet	Tinfos	
British Steel	42162.119	37741.832	53284.21	58523.67	
Europipe	12958.544	18675.020	19209.07	31725.62	
Thyssen Stahl	89506.410	85018.277	100044.63	103035.38	
Thyssen Krupp	58478.310	54460.481	70222.69	75475.10	
CMC	8248.458	8078.865	12218.14	20952.21	
Huta Zawiercie	11843.269	14005.995	18984.04	29963.85	

LNM Holdings	63451.816	59163.878	74875.88	79755.92
PHS	14132.594	13154.128	24652.38	34122.21
Celsa Group	9046.810	7715.934	19080.94	28349.65
Huta Ostrowiec	18376.904	22467.329	21066.43	33062.66
ZAO Severstal	13328.798	10233.696	25129.50	33898.26
Lucchini	17240.070	20100.312	25753.29	37856.21
Evrz	27638.086	23912.898	39327.21	46709.18
Vitkovice Steel	14042.005	17777.719	16148.85	28280.08
MSC	214094.198	209687.643	224993.28	228186.84
Arcelor Mittal	33698.720	34641.281	34804.77	42101.22
Tata Steel	71528.980	66673.841	81738.19	85103.75
Corus Group	14447.791	10040.091	23448.30	29469.11
Salzgitter	0.000	6145.122	13536.46	24650.61
VPE	6145.122	0.000	15983.96	24405.33
Eramet	13536.462	15983.963	0.00	14439.76
Tinfos	24650.609	24405.328	14439.76	0.00

```
> sort(apply(d,1,sum))/nrow(d)
```

ZAO Severstal	Celsa Group	VPE	PHS	Salzgitter
34092.68	34225.17	34549.26	35208.50	35388.91
CMC	Corus Group	Huta Zawiercie	Evrz	Lucchini
36340.81	36457.93	36701.84	38351.58	39352.56
Vitkovice Steel	Europipe	Eramet	Huta Ostrowiec	British Steel
39918.76	41745.38	42224.64	42693.83	44509.17
Tinfos	Arcelor Mittal	Thyssen Krupp	LNM Holdings	Tata Steel
49548.48	53337.26	53477.06	56490.63	62438.95
Thyssen Stahl	MSC			
77357.46	189232.04			

3.2. For variables concerning knowledge

The distance matrix, calculated for variables concerning knowledge (from y14.1 to y16.4), used to construct the dendrite is given below.

	British Steel	Europipe	Thyssen Stahl	Thyssen Krupp	CMC
Europipe	5.477226				
Thyssen Stahl	4.242641	5.291503			
Thyssen Krupp	3.162278	5.291503	4.242641		
CMC	3.162278	4.472136	4.242641	4.000000	
Huta Zawiercie	3.872983	3.000000	4.795832	3.000000	3.316625
LNM Holdings	4.898979	7.348469	5.099020	6.000000	6.000000
PHS	4.123106	4.358899	5.567764	3.000000	4.358899
Celsa Group	2.645751	5.196152	3.316625	2.645751	3.605551
Huta Ostrowiec	2.828427	4.472136	4.472136	2.449490	3.741657
ZAO Severstal	4.000000	5.656854	5.656854	3.741657	5.291503
Lucchini	4.690416	4.690416	5.099020	4.898979	4.000000
Evrz	4.795832	2.236068	4.358899	4.358899	3.872983
Vitkovice Steel	2.828427	4.898979	4.898979	2.449490	4.242641
MSC	6.855655	7.416198	6.557439	8.062258	6.244998
Arcelor Mittal	4.123106	4.358899	5.567764	3.000000	4.358899
Tata Steel	5.477226	6.928203	4.690416	6.633250	4.898979
Corus Group	3.741657	4.242641	5.477226	3.162278	4.242641
Salzgitter	3.605551	4.358899	3.000000	3.872983	3.605551
VPE	3.605551	4.358899	5.000000	3.000000	4.358899
Eramet	2.828427	5.099020	3.741657	3.162278	4.472136
Tinfos	4.582576	4.795832	5.196152	3.605551	4.358899
	Huta Zawiercie	LNM Holdings	PHS	Celsa Group	Huta Ostrowiec
Europipe					
Thyssen Stahl					
Thyssen Krupp					
CMC					

Huta Zawiercie					
LNM Holdings	6.403124				
PHS	2.449490	7.280110			
Celsa Group	3.464102	5.385165	3.162278		
Huta Ostrowiec	2.645751	6.164414	1.732051	1.732051	
ZAO Severstal	3.872983	4.898979	3.872983	3.872983	3.464102
Lucchini	4.123106	6.324555	3.872983	3.872983	3.741657
Evráz	2.449490	6.557439	3.464102	3.741657	3.316625
Vitkovice Steel	2.645751	5.099020	2.645751	2.645751	2.000000
MSC	7.483315	5.000000	9.273618	7.874008	8.426150
Arcelor Mittal	2.449490	7.280110	0.000000	3.162278	1.732051
Tata Steel	6.557439	4.242641	7.681146	5.744563	6.633250
Corus Group	2.645751	6.928203	1.000000	3.000000	1.414214
Salzgitter	3.741657	5.196152	4.000000	2.828427	3.316625
VPE	2.828427	6.557439	1.414214	2.449490	1.000000
Eramet	3.872983	4.898979	3.605551	2.236068	2.449490
Tinfos	3.162278	7.000000	2.000000	3.162278	2.645751
	ZAO Severstal	Lucchini	Evráz	Vitkovice Steel	MSC
Europipe					
Thyssen Stahl					
Thyssen Krupp					
CMC					
Huta Zawiercie					
LNM Holdings					
PHS					
Celsa Group					
Huta Ostrowiec					
ZAO Severstal					
Lucchini	4.898979				
Evráz	4.582576	3.316625			
Vitkovice Steel	2.000000	4.242641	3.872983		
MSC	7.549834	7.810250	7.348469	7.681146	
Arcelor Mittal	3.872983	3.872983	3.464102	2.645751	9.273618
Tata Steel	6.164414	5.656854	5.916080	6.324555	3.872983
Corus Group	3.741657	3.464102	3.316625	2.449490	9.000000
Salzgitter	5.000000	3.605551	3.741657	3.872983	7.211103
VPE	3.316625	3.605551	3.162278	2.236068	8.831761
Eramet	3.162278	3.741657	3.872983	2.449490	7.549834
Tinfos	4.358899	2.645751	3.464102	3.316625	9.055385
	Arcelor Mittal	Tata Steel	Corus Group	Salzgitter	VPE
Europipe					
Thyssen Stahl					
Thyssen Krupp					
CMC					
Huta Zawiercie					
LNM Holdings					
PHS					
Celsa Group					
Huta Ostrowiec					
ZAO Severstal					
Lucchini					
Evráz					
Vitkovice Steel					
MSC					
Arcelor Mittal					
Tata Steel	7.681146				
Corus Group	1.000000	7.348469			
Salzgitter	4.000000	5.744563	3.872983		
VPE	1.414214	7.000000	1.000000	3.741657	
Eramet	3.605551	5.477226	3.162278	3.316625	2.645751
Tinfos	2.000000	7.141428	2.236068	3.464102	2.449490
	Eramet				
Europipe					

```

Thyssen Stahl
Thyssen Krupp
CMC
Huta Zawiercie
LNM Holdings
PHS
Celsa Group
Huta Ostrowiec
ZAO Severstal
Lucchini
Evraz
Vitkovice Steel
MSC
Arcelor Mittal
Tata Steel
Corus Group
Salzgitter
VPE
Eramet
Tinfos          3.605551

```

K-means clustering with 2 clusters of sizes 3, 19

Cluster means:

```

      y14.1  y14.2  y14.3  y14.4  y15.1  y15.2  y15.3  y15.4
1  4.000000  4.333333  4.000000  4.333333  3.333333  3.666667  3.333333  2.000000
2  1.894737  1.473684  1.789474  2.000000  1.684211  1.842105  1.263158  1.210526
      y16.1  y16.2  y16.3  y16.4
1  1.000000  1.333333  1.333333  1.333333
2  1.105263  1.263158  1.157895  1.052632

```

Clustering vector:

```

British Steel      Europipe  Thyssen Stahl      Thyssen Krupp      CMC
      2              2              2              2              2
Huta Zawiercie  LNM Holdings      PHS      Celsa Group  Huta Ostrowiec
      2              1              2              2              2
      ZAO Severstal      Lucchini      Evraz  Vitkovice Steel      MSC
      2              2              2              2              1
Arcelor Mittal  Tata Steel      Corus Group      Salzgitter      VPE
      2              1              2              2              2
      Eramet      Tinfos
      2              2

```

Within cluster sum of squares by cluster:

```

[1] 19.33333 122.10526
(between_SS / total_SS = 38.4 %)

```

Available components:

```

[1] "cluster"      "centers"      "totss"      "withinss"      "tot.withinss"
[6] "betweenss"    "size"         "iter"       "ifault"

```

Centroids of individual classes:

```

      y14.1  y14.2  y14.3  y14.4  y15.1  y15.2  y15.3  y15.4
1  4.000000  4.333333  4.000000  4.333333  3.333333  3.666667  3.333333  2.000000
2  1.894737  1.473684  1.789474  2.000000  1.684211  1.842105  1.263158  1.210526
      y16.1  y16.2  y16.3  y16.4
1  1.000000  1.333333  1.333333  1.333333
2  1.105263  1.263158  1.157895  1.052632

```

Assignment to individual classes:

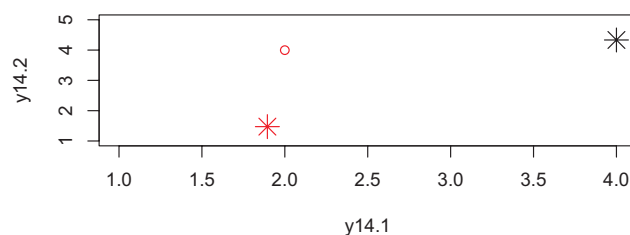
British Steel	Europipe	Thyssen Stahl	Thyssen Krupp	CMC
2	2	2	2	2
Huta Zawiercie	LNM Holdings	PHS	Celsa Group	Huta Ostrowiec
2	1	2	2	2
ZAO Severstal	Lucchini	Evraz	Vitkovice Steel	MSC
2	2	2	2	1
Arcelor Mittal	Tata Steel	Corus Group	Salzgitter	VPE
2	1	2	2	2
Eramet	Tinfos			
2	2			

First class:

LNM Holdings	MSC	Tata Steel
1	1	1

Second class:

British Steel	Europipe	Thyssen Stahl	Thyssen Krupp	CMC
2	2	2	2	2
Huta Zawiercie	PHS	Celsa Group	Huta Ostrowiec	ZAO Severstal
2	2	2	2	2
Lucchini	Evraz	Vitkovice Steel	Arcelor Mittal	Corus Group
2	2	2	2	2
Salzgitter	VPE	Eramet	Tinfos	
2	2	2	2	



The dendrogram for variables concerning knowledge is shown in Figure 59. Descriptions of the above dendrites are included in subsequent prints-outs.

```
> hs<-hclust(d^2,"ward")
Call:
hclust(d = d^2, method = "ward")
```

Figure 54. Dendrogram for variables concerning knowledge (Ward)

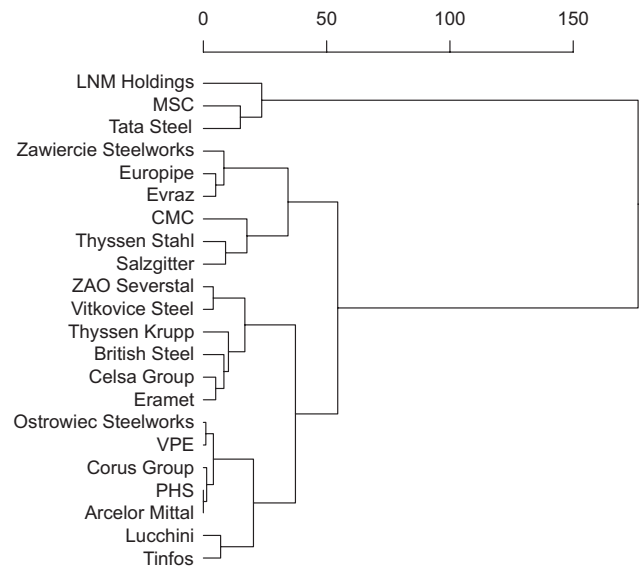


Figure 55. Dendrogram (average)

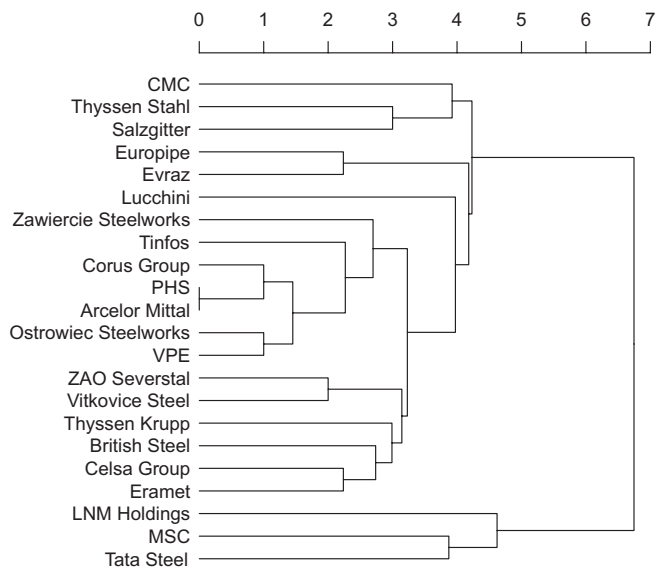


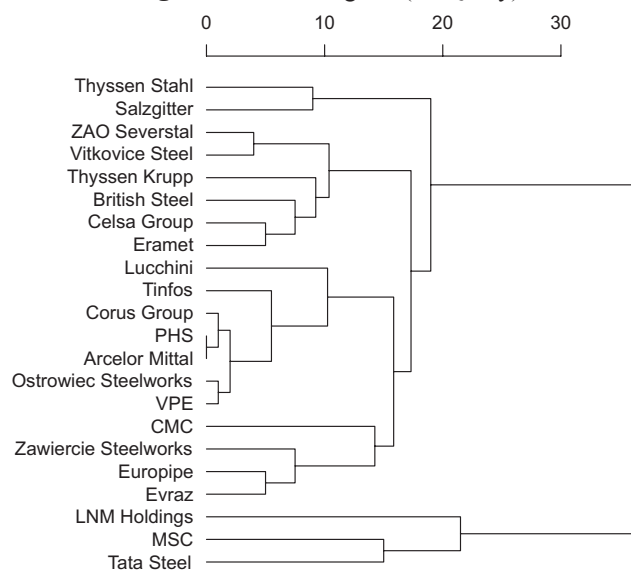
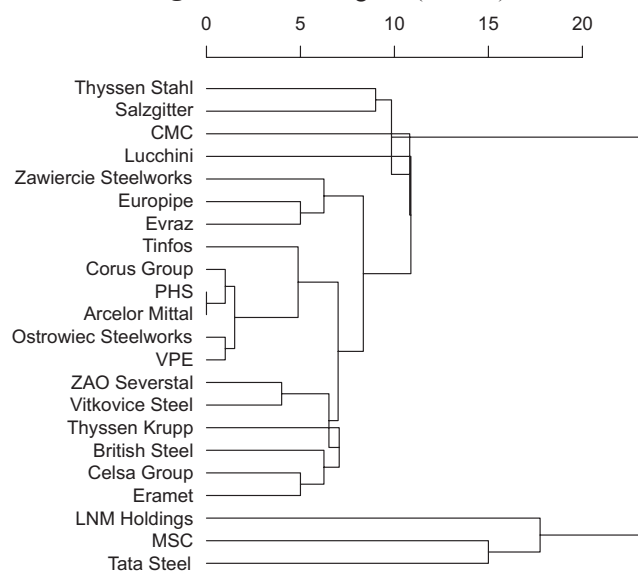
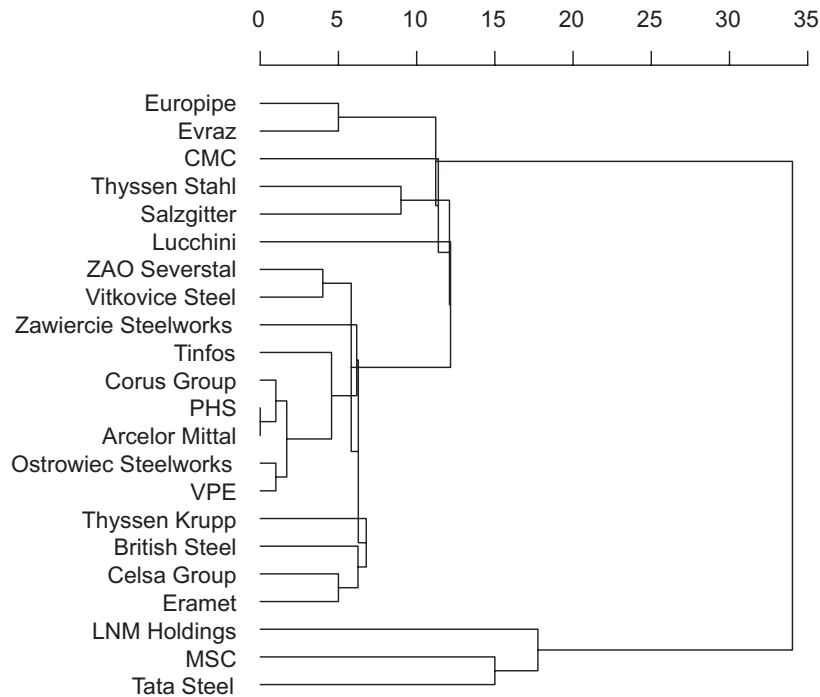
Figure 56. Dendrogram (McQuitty)**Figure 57.** Dendrogram (median)

Figure 58. Dendrogram (centroid)



```
Cluster method : ward
Distance : euclidean
Number of objects: 22

> hs

Call:
hclust(d = d^2, method = "ward")

Cluster method : ward
Distance : euclidean
Number of objects: 22

> cbind(polaczenia=hs$merge,wysokosc=hs$height)

      wysokosc
[1,] -8 -16 0.000000
[2,] -10 -20 1.000000
[3,] -18 1 1.333333
[4,] -11 -14 4.000000
[5,] 2 3 4.066667
[6,] -2 -13 5.000000
[7,] -9 -21 5.000000
[8,] -12 -22 7.000000
[9,] -6 6 8.333333
[10,] -1 7 8.333333
[11,] -3 -19 9.000000
[12,] -4 10 10.166667
[13,] -15 -17 15.000000
[14,] 4 12 16.833333
[15,] -5 11 17.666667
[16,] 5 8 20.314286
```

```

[17,] -7 13 23.666667
[18,] 9 15 34.333333
[19,] 14 16 37.336996
[20,] 18 19 54.492578
[21,] 17 20 176.304625

> hs<-hclust(d,"ave")

Call:
hclust(d = d, method = "ave")

Cluster method : average
Distance       : euclidean
Number of objects: 22

> hs

Call:
hclust(d = d, method = "ave")

Cluster method : average
Distance       : euclidean
Number of objects: 22

> cbind(polaczenia=hs$merge,wysokosc=hs$height)

      wysokosc
[1,] -8 -16 0.000000
[2,] -18 1 1.000000
[3,] -10 -20 1.000000
[4,] 2 3 1.451124
[5,] -11 -14 2.000000
[6,] -2 -13 2.236068
[7,] -9 -21 2.236068
[8,] -22 4 2.266262
[9,] -6 8 2.696864
[10,] -1 7 2.737089
[11,] -4 10 2.990102
[12,] -3 -19 3.000000
[13,] 5 11 3.143760
[14,] 9 13 3.228905
[15,] -15 -17 3.872983
[16,] -5 12 3.924096
[17,] -12 14 3.974753
[18,] 6 17 4.181298
[19,] 16 18 4.231690
[20,] -7 15 4.621320
[21,] 19 20 6.746042

> hs<-hclust(d^2,"mcquitty")

Call:
hclust(d = d^2, method = "mcquitty")

Cluster method : mcquitty
Distance       : euclidean
Number of objects: 22

> hs

Call:
hclust(d = d^2, method = "mcquitty")

Cluster method : mcquitty
Distance       : euclidean
Number of objects: 22

```

```
> cbind(polaczenia=hs$merge,wysokosc=hs$height)
```

```
      wysokosc
[1,]  -8 -16  0.00000
[2,] -18  1  1.00000
[3,] -10 -20  1.00000
[4,]  2  3  2.00000
[5,] -11 -14  4.00000
[6,]  -2 -13  5.00000
[7,]  -9 -21  5.00000
[8,] -22  4  5.50000
[9,]  -6  6  7.50000
[10,] -1  7  7.50000
[11,]  -3 -19  9.00000
[12,]  -4  10  9.25000
[13,] -12  8 10.25000
[14,]  5 12 10.37500
[15,]  -5  9 14.25000
[16,] -15 -17 15.00000
[17,] 13 15 15.84375
[18,] 14 17 17.31250
[19,] 11 18 18.98438
[20,]  -7 16 21.50000
[21,] 19 20 36.79297
```

```
> hs<-hclust(d^2,"median")
```

```
Call:
hclust(d = d^2, method = "median")
```

```
Cluster method : median
Distance       : euclidean
Number of objects: 22
```

```
> hs
```

```
Call:
hclust(d = d^2, method = "median")
```

```
Cluster method : median
Distance       : euclidean
Number of objects: 22
```

```
> cbind(polaczenia=hs$merge,wysokosc=hs$height)
```

```
      wysokosc
[1,]  -8 -16  0.000000
[2,] -18  1  1.000000
[3,] -10 -20  1.000000
[4,]  2  3  1.500000
[5,] -11 -14  4.000000
[6,] -22  4  4.875000
[7,]  -2 -13  5.000000
[8,]  -9 -21  5.000000
[9,]  -6  7  6.250000
[10,] -1  8  6.250000
[11,]  -4 10  7.062500
[12,]  5 11  6.515625
[13,]  6 12  7.003906
[14,]  9 13  8.344727
[15,] -3 -19  9.000000
[16,] -12 14 10.875244
[17,]  -5 16 10.812561
[18,] 15 17  9.843765
[19,] -15 -17 15.000000
[20,]  -7 19 17.750000
[21,] 18 20 23.127934
```

```

> hs<-hclust(d^2,"centroid")

Call:
hclust(d = d^2, method = "centroid")

Cluster method   : centroid
Distance         : euclidean
Number of objects: 22

> hs

Call:
hclust(d = d^2, method = "centroid")

Cluster method   : centroid
Distance         : euclidean
Number of objects: 22

> cbind(polaczenia=hs$merge,wysokosc=hs$height)

      wysokosc
[1,]  -8 -16  0.000000
[2,] -18  1  1.000000
[3,] -10 -20  1.000000
[4,]  2  3  1.694444
[5,] -11 -14  4.000000
[6,] -22  4  4.560000
[7,]  -2 -13  5.000000
[8,]  -9 -21  5.000000
[9,]  -6  6  6.166667
[10,] -1  8  6.250000
[11,] -4 10  6.777778
[12,]  9 11  6.271684
[13,]  5 12  5.818182
[14,] -3 -19  9.000000
[15,] -12 13 12.165680
[16,] 14 15 12.096939
[17,] -5 16 11.386719
[18,]  7 17 11.218858
[19,] -15 -17 15.000000
[20,] -7 19 17.750000
[21,] 18 20 34.023700

> d<-as.matrix(d)

      British Steel Europipe Thyssen Stahl Thyssen Krupp CMC
British Steel      0.000000 5.477226      4.242641      3.162278 3.162278
Europipe           5.477226 0.000000      5.291503      5.291503 4.472136
Thyssen Stahl      4.242641 5.291503      0.000000      4.242641 4.242641
Thyssen Krupp      3.162278 5.291503      4.242641      0.000000 4.000000
CMC                3.162278 4.472136      4.242641      4.000000 0.000000
Huta Zawiercie     3.872983 3.000000      4.795832      3.000000 3.316625
LNM Holdings         4.898979 7.348469      5.099020      6.000000 6.000000
PHS                 4.123106 4.358899      5.567764      3.000000 4.358899
Celsa Group         2.645751 5.196152      3.316625      2.645751 3.605551
Corus Group         3.741657 3.464102      3.316625      2.449490 9.000000
Salzgitter          5.000000 3.605551      3.741657      3.872983 7.211103
VPE                 3.316625 3.605551      3.162278      2.236068 8.831761
Eramet              3.162278 3.741657      3.872983      2.449490 7.549834
Tinfos             4.358899 2.645751      3.464102      3.316625 9.055385

      Arcelor Mittal Tata Steel Corus Group Salzgitter VPE
British Steel      4.123106 5.477226      3.741657      3.605551 3.605551
Europipe           4.358899 6.928203      4.242641      4.358899 4.358899
Thyssen Stahl      5.567764 4.690416      5.477226      3.000000 5.000000
Thyssen Krupp      3.000000 6.633250      3.162278      3.872983 3.000000
CMC                4.358899 4.898979      4.242641      3.605551 4.358899

```

Huta Zawiercie	2.449490	6.557439	2.645751	3.741657	2.828427
LNH Holdings	7.280110	4.242641	6.928203	5.196152	6.557439
PHS	0.000000	7.681146	1.000000	4.000000	1.414214
Celsa Group	3.162278	5.744563	3.000000	2.828427	2.449490
Huta Ostrowiec	1.732051	6.633250	1.414214	3.316625	1.000000
ZAO Severstal	3.872983	6.164414	3.741657	5.000000	3.316625
Lucchini	3.872983	5.656854	3.464102	3.605551	3.605551
Evrz	3.464102	5.916080	3.316625	3.741657	3.162278
Vitkovice Steel	2.645751	6.324555	2.449490	3.872983	2.236068
MSC	9.273618	3.872983	9.000000	7.211103	8.831761
Arcelor Mittal	0.000000	7.681146	1.000000	4.000000	1.414214
Tata Steel	7.681146	0.000000	7.348469	5.744563	7.000000
Corus Group	1.000000	7.348469	0.000000	3.872983	1.000000
Salzgitter	4.000000	5.744563	3.872983	0.000000	3.741657
VPE	1.414214	7.000000	1.000000	3.741657	0.000000
Eramet	3.605551	5.477226	3.162278	3.316625	2.645751
Tinfos	2.000000	7.141428	2.236068	3.464102	2.449490
Eramet	Tinfos				
British Steel	2.828427	4.582576			
Europipe	5.099020	4.795832			
Thyssen Stahl	3.741657	5.196152			
Thyssen Krupp	3.162278	3.605551			
CMC	4.472136	4.358899			
Huta Zawiercie	3.872983	3.162278			
LNH Holdings	4.898979	7.000000			
PHS	3.605551	2.000000			
Celsa Group	2.236068	3.162278			
Huta Ostrowiec	2.449490	2.645751			
ZAO Severstal	3.162278	4.358899			
Lucchini	3.741657	2.645751			
Evrz	3.872983	3.464102			
Vitkovice Steel	2.449490	3.316625			
MSC	7.549834	9.055385			
Arcelor Mittal	3.605551	2.000000			
Tata Steel	5.477226	7.141428			
Corus Group	3.162278	2.236068			
Salzgitter	3.316625	3.464102			
VPE	2.645751	2.449490			
Eramet	0.000000	3.605551			
Tinfos	3.605551	0.000000			

```
> sort(apply(d,1,sum))/nrow(d)
```

Huta Ostrowiec	VPE	Vitkovice Steel	Celsa Group	Corus Group
3.199001	3.362560	3.429387	3.442905	3.474831
Huta Zawiercie	PHS	Arcelor Mittal	Eramet	Thyssen Krupp
3.580935	3.584679	3.584679	3.588901	3.806331
Tinfos	Salzgitter	Evrz	British Steel	CMC
3.829396	3.868049	3.873203	3.888550	4.129451
Lucchini	ZAO Severstal	Thyssen Stahl	Europipe	LNH Holdings
4.189775	4.226234	4.568873	4.724951	5.661945
Tata Steel	MSC			
5.809765	7.199001			

3.3. For variables related to knowledge and 3 general variables

The distance matrix, calculated for variables concerning knowledge and 3 general variables (y3, y5, y7 and y14.1 to y16.4), used to construct the dendrite is given below.

	British Steel	Europipe	Thyssen Stahl	Thyssen Krupp		
Europipe	48611.3473					
Thyssen Stahl	46296.3184	94902.3790				
Thyssen Krupp	16199.4221	64506.2590	30604.1602			
CMC	43259.9804	5783.4299	89503.1444	59024.7524		
Huta Zawiercie	43437.1413	6013.0284	89647.1078	59139.2194		
LNM Holdings	21133.8696	69532.9006	25588.2210	5035.4009		
PHS	34765.9250	14569.8168	80890.5491	50349.1268		
Celsa Group	37550.8393	11494.1319	83754.9307	53251.4654		
Huta Ostrowiec	51988.3104	3863.6351	98242.7880	67766.7622		
ZAO Severstal	30311.3930	18407.2349	76559.1518	46110.1317		
Lucchini	42547.2265	6676.0787	88768.0637	58269.8141		
Evrax	16348.0161	32444.1500	62521.7052	32063.0022		
Vitkovice Steel	50061.5826	1491.0443	96348.3796	65934.7996		
MSC	171369.3126	219979.2758	125100.8956	155651.0775		
Arcelor Mittal	46734.8009	24632.1969	90138.4879	62405.0498		
Tata Steel	29299.1203	77863.6055	17336.6106	14587.6524		
Corus Group	29964.4341	18735.3643	76254.3491	46000.3217		
Salzgitter	42146.4644	6500.7713	88428.3389	58011.8714		
VPE	37401.9527	11225.0851	83685.5784	53281.7831		
Eramet	52484.0449	4814.6254	98764.8419	68510.1112		
Tinfos	53916.2153	5460.0861	100185.7616	69729.3612		
	CMC	Huta Zawiercie	LNM Holdings	PHS	Celsa Group	
Europipe						
Thyssen Stahl						
Thyssen Krupp						
CMC						
Huta Zawiercie	835.8044					
LNM Holdings	64057.8693	64173.9189				
PHS	8833.8902	8836.2181	55384.5221			
Celsa Group	5800.0522	5892.2200	58285.8067	3092.3315		
Huta Ostrowiec	8742.5055	8664.0397	72800.0663	17500.2213	14524.1954	
ZAO Severstal	12949.3474	13136.9910	51139.9647	4845.0780	7275.7318	
Lucchini	920.3641	918.3218	63304.0508	8006.3193	5018.6305	
Evrax	26982.9726	27128.3558	37091.5903	18419.7755	21236.4221	
Vitkovice Steel	7061.7781	7184.6779	70963.2027	15891.7284	12835.5770	
MSC	214602.6359	214747.9123	150617.5974	205985.3430	208855.7612	
Arcelor Mittal	25478.7866	26313.5113	66973.9484	27750.9461	26197.3474	
Tata Steel	72554.1619	72736.0466	10129.1522	64053.0679	66849.9362	
Corus Group	13732.4709	14089.2650	51005.7828	7002.0007	8600.5824	
Salzgitter	1788.0400	2557.4425	63039.8671	8233.0520	5144.7675	
VPE	6014.8240	6398.8600	58307.9863	4364.5194	2227.0002	
Eramet	10480.6033	10792.1885	73521.3817	19098.0779	16005.8136	
Tinfos	10711.9143	10669.1056	74761.4544	19501.8419	16507.0390	
	Huta Ostrowiec	ZAO Severstal	Lucchini	Evrax		
Europipe						
Thyssen Stahl						
Thyssen Krupp						
CMC						
Huta Zawiercie						
LNM Holdings						
PHS						
Celsa Group						
Huta Ostrowiec						
ZAO Severstal	21684.4116					
Lucchini	9508.6728	12240.7963				
Evrax	35724.4179	14049.3061	26246.9519			
Vitkovice Steel	2470.8001	19826.7207	7922.3605	33871.8476		
MSC	223341.0856	201656.7236	213868.9258	187622.3464		
Arcelor Mittal	27676.5773	26870.9751	25952.2739	35044.5474		
Tata Steel	81276.4304	59607.5606	71845.4415	45634.1185		
Corus Group	22277.7295	3013.0027	13170.9554	14120.0067		
Salzgitter	9896.9112	11907.2701	2002.5037	25948.8821		
VPE	14622.8978	7203.8024	5482.9304	21220.9185		
Eramet	4932.4345	22589.4240	11393.9371	36509.4816		
Tinfos	2031.4409	23629.0325	11500.1098	37676.4407		
	Vitkovice Steel	MSC	Arcelor Mittal	Tata Steel		

Europipe
 Thyssen Stahl
 Thyssen Krupp
 CMC
 Huta Zawiercie
 LNM Holdings
 PHS
 Celsa Group
 Huta Ostrowiec
 ZAO Severstal
 Lucchini
 Evraz
 Vitkovice Steel
 MSC 221430.8497
 Arcelor Mittal 25470.4953 213012.1932
 Tata Steel 79322.1606 142140.4180 72896.8059
 Corus Group 20208.3590 201293.4815 24277.8504 59158.2461
 Salzgitter 7923.7484 213515.0568 23958.2659 71417.9635
 VPE 12663.1425 208770.8228 23994.5430 66673.7329
 Eramet 4063.6657 223768.0038 23513.5513 81628.6076
 Tinfos 3969.2555 225279.8066 28024.3875 83194.9389
 Corus Group Salzgitter VPE Eramet

Europipe
 Thyssen Stahl
 Thyssen Krupp
 CMC
 Huta Zawiercie
 LNM Holdings
 PHS
 Celsa Group
 Huta Ostrowiec
 ZAO Severstal
 Lucchini
 Evraz
 Vitkovice Steel
 MSC
 Arcelor Mittal
 Tata Steel
 Corus Group
 Salzgitter 12384.1858
 VPE 7717.6967 4744.7355
 Eramet 22522.4340 10873.6281 15402.5025
 Tinfos 24130.2600 11779.7502 16522.1066 4584.3964

K-means clustering with 2 clusters of sizes 5, 17

Cluster means:

	y3	y5	y7	y14.1	y14.2	y14.3	y14.4	y15.1
1	13338.000	110340.00	2.800000	3.000000	3.200000	3.200000	4.000000	2.800000
2	3794.529	15615.53	2.705882	1.941176	1.470588	1.764706	1.823529	1.647059

	y15.2	y15.3	y15.4	y16.1	y16.2	y16.3	y16.4	y17.3
1	3.400000	2.400000	1.800000	1.4	1.400000	1.600000	1.4	9.600000
2	1.705882	1.294118	1.176471	1.0	1.235294	1.058824	1.0	2.352941

Clustering vector:

	British Steel	Europipe	Thyssen Stahl	Thyssen Krupp	CMC
	2	2	1	1	2
Huta Zawiercie	LNM Holdings	PHS	Celsa Group	Huta Ostrowiec	
	2	1	2	2	2
ZAO Severstal	Lucchini	Evraz	Vitkovice Steel	MSC	
	2	2	2	2	1
Arcelor Mittal	Tata Steel	Corus Group	Salzgitter	VPE	
	2	1	2	2	2
Eramet	Tinfos				
	2	2			

Within cluster sum of squares by cluster:

```
[1] 16999947084 3668489334
(between_SS / total_SS = 62.9 %)
```

Available components:

```
[1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
[6] "betweenss"    "size"         "iter"         "ifault"
```

Centroids of individual classes:

```
      y3      y5      y7      y14.1      y14.2      y14.3      y14.4      y15.1
1 13338.000 110340.00 2.800000 3.000000 3.200000 3.200000 4.000000 2.800000
2  3794.529 15615.53 2.705882 1.941176 1.470588 1.764706 1.823529 1.647059
      y15.2      y15.3      y15.4 y16.1      y16.2      y16.3 y16.4      y17.3
1  3.400000 2.400000 1.800000  1.4 1.400000 1.600000  1.4 9.600000
2  1.705882 1.294118 1.176471  1.0 1.235294 1.058824  1.0 2.352941
```

Assignment to individual classes:

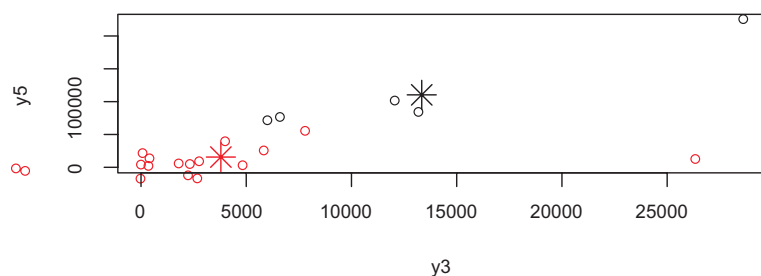
British Steel	Europipe	Thyssen Stahl	Thyssen Krupp	CMC
2	2	1	1	2
Huta Zawiercie	LNM Holdings	PHS	Celsa Group	Huta Ostrowiec
2	1	2	2	2
ZAO Severstal	Lucchini	Evrast	Vitkovice Steel	MSC
2	2	2	2	1
Arcelor Mittal	Tata Steel	Corus Group	Salzgitter	VPE
2	1	2	2	1
Eramet	Tinfos			
2	2			

First class:

Thyssen Stahl	Thyssen Krupp	LNM Holdings	MSC	Tata Steel
1	1	1	1	1

Second class:

British Steel	Europipe	CMC	Huta Zawiercie	PHS
2	2	2	2	2
Celsa Group	Huta Ostrowiec	ZAO Severstal	Lucchini	Evrast
2	2	2	2	2
Vitkovice Steel	Arcelor Mittal	Corus Group	Salzgitter	VPE
2	2	2	2	2
Eramet	Tinfos			
2	2			



The dendrogram is shown in Figure 59.

The dendrogram with text description is shown in the following printouts. The first two columns describing the dendrogram have the following interpretation. The line i (1 to 21) describes clustering in step i . If element j in step i assumes a negative value (preceded by a sign -), then the object $-j$ has been included at this stage. If element j is not preceded by any symbol, then the combination of the object in the cluster occurred at earlier stages of the algorithm. Hence negative elements denote single objects, and positive structures not being single objects. The „height” column contains the criterion values assigned to the method used to create the clusters in a specific structure/dendrite.

```
> hs<-hclust(d^2,"ward")
```

```
Call:
```

```
hclust(d = d^2, method = "ward")
```

```
Cluster method : ward
```

```
Distance : euclidean
```

```
Number of objects: 22
```

```
> hs
```

```
Call:
```

```
hclust(d = d^2, method = "ward")
```

```
Cluster method : ward
```

```
Distance : euclidean
```

```
Number of objects: 22
```

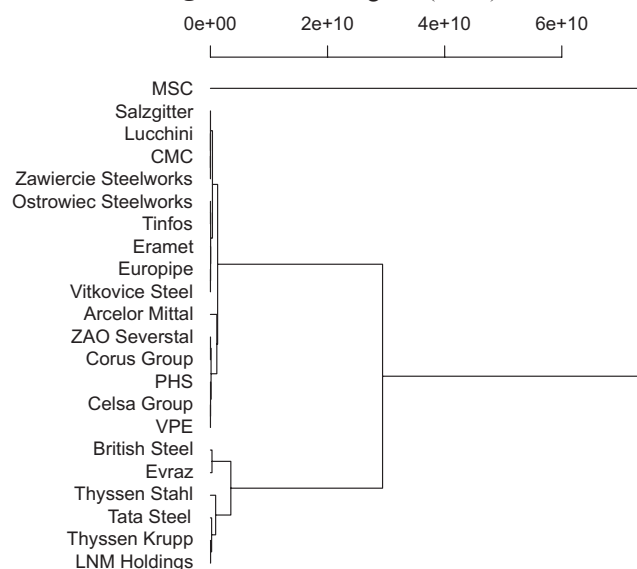
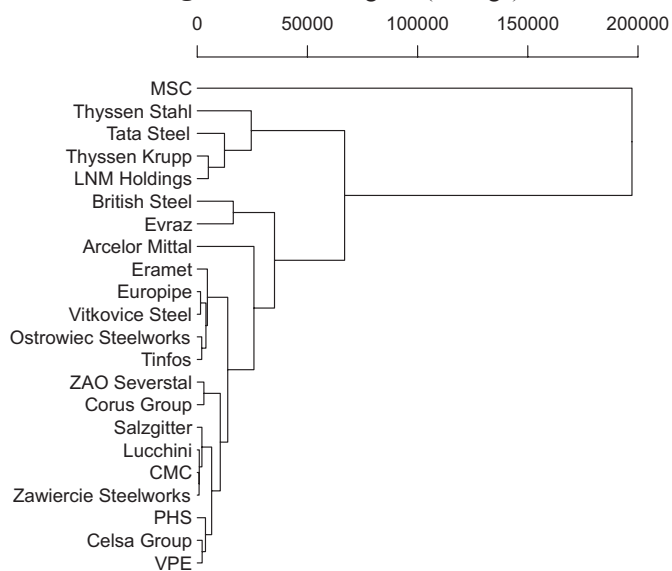
Figure 59. Dendrogram (Ward)**Figure 60.** Dendrogram (average)

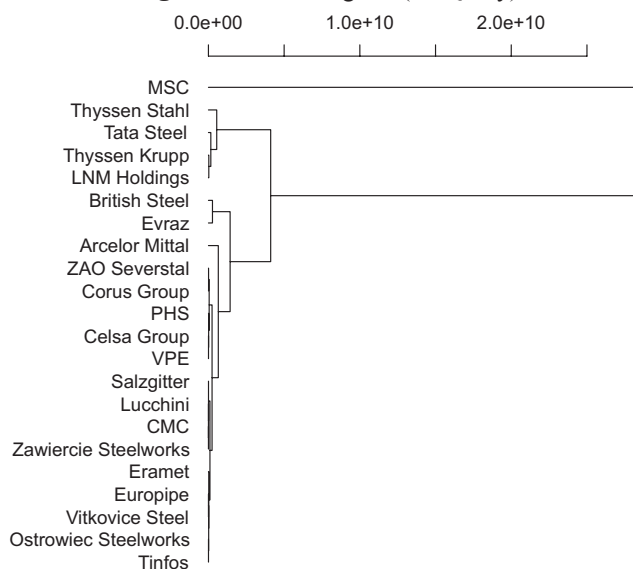
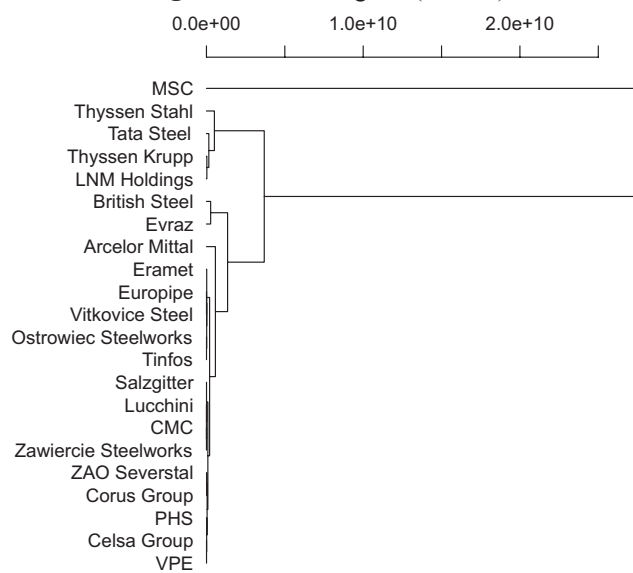
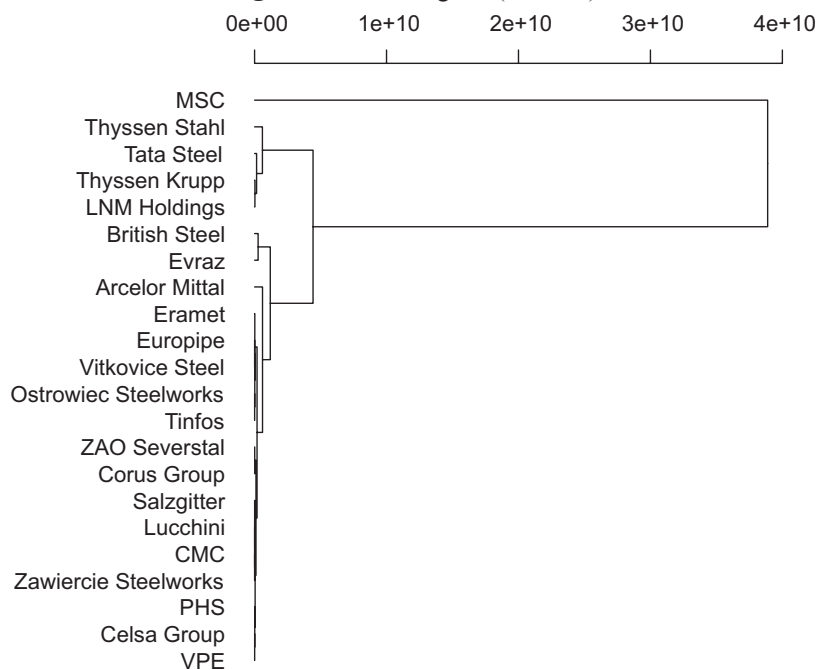
Figure 61. Dendrogram (McQuitty)**Figure 62.** Dendrogram (median)

Figure 63. Dendrogram (centroid)

```
> cbind(polaczenia=hs$merge,wysokosc=hs$height)
```

			wysokosc
[1,]	-5	-6	698569
[2,]	-12	1	894067
[3,]	-2	-14	2223213
[4,]	-10	-22	4126752
[5,]	-9	-20	4959530
[6,]	-19	2	6475651
[7,]	-11	-18	9078185
[8,]	-8	5	17421186
[9,]	-4	-7	25355262
[10,]	-21	3	25721594
[11,]	4	10	31124289
[12,]	7	8	109947481
[13,]	-17	9	201814463
[14,]	-1	-13	267257629
[15,]	6	11	344607274
[16,]	-3	13	889172441
[17,]	-16	12	1090971415
[18,]	15	17	1229072882
[19,]	14	16	3485083475
[20,]	18	19	29394107860
[21,]	-15	20	74235239115

```
> hs<-hclust(d,"ave")
```

```
Call:
```

```
hclust(d = d, method = "ave")
```

```
Cluster method : average
Distance       : euclidean
Number of objects: 22
```

```
> hs

Call:
hclust(d = d, method = "ave")

Cluster method   : average
Distance         : euclidean
Number of objects: 22

> cbind(polaczenia=hs$merge,wysokosc=hs$height)
```

			wysokosc
[1,]	-5	-6	835.8044
[2,]	-12	1	919.3429
[3,]	-2	-14	1491.0443
[4,]	-10	-22	2031.4409
[5,]	-19	2	2115.9954
[6,]	-9	-20	2227.0002
[7,]	-11	-18	3013.0027
[8,]	-8	6	3728.4255
[9,]	3	4	3940.9442
[10,]	-21	9	4598.7805
[11,]	-4	-7	5035.4009
[12,]	5	8	6533.8750
[13,]	7	12	10446.8696
[14,]	-17	11	12358.4023
[15,]	10	13	13832.3197
[16,]	-1	-13	16348.0161
[17,]	-3	14	24509.6639
[18,]	-16	15	25722.2649
[19,]	16	18	35060.2045
[20,]	17	19	66866.6950
[21,]	-15	20	197267.1202

```
> hs<-hclust(d^2,"mcquitty")

Call:
hclust(d = d^2, method = "mcquitty")

Cluster method   : mcquitty
Distance         : euclidean
Number of objects: 22

> hs

Call:
hclust(d = d^2, method = "mcquitty")

Cluster method   : mcquitty
Distance         : euclidean
Number of objects: 22

> cbind(polaczenia=hs$merge,wysokosc=hs$height)
```

			wysokosc
[1,]	-5	-6	6.985690e+05
[2,]	-12	1	8.451925e+05
[3,]	-2	-14	2.223213e+06
[4,]	-10	-22	4.126752e+06
[5,]	-19	2	4.439410e+06
[6,]	-9	-20	4.959530e+06
[7,]	-11	-18	9.078185e+06
[8,]	-8	6	1.430577e+07
[9,]	3	4	1.665001e+07
[10,]	-21	9	2.125990e+07
[11,]	-4	-7	2.535526e+07
[12,]	7	8	4.792119e+07

```

[13,]  5  10 1.002156e+08
[14,] -17 11 1.576997e+08
[15,] 12 13 2.402893e+08
[16,] -1 -13 2.672576e+08
[17,] -3 14 5.481220e+08
[18,] -16 15 6.516686e+08
[19,] 16 18 1.432831e+09
[20,] 17 19 4.112262e+09
[21,] -15 20 2.871159e+10

> hs<-hclust(d^2,"median")

Call:
hclust(d = d^2, method = "median")

Cluster method : median
Distance       : euclidean
Number of objects: 22

> hs

Call:
hclust(d = d^2, method = "median")

Cluster method : median
Distance       : euclidean
Number of objects: 22

> cbind(polaczenia=hs$merge,wysokosc=hs$height)

wysokosc [1,] -5 -6 6.985690e+05
[2,] -12 1 6.705502e+05
[3,] -2 -14 2.223213e+06
[4,] -10 -22 4.126752e+06
[5,] -19 2 4.184452e+06
[6,] -9 -20 4.959530e+06
[7,] -11 -18 9.078185e+06
[8,] -8 6 1.306589e+07
[9,] 3 4 1.506252e+07
[10,] -21 9 1.670052e+07
[11,] -4 -7 2.535526e+07
[12,] 7 8 4.176523e+07
[13,] 5 12 8.955665e+07
[14,] -17 11 1.513608e+08
[15,] 10 13 2.020819e+08
[16,] -1 -13 2.672576e+08
[17,] -3 14 5.071123e+08
[18,] -16 15 5.703405e+08
[19,] 16 18 1.349215e+09
[20,] 17 19 3.686780e+09
[21,] -15 20 2.773631e+10

> hs<-hclust(d^2,"centroid")

Call:
hclust(d = d^2, method = "centroid")

Cluster method : centroid
Distance       : euclidean
Number of objects: 22

> hs

Call:
hclust(d = d^2, method = "centroid")

Cluster method : centroid

```

```
Distance          : euclidean
Number of objects: 22
```

```
> cbind(polaczenia=hs$merge,wysokosc=hs$height)
```

```
      wysokosc
[1,]  -5  -6 6.985690e+05
[2,] -12   1 6.705502e+05
[3,]  -2 -14 2.223213e+06
[4,] -10 -22 4.126752e+06
[5,] -19   2 4.317101e+06
[6,]  -9 -20 4.959530e+06
[7,] -11 -18 9.078185e+06
[8,]  -8   6 1.306589e+07
[9,]   3   4 1.506252e+07
[10,] -21   9 1.670052e+07
[11,]  -4  -7 2.535526e+07
[12,]   5   8 4.007079e+07
[13,]   7  12 1.040768e+08
[14,] -17  11 1.513608e+08
[15,]  10  13 1.853367e+08
[16,]  -1 -13 2.672576e+08
[17,]  -3  14 5.927816e+08
[18,] -16  15 6.010548e+08
[19,]  16  18 1.187846e+09
[20,]  17  19 4.429578e+09
[21,] -15  20 3.888513e+10
```

```
> k<-kmeans(x,3)
```

K-means clustering with 3 clusters of sizes 5, 16, 1

Cluster means:

	y3	y5	y7	y14.1	y14.2	y14.3	y14.4	y15.1	y15.2	y15.3
1	9174.2	76320.00	3.0000	2.800	2.6000	2.2000	3.8000	2.4000	3.2000	2.00
2	3541.5	13222.75	2.6875	1.875	1.4375	1.8125	1.6875	1.6875	1.6875	1.25
3	28662.0	224000.00	2.0000	4.000	5.0000	6.0000	5.0000	3.0000	3.0000	4.00

	y15.4	y16.1	y16.2	y16.3	y16.4	y17.3
1	1.6000	1.4	1.4000	1.6000	1.2	5.200
2	1.1875	1.0	1.1875	1.0625	1.0	2.375
3	2.0000	1.0	2.0000	1.0000	2.0	24.000

Clustering vector:

British Steel	Europipe	Thyssen Stahl	Thyssen Krupp	CMC
1	2	1	1	2
Huta Zawiercie	INM Holdings	PHS	Celsa Group	Huta Ostrowiec
2	1	2	2	2
ZAO Severstal	Lucchini	Evrast	Vitkovice Steel	MSC
2	2	2	2	3
Arcelor Mittal	Tata Steel	Corus Group	Salzgitter	VPE
2	1	2	2	2
Eramet	Tinfos			
2	2			

Within cluster sum of squares by cluster:

```
[1] 1188706721 2093767847 0
(between_SS / total_SS = 94.1 %)
```

Available components:

```
[1] "cluster" "centers" "totss" "withinss" "tot.withinss"
[6] "betweenss" "size" "iter" "ifault"
```

```
> k
```

K-means clustering with 3 clusters of sizes 5, 16, 1

Cluster means:

	y3	y5	y7	y14.1	y14.2	y14.3	y14.4	y15.1	y15.2	y15.3
1	9174.2	76320.00	3.0000	2.800	2.6000	2.2000	3.8000	2.4000	3.2000	2.00
2	3541.5	13222.75	2.6875	1.875	1.4375	1.8125	1.6875	1.6875	1.6875	1.25
3	28662.0	224000.00	2.0000	4.000	5.0000	6.0000	5.0000	3.0000	3.0000	4.00

	y15.4	y16.1	y16.2	y16.3	y16.4	y17.3
1	1.6000	1.4	1.4000	1.6000	1.2	5.200
2	1.1875	1.0	1.1875	1.0625	1.0	2.375
3	2.0000	1.0	2.0000	1.0000	2.0	24.000

Clustering vector:

	British Steel	Europipe	Thyssen Stahl	Thyssen Krupp	CMC
1	1	2	1	1	2
Huta Zawiercie	LNM Holdings	PHS	Celsa Group	Huta Ostrowiec	2
2	1	2	2	2	2
ZAO Severstal	Lucchini	Evraz	Vitkovice Steel	MSC	3
2	2	2	2	2	3
Arcelor Mittal	Tata Steel	Corus Group	Salzgitter	VPE	2
2	1	2	2	2	2
Eramet	Tinfos				
2	2				

Within cluster sum of squares by cluster:

```
[1] 1188706721 2093767847 0
      (between_SS / total_SS = 94.1 %)
```

Available components:

```
[1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
[6] "betweenss"    "size"         "iter"         "ifault"
```

```
> d<-as.matrix(d)
```

	British Steel	Europipe	Thyssen Stahl	Thyssen Krupp
British Steel	0.00	48611.347	46296.32	16199.422
Europipe	48611.35	0.000	94902.38	64506.259
Thyssen Stahl	46296.32	94902.379	0.00	30604.160
Thyssen Krupp	16199.42	64506.259	30604.16	0.000
CMC	43259.98	5783.430	89503.14	59024.752
Huta Zawiercie	43437.14	6013.028	89647.11	59139.219
LNM Holdings	21133.87	69532.901	25588.22	5035.401
PHS	34765.93	14569.817	80890.55	50349.127
Celsa Group	37550.84	11494.132	83754.93	53251.465
Huta Ostrowiec	51988.31	3863.635	98242.79	67766.762
ZAO Severstal	30311.39	18407.235	76559.15	46110.132
Lucchini	42547.23	6676.079	88768.06	58269.814
Evraz	16348.02	32444.150	62521.71	32063.002
Vitkovice Steel	50061.58	1491.044	96348.38	65934.800
MSC	171369.31	219979.276	125100.90	155651.077
Arcelor Mittal	46734.80	24632.197	90138.49	62405.050
Tata Steel	29299.12	77863.605	17336.61	14587.652
Corus Group	29964.43	18735.364	76254.35	46000.322
Salzgitter	42146.46	6500.771	88428.34	58011.871
VPE	37401.95	11225.085	83685.58	53281.783
Eramet	52484.04	4814.625	98764.84	68510.111
Tinfos	53916.22	5460.086	100185.76	69729.361

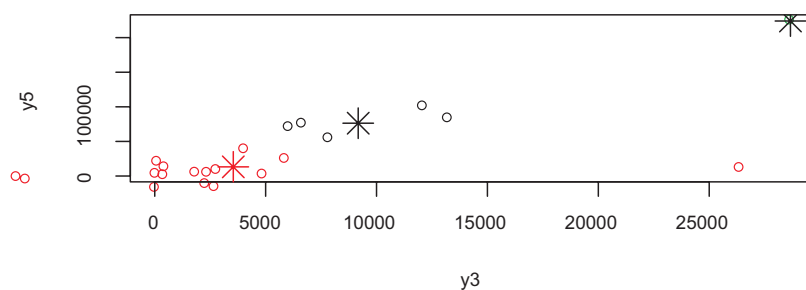
	CMC	Huta Zawiercie	LNM Holdings	PHS	Celsa Group
British Steel	43259.9804	43437.1413	21133.870	34765.925	37550.839
Europipe	5783.4299	6013.0284	69532.901	14569.817	11494.132
Thyssen Stahl	89503.1444	89647.1078	25588.221	80890.549	83754.931
Thyssen Krupp	59024.7524	59139.2194	5035.401	50349.127	53251.465
CMC	0.0000	835.8044	64057.869	8833.890	5800.052
Huta Zawiercie	835.8044	0.0000	64173.919	8836.218	5892.220
LNM Holdings	64057.8693	64173.9189	0.000	55384.522	58285.807
PHS	8833.8902	8836.2181	55384.522	0.000	3092.331
Celsa Group	5800.0522	5892.2200	58285.807	3092.331	0.000
Huta Ostrowiec	8742.5055	8664.0397	72800.066	17500.221	14524.195

ZAO Severstal	12949.3474	13136.9910	51139.965	4845.078	7275.732
Lucchini	920.3641	918.3218	63304.051	8006.319	5018.630
Evrax	26982.9726	27128.3558	37091.590	18419.776	21236.422
Vitkovice Steel	7061.7781	7184.6779	70963.203	15891.728	12835.577
MSC	214602.6359	214747.9123	150617.597	205985.343	208855.761
Arcelor Mittal	25478.7866	26313.5113	66973.948	27750.946	26197.347
Tata Steel	72554.1619	72736.0466	10129.152	64053.068	66849.936
Corus Group	13732.4709	14089.2650	51005.783	7002.001	8600.582
Salzgitter	1788.0400	2557.4425	63039.867	8233.052	5144.768
VPE	6014.8240	6398.8600	58307.986	4364.519	2227.000
Eramet	10480.6033	10792.1885	73521.382	19098.078	16005.814
Tinfos	10711.9143	10669.1056	74761.454	19501.842	16507.039
Huta Ostrowiec		ZAO Severstal	Lucchini	Evrax	
British Steel	51988.310	30311.393	42547.2265	16348.02	
Europipe	3863.635	18407.235	6676.0787	32444.15	
Thyssen Stahl	98242.788	76559.152	88768.0637	62521.71	
Thyssen Krupp	67766.762	46110.132	58269.8141	32063.00	
CMC	8742.506	12949.347	920.3641	26982.97	
Huta Zawiercie	8664.040	13136.991	918.3218	27128.36	
LNМ Holdings	72800.066	51139.965	63304.0508	37091.59	
PHS	17500.221	4845.078	8006.3193	18419.78	
Celsa Group	14524.195	7275.732	5018.6305	21236.42	
Huta Ostrowiec	0.000	21684.412	9508.6728	35724.42	
ZAO Severstal	21684.412	0.000	12240.7963	14049.31	
Lucchini	9508.673	12240.796	0.0000	26246.95	
Evrax	35724.418	14049.306	26246.9519	0.00	
Vitkovice Steel	2470.800	19826.721	7922.3605	33871.85	
MSC	223341.086	201656.724	213868.9258	187622.35	
Arcelor Mittal	27676.577	26870.975	25952.2739	35044.55	
Tata Steel	81276.430	59607.561	71845.4415	45634.12	
Corus Group	22277.729	3013.003	13170.9554	14120.01	
Salzgitter	9896.911	11907.270	2002.5037	25948.88	
VPE	14622.898	7203.802	5482.9304	21220.92	
Eramet	4932.434	22589.424	11393.9371	36509.48	
Tinfos	2031.441	23629.032	11500.1098	37676.44	
Vitkovice Steel		MSC	Arcelor Mittal	Tata Steel	Corus Group
British Steel	50061.583	171369.3	46734.80	29299.12	29964.434
Europipe	1491.044	219979.3	24632.20	77863.61	18735.364
Thyssen Stahl	96348.380	125100.9	90138.49	17336.61	76254.349
Thyssen Krupp	65934.800	155651.1	62405.05	14587.65	46000.322
CMC	7061.778	214602.6	25478.79	72554.16	13732.471
Huta Zawiercie	7184.678	214747.9	26313.51	72736.05	14089.265
LNМ Holdings	70963.203	150617.6	66973.95	10129.15	51005.783
PHS	15891.728	205985.3	27750.95	64053.07	7002.001
Celsa Group	12835.577	208855.8	26197.35	66849.94	8600.582
Huta Ostrowiec	2470.800	223341.1	27676.58	81276.43	22277.729
ZAO Severstal	19826.721	201656.7	26870.98	59607.56	3013.003
Lucchini	7922.361	213868.9	25952.27	71845.44	13170.955
Evrax	33871.848	187622.3	35044.55	45634.12	14120.007
Vitkovice Steel	0.000	221430.8	25470.50	79322.16	20208.359
MSC	221430.850	0.0	213012.19	142140.42	201293.482
Arcelor Mittal	25470.495	213012.2	0.00	72896.81	24277.850
Tata Steel	79322.161	142140.4	72896.81	0.00	59158.246
Corus Group	20208.359	201293.5	24277.85	59158.25	0.000
Salzgitter	7923.748	213515.1	23958.27	71417.96	12384.186
VPE	12663.143	208770.8	23994.54	66673.73	7717.697
Eramet	4063.666	223768.0	23513.55	81628.61	22522.434
Tinfos	3969.255	225279.8	28024.39	83194.94	24130.260
Salzgitter		VPE	Eramet	Tinfos	
British Steel	42146.464	37401.953	52484.045	53916.215	
Europipe	6500.771	11225.085	4814.625	5460.086	
Thyssen Stahl	88428.339	83685.578	98764.842	100185.762	
Thyssen Krupp	58011.871	53281.783	68510.111	69729.361	
CMC	1788.040	6014.824	10480.603	10711.914	
Huta Zawiercie	2557.442	6398.860	10792.188	10669.106	
LNМ Holdings	63039.867	58307.986	73521.382	74761.454	
PHS	8233.052	4364.519	19098.078	19501.842	

Celsa Group	5144.768	2227.000	16005.814	16507.039
Huta Ostrowiec	9896.911	14622.898	4932.434	2031.441
ZAO Severstal	11907.270	7203.802	22589.424	23629.032
Lucchini	2002.504	5482.930	11393.937	11500.110
Evrax	25948.882	21220.919	36509.482	37676.441
Vitkovice Steel	7923.748	12663.143	4063.666	3969.255
MSC	213515.057	208770.823	223768.004	225279.807
Arcelor Mittal	23958.266	23994.543	23513.551	28024.387
Tata Steel	71417.964	66673.733	81628.608	83194.939
Corus Group	12384.186	7717.697	22522.434	24130.260
Salzgitter	0.000	4744.736	10873.628	11779.750
VPE	4744.736	0.000	15402.502	16522.107
Eramet	10873.628	15402.502	0.000	4584.396
Tinfos	11779.750	16522.107	4584.396	0.000

```
> sort(apply(d,1,sum))/nrow(d)
```

VPE	Celsa Group	PHS	Salzgitter	ZAO Severstal
30360.34	30472.75	30789.74	31009.25	31137.00
Lucchini	CMC	Corus Group	Huta Zawiercie	Europipe
31162.03	31323.61	31348.13	31514.15	33977.57
Vitkovice Steel	Evrax	Huta Ostrowiec	Eramet	Tinfos
34859.83	35813.88	36342.56	37102.44	37898.40
British Steel	Arcelor Mittal	Thyssen Krupp	LNH Holdings	Tata Steel
42992.17	43059.89	51655.98	54856.75	60918.44
Thyssen Stahl	MSC			
74705.53	188300.43			



Source: Own study.

Annexe No. 19**Procedure for establishing necessary size of the sample – stage III****Sampling with replacement**

Knowing the variance of the estimator and assuming the value of an average error of the estimation of the parameter, the desired sample size is obtained by referring the estimator variance (in this case the mean \bar{x}) to the square of the assumed average estimate error (Δ^2).

Assuming sampling with replacement with setting the average value, the following formula was used:

$$n_z = \sigma^2 / \Delta^2 \quad (2)$$

where:

n_z – size of the sample at sampling with replacement,

σ^2 – population variance,

Δ^2 – average parameter estimation error.

Using the above pattern, a sample was drawn from a population of 45 pairs of consolidating enterprises. The value Δ determining the accuracy of the result is given by the assumption. Certain difficulty was the amount of variance. It was obtained from a small preliminary sample.

After making simple calculations, the size of the needed sample was obtained. It has 11 pairs of enterprises. This is a relatively large sample and sufficient if the size of the general population of 45 pairs is taken into account.

Source: Own study.

² A. Zielaś, B. Pawełek, S. Wanat, *Metody statystyczne: Zadania i sprawdziany*. PWE, Warsaw 2002, p. 335.