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Technological practices in the European auto industry: Exploring cases from Belgium, Germany and Portugal

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Abstract

The relation between work organisation and technological practices in auto industry is analysed in this article. The concept of technological practice in this sector is used to describe the specific ways of embedding information and communication technology applications into the organizational forms and cultural patterns. This concept was developed with the Sowing project (TSER, DG XII) and that approach included either the shop floor cooperation up to the regionally based networks of companies and supporting institutions. The authors studied different sectors in the automotive firms of different European countries (Germany, Belgium and Portugal): shopfloor and production lines, design and management and the local inter-relationships. It was underlined some evidencies of the different alternatives in terms of technological practices for the same sector. Much of the litterature try to disseminate an idea of a single (and optimum) organisational model for the same type of product. And here, even with the same type of technology, and of product (medium-high

range), one can find different models, different cultures, different ways of organising the industrial structure (firms, regional institutions, R&D centres) in the same sector (auto industry).

Keywords

Automobile sector; technological practice; Information and Communication Technologies; work organisation; industrial structure; production models.

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Rik Huys has got a Ph D in Social Sciences in 2000 at the University of Leuven on *The structure of the division of labour in the Belgian car assembly industry*. For the moment he has got a Post-doctoral mandate at the department of Labour- and Organisational Sociology at the Faculty of Social Sciences. His is currently working on organisational structures, the organisation of labour and its consequences on the quality of labour.

Introduction

This paper refers to the relation between work organisation and technological practices in automobile industry. The concept of technological practice in this sector is used to describe the specific ways of embedding information and communication technology (ICT) applications into the organizational forms and cultural patterns. This concept was developed with the Sowing project (TSER Programme-Targeted Socio Economical Research, European Commission) that analysed the process of such practices held in different intra- and inter-organizational fields. This research project involved eight European research institutes from similar number of countries (WRC of University of Tampere, Finland; ITAS-Forschungszentrum Karlsruhe, Germany; Nexus Europe, Ireland; IRES, Italy, Fac. Sciences & Technology of University Nova of Lisbon, Portugal; HIVA of Leuven University, Belgium; Institute of Employment Studies, United Kingdom, and FORBA, Austria). The aim of the firm survey was to focus on the opinions and perceptions of company managers in the eight regions. It was decided that the number of observations would be small (100 per region) in order to have comprehensive data concerning all the aspects relevant in the research. Since the sample was small, it was considered impossible to conduct a representative sectorial analysis by limiting the number of industrial sectors, as many sectors were heterogeneous. The small numbers of cases in each sector do not allow to cover their diversity, so the samples in different regions may very well cover companies of a different nature. This happened to be the case of the automobile sector. In all cases it was mailed a questionnaire and conducted interviews.

In this article, we will describe the technological practice relying on the automobile industry in three of those European countries (Germany, Belgium and Portugal). The research focus on the question is how the emerging technological practices within companies were influenced by the ICT and how these technologies have been supported by the institutions of regional and national environments. Methodologically the concept of technological practise was divided into three levels: the level of application, the level of organisational change and the level of the firm's culture. Thus we could identify different concepts of technological practises in different European countries.

The automobile industry played an important role of the empirical findings in different countries. Here we have been analysed the findings from Germany, Belgium and Portugal, where the industrial structures are know to be very

different.

The production logic of VCG-Volvo Cars Ghent (Belgium) and AutoEuropa (Portugal) still shows some characteristics of *Fordism*, such as its traditional belt-driven assembly line and production jobs containing mainly short-cycle tasks. On other hand, the team concept is implemented and supported by intensive rotation-schemes. The VW-Volkswagen group factory in Portugal revealed an interesting dimension, and that is the specificity of the local network of institutions and firms that developed new forms of co-operation with evident regional impact. At Daimler Benz (Germany) the analysis was done specifically to the service sector, although the changes are of the same type as in the automobile division.

In spite of the expectation of the project, a turning point in the evolution of the companies organizational culture can nonetheless be made out. The Daimler-Benz group had been active on the global level much earlier than the merger with Chrysler, but executive functions were c ulturally and organizationally m still strongly imbedded in regional and national structures. This, however, seems to have come to an end with the merger with Chrysler. Information technologies, however, can b e held responsible (in the sense of giving the impulse) for these various transformations, but are rather to be seen as technologies which support this process, and make it technically feasible.

So, in this paper, we will underline some evidencies of the importance and different alternatives in terms of technological practices for the same sector. Generally the litterature describes the idea of a single and optimized organisational model for the same type of product [cf. 2, 12, 16], where contingency can be found [9, 10]. But even with the same type of technology, one can identify different models, different cultures, different ways of organising the industrial structure (firms, regional institutions, R&D centres) in the same sector (auto industry). Technological practise cannot be regarded as a single pattern, which takes part in the global production process.

Technological practices

In the Sowing project conclusion, we could find for all the sectors that modern ICT are providing options for horizontal co-ordination and communication. And it becomes the technological basis for the development of intra- and inter-organisational network forms. However, were found barriers that hinder the diffusion of network structures within and between companies. Not all companies studied in the Sowing survey apply modern network technologies,

although the case studies in the automobile sector demonstrate the use of those technologies. And, some companies didn't realise the enabling character of modern ICT opening up opportunities to designing organisation forms according to the network model.

In this European research project was included quantitative research, with a company survey conducted in each country. A questionnaire was designed to be administered in the region selected by each project partner. The questionnaire addressed the extent and nature of ICT use, aims and barriers related to introducing ICTs, companies' organisational restructuring practices and personnel policy as well as managers' attitudes to modern ICTs. The firm survey was conducted at the establishment level.

Besides the applications of modern ICT, technological practices also include organisation forms, companies' strategic goals and specific cultural patterns. As the elements of technological practices are closely linked and mutually influence each other, we can speak of a process of co-evolution [17]. Also, the technological practices can be analysed on different organisational levels. In general there exists a variety of technological practices in companies, so one can speak of a fractional organisation. Each practice creates a specific potential way of use of modern ICTs. The Sowing project research, however, has mainly focused on the analysis of technological practices on the organisation level

The empirical analysis demonstrated that the organisational restructuring seems to be a common practice within companies. About 75% of all companies that took part in our study have undergone organisational changes during the period 1994-1999. In more than half of all cases in which restructuring has taken place, modern ICTs were seen as playing an important role, either as the driving or facilitating factor. Over 80% of the companies in the Stuttgart area, Portugal, and the Tampere region (three of the studied regions) had introduced organisational changes. In particular, companies in Portugal, and especially companies in the Tampere region, had restructured their organisations more extensively (idem).

Data from this Sowing project also mention that companies in the transport and finance sectors, in the business services, in light manufacturing and other manufacturing are more advanced in introducing organisational changes, whereas companies in the sales and hotel sector are less active in this respect. Particularly companies in the manufacturing sectors mention modern ICTs (EDI, NC machine-tools, robotics, CAD/CAM, CAP) as an important stimulating or enabling factor for organisational changes.

The analysis of this firm survey suggests the distinction between four patterns of

techno-organisational systems. 20% of all companies have not taken steps to re-structure their organisation form and use ICT only as information processing tool, if at all. We can characterise these companies as *conservative* concerning their re-structuring strategy. One out of three companies only focuses its modernisation strategy on the use of ICT in the modern form as communication device (the *technically oriented modernisers*), while about 20% of all companies focus their renewal strategies on organisational re-structuring, hardly using ICT in a modern way (the *organisationally oriented modernisers*).

About 25% of all companies seem to orient their restructuring strategies on the network organisation, together with the massive introduction of modern ICT. Nevertheless, these firms have developed new organisational practices. Here we can speak of a *high-tech network organisation*. Those were most of automobile sector cases. But only 10% of all companies have fully applied the network model, having vertically and horizontally restructured their organisation model together with the establishment of technical connections internally and externally. The majority of the companies have only partly introduced the network model, they have established technological networks with external partners and they have only partly restructured their business processes. 2/3 of them have hierarchically de-integrated while the rest has introduces measures to functionally integrate production processes.

The restructuring clusters also revealed significant differences concerning the way how modern ICT is used. In this Sowing project survey finding it is clear that, with a few exceptions, differences occur between the two Fordist types of organisation on the one hand (the one that represents the companies that have not taken steps to restructure their organisation form and use ICT only as information processing tool ㊦or the low-tech Fordist model, and the other that represents the group of companies as technically oriented modernisers ㊦he ㊦high-tech Fordism㊦) and the more flexible network forms on the other. This holds true for the two tool functions (time and quality), for the organisation function and for the information provider function. Not surprisingly control and communication function are also important for the ICT based Fordism, while the surveillance function is most important for low-tech Fordist companies.

Volkswagen (AutoEuropa) case ㊦Palmela (Portugal)

This company was created in 1991 from a joint venture between Ford and Volkswagen, and since it started its production (in early 1995) then had a larger impact in the productive structure in Portugal, once it incorporates almost 50% of national added value. It ㊦production volume is around 130 thousand

vehicles/year, which give an average of 32 vehicles produced per worker.

The case presented here is the AutoEuropa factory that assembles multi-purpose vehicles from Ford, VW and Seat (and is expected to start a new one for Skoda). Although it was a Ford-VW joint venture, since 1999, VW assumed the control all over the company. Its implantation as a *greenfield site* originated substantial changes in the way as firms relate themselves in a network [12], although it didn't produce a modern industrial district. In other words, it didn't create a true manufacturing system that stimulated externalities and synergies, influencing all the local entrepreneurial fabric [5]. Nevertheless, it was a case that assumed its functions on the qualification and training process, articulating also with the regional vocational training institutions. At the same time, it was a case of significant investment on ICT for a single large factory, specially in the field of manufacturing automation and robotics.

When this is combined with short lead-times and minimum inventories of incoming components, it produces a system that is extremely dependent on reliability in deliveries, especially in the last stage from the first-tier supplier to the point-of-assembly. A high level of importance regarding logistical relationships is associated with frequent deliveries and sequential Just-in-Time production [11].

As several authors mention, one way to overcome problems with product quality or delivery is to organise the supply-linkages in such a way that new products and production plans are developed in co-operation. In order to benefit, the buyer needs to build a collaborative relationship with the subcontractor within a lean production strategy. This includes sharing information and integrating the production process so that the new products can be put into production without delay. In fact, AutoEuropa developed an information system with suppliers that enables this kind of strategy, once can be considered as high-tech network organisation, with wide usage of ICT. These applications are not only located for administration, process control or engineering activities, but are also disseminated at the shopfloor, characterised by NC machine-tools, robotic cells, AGV, or automatic warehouses. This kind of flexible manufacturing equipment is connected with quality control systems and computer-aided planning that can be used by shopfloor working teams.

The establishment of strategic alliances is one commonly used form of formal inter-firm arrangement around a specific purpose or project [1, 5, 11]. The main area for strategic alliances in the automotive industry is in Research & Development where costs generally are extremely high and problematic for one company to handle. This was one of the reasons for VW and Ford begin their co-operation in the new multi-purpose class vehicles.

One further method of integration is to establish relationships with suppliers with responsibility to develop entire modules. A module-supplier has responsibility for product development and co-ordination of the assembly of a number of components into a finished product, ready to fit into the car. Examples of this are complete seats with the correct colour and clothing; painted bumpers complete with spoilers and fog-lights or entire interiors such as cockpit-modules.

The most striking outcome of the new supplier strategies based on modules and sequential deliveries was the establishment of a supplier-park in close proximity to the assembly plant in Palmela (near Setúbal). On this site the first tier supplier units were located. These units are also international joint ventures among national second tier suppliers and foreign firms. We could acknowledge clear similarities between this type of organisation, and other type, as for example in Volvo in Sweden [1].

This shift in supplier practices opened up for the large international supplier groups to develop links with national industries and establish themselves in the supplier-park. The traditional suppliers did not have the capacity to become responsible for entire modules, most of them with technological complexities. In this process, the Ford company (that was a member of the AutoEuropa joint venture) was responsible for the certification of those supplier units. And this certification process was not only agreed with the ISO 9000 principles, but included several other items related with work organisation principles. The influence in the regional and national industrial fabric related to this project was very strong, once new organisational themes were discussed and introduced in all those firms. The *work group* concept was a novelty for most of those firms.

Furthermore this Ford certification process (Q-1 and Q101) worked as a catalyst for new a supplier hierarchy with a small number of module/system integrators at the top (first tier) that can react in 2 hours to the demand, followed by many of the traditional suppliers established in national market in the second tier (nearby suppliers that respond within 1 day or 1,5 days). The first tier represents firms that, for example, assemble the driving clusters, the seating groups, or the complete wheel system, and are located very close to the VW factory. The second one is more specialized on specific assembled products (cabling systems, optics, sensors, driving wheels, transmissions). The third tier (external suppliers) are normally the national and regional firms that are specialised suppliers of international groups and firms (tyres, glasses, motor components, metal moulds for casting, plastic components, suspensions, etc.). Most of them are traditional suppliers in the automotive chain, and have more than 2 days to react to AutoEuropa demands.

The development of local supplying firms can be an indication of the increasingly networked organisation where large international suppliers act as integrators of resources rather than manufacturers of single products. What we should look for is the location and distribution of resources in the network belonging to each supplier. In the AutoEuropa case, we can include as assembling integrators the Delphi, Continental tires, Visteon, Bosch, Sommer Allibert, Vanpro, Gillet, Siemens, among other companies that are developing joint-ventures with Portuguese firms. Using this point of departure we can say that economies are created for the entire network, thus diminishing the need for scale-economies at local plant level. This means that in spite AutoEuropa has 4 thousand direct workers at Palmela plant, the employment volume of people related with this Ford-VW product are around 9 thousand in Portugal. It is rather a question of where to locate resources such as manufacturing, development, management, sales, procurement and others.

The work organisation is based on group work concepts where the operators are involved in job rotation schemes but not in job enrichment: the workers only participate on quality control decisions. They don't elect the team leaders, don't participate in the decision about division of tasks, or working times. The nature of the working teams are inspired on the Toyota model of organisation.

The emphasis lays on the control issues, where the job autonomy is restricted. The selection of members of working groups is done by the sector responsables (supervisors and superintendents), although workers are encouraged to contribute their ideas and suggestions to improve their jobs, following the Japanese *kaizen* principles [3]. These continuous improvement activities are task-centred, rather than power centred. That means that are oriented to the operational level (task) more than to the decisional level (power).

The studies done here demonstrated that these *kaizen* activities represent a form of involvement rather than an opportunity for participation, leading to a simplification of procedures that can be transformed into norms and regulations. It seems that there is no clear shift from the Taylorist form of work organisation, although it includes steps forward into the process of involvement of workers.

Daimler-Chrysler case 3 Sindelfingen and Stuttgart-Untertürkheim (Germany)

In 1997, the Daimler-Benz concern gave itself a new organizational structure. At the same time, the Mercedes-Benz Corp. was renamed Daimler-Benz Corp.

The business segments Passenger Cars, Commercial Vehicles, Aerospace (Daimler-Benz Aerospace), Services (debis), as well as directly-led industrial holdings were established. Daimler-Benz Aerospace was sub-divided into six operating areas (Commercial Aircraft and Helicopters, Military Aircraft, Space Flight Infrastructure, Satellites, Defense and Civil Systems, as well as Propulsion Systems). The business segment Services, represented by debis, comprises the areas Financial Services and Insurance, IT-Services, Telecommunications and Media Services, Commerce and Real Estate Management. The holdings are railway systems with Adtrans (ABB/Daimler-Benz Transportation Corp. resp. PLC), the area Diesel Engines (MTU), as well as micro-electronics (TEMIC).

The corporation's history is characterized by continuous and consistent expansion. Every merger resulted in organizational changes within the newly-refounded company, which can be retraced for only the past decade. This history, however, shows in a quite impressive manner that its specific corporate logic and corporate culture had been laid down from the very beginnings. By means of its technical innovations, the company has, by making use of its *leader role*, first opened and then formed the automotive market, and has been able to maintain its market-leader position to the present. The intensive scientific development of automotive technology became in this manner the motor and basis of its success on the markets. Continuous expansion, influence in other branches of the economy, as well as mergers with other business enterprises gave impetus for permanent transformation of the entire Daimler-Chrysler group.

If one lets the concern's history pass in review, the changes in the years 1997 to 1999 appear as a *logical* continuation of a market strategy which has committed itself to growth as well as to market leadership. The concern has developed itself steadily from a local to a global economic actor.

A turning point in the evolution of the company's organizational culture can nonetheless be made out. Daimler-Benz had been active on the global level much earlier than the merger with Chrysler, but executive functions were *ま* culturally and organizationally *ま* still strongly imbedded in regional and national structures. This, however, seems to have come to an end with the merger with Chrysler. There are signs for intensive orientation on a US-American model of management (gradual cutback in conditions negotiated in collective bargaining, reliable commitments in favor of the jobs in the Stuttgart area only until the end of the year 2000, even more comprehensive rationalization measures in planning, etc.).

This group is active in quite different branches, in which ICT-application has

developed into the technical basis for work-processes (manufacturing, services, administration and management). The fields of application for ICT have a broad, multifunctional nature which in the course of time has decimated jobs in the training occupations through rationalization, but has always reformed and accelerated work. In retrospect, these changes make judgement of the relation of cause and effect by the introduction of ICT quite difficult. In the case of this company, one can nonetheless postulate a decision-based transformation which according to the maximization strategy of corporate logic is constantly on the search for means and methods of increasing efficiency, respectively, of quality assurance for products on the market.

In particular, the Daimler-Chrysler group's role as a global player makes ICT a decisive application-oriented instrument which enables the concern to give up regional production sites, or to build up new ones. Standardization of the ICT-system is, further, intended to make it possible to interlace complex work-processes. These processes can then be accelerated and decentrally organized, that is to say, fundamental conditions of time and space for work-processes are being radically changed. Which concrete effects this would have on occupational profiles and on working conditions can yet be foreseen.

Organizational changes were initiated as a result of the merger with Chrysler. This is remarkable, because only a few years earlier, the internal structure had already been reorganized into more decentralised forms of organization. In the first phase of restructuring, levels of authority had been reduced, individual divisions, commercial segments etc. granted more autonomy and empowered to make decisions, among other measures. After the merger in the past year, this reform was rescinded in favor of centralized corporate leadership. This means that levels of management were established which have assumed the responsibility for an area in all concern segments worldwide. In this way, a standardization of the styles of management as well as of the objectives takes place. The specific, nationally or regionally diverse organizational principles of the various segments lose importance in the process.

Working conditions for the individual employee changed in just the reverse direction as described above, i. e., standardized or formal conditions are transformed into individualized employment contracts. Time- and decision-making structures, tasks and goals, are increasingly being agreed upon and laid down in an individual labor contract and are evaluated by various methods in the course of the work. In this manner, career plans and performance patterns develop, which differ from those of the standard negotiated collective agreements. The individual employee is put into the position of *working to one's own account*. Further, good work is rewarded by means of various incentives.

On the whole, the individual's decision-making competence has been reduced by central management following the merger. By means of individually-negotiated performance requirements, however, the multipurpose job profile is gaining ground. This is brought about by means of various mechanisms: In the first place, by periodic evaluation of performance, management tries to employ labor as efficiently and as selectively as possible. Second: the prevalence of team- and project-work makes abilities such as social competence, foreign languages and the like, necessary. And third, due to the general acceleration of work-processes, so-called *lifelong learning* is becoming more and more important, and is being rated as a prerequisite for a successful career. The individual is much more often than ever subject to the mechanisms for evaluation of his work. According to individual demands on oneself, or on life, this situation can be perceived as positive or negative.

ICT play a central role in these transformations, although it is not to be assumed that they were the cause for these changes. Putting these decision-based reforms into practice, however, would be inconceivable without the technical basis ICT provide. Especially in consequence of the spatial interlacing of the concern, ICT have become indispensable [7].

Formerly, working conditions in Germany had been organized according to collective bargaining agreements. The employees profited by way of dividend payout procedures from the corporation's material successes, and, as a rule, identified themselves strongly with their workplace. The concern's workers are primarily men. Women are employed above all in administration, so that full-time employment is the normal time-structure (but part-time models can also be negotiated).

Following the merger, a great deal of insecurity arose among the employees, because the jobs at the main production site were guaranteed only until the end of the year 2000. The future of the business segments in the Stuttgart area is uncertain. Because the Daimler-Chrysler group is very strongly oriented on the market, or rather, on the profit-margin, there is, on the whole, little confidence in the executive floor's commitment to keep the jobs in the region if interesting alternative offers are made. This insecurity has already led to conflicts among the employees.

The orientation in the direction of a globally operating concern therefore leads to a certain *decoupling* of the region, especially when corporate objectives are formulated elsewhere (USA). The goal *worldwide standardization of the concern* can turn into a threat to the further existence of individual sites.

VCG/Volvo 在 Ghent (Belgium)

Belgium is a country of car manufacturers. Every year, more than one million cars are constructed here by Ford (33.5%), Opel (31.6%), Volkswagen (19%) and Volvo (16%). The Belgians assemble most cars in the world per head of the population: in 1998, 105 cars were assembled for every 1 000 inhabitants, which is more than the Japanese (87 cars) or the German (61 cars) average. The plant studied was established in 1965 as the first Volvo plant outside Sweden. VCG-Volvo Cars Ghent is the largest *manufacturing unit* of the Volvo Car Corporation with 4 thousand direct workers, and mainly produces cars. The activities related to sales, purchase, marketing, etc. belong to the responsibility of the headquarters in Göteborg. This Ghent plant assembled in 1998 more than 150 thousand cars.

Price, productivity and quality have always been important competitiveness features. More recently, delivery periods have become an important field of competition, plus the flexibility to allow for late changes in customer orders. Flexibility and innovation also grew in importance in view of increasing fluctuations in demand response the ever shortening of product life cycles.

The creation of a car is the result of three activities: welding, painting and final assembly. These are also the three major business units of VCG, belonging to the department *Manufacturing*. The responsibilities of this department are much broader than production *sensu strictu* and in fact, they are still increasing. Over the years, almost all activities related to quality control and maintenance have been integrated in the manufacturing department, which is also responsible for its own logistics and material handling. The underlying reasons for the ongoing incorporation of supporting activities in the manufacturing department, is achieving a more efficient course of the production process, together with the empowerment of the people involved (based on teamwork).

In general, the amount of supporting (staff) services and indirect employees is rather small, given the size of the company. VCG also has very *little hierarchy* for a company of almost 4 000 employees. In fact, there are only 4 layers : board of directors, core management, *Area* responsables (e.g., white collar employees responsible for first line supervision in a specific area) and production teams (blue-collar core workers coached by a team leader, who is also a blue collar worker). In the course of past 20 years, the amount of hierarchical levels has been reduced drastically, together with the gradual development of teamwork and the dismantling of huge supporting departments.

The cornerstone of VCG's organisational logic, as already insinuated a couple of times, is its well-elaborated *teamwork*. VCG really was and still is - a pioneer in the field of teamwork. The company already started working with its VEC-teams (VEC stands for Volvo Europe Cars) somewhere in the beginning of the 80ies.

A VEC-team consists of 10 to 15 members and a team leader, co-ordinating the internal work organisation of the team. Within the teams, a flexible allocation of workers is reached through job *rotation*. A comparative analysis of all Belgian automobile companies showed that job rotation at VCG is most systematic and extensive : all production workers are involved in rotation, rotation happens over ca. 4 (sometimes up to 10) work places, rotation can happen every 2 hours, etc. In the other plants, rotation is much more limited and incidental. Rotation between work places allows the job content to be enhanced; in other words, it results into *job enlargement*. For employees, it has the advantage of giving more variety, thereby reducing the routine & blunt character of the machine-paced work. For the organisation, the resulting polyvalence is a handsome tool for coping with unforeseen absentees or for redistributing operations, e.g. after rebalancing of the line [4].

However, VCG's teamwork goes far beyond simple job rotation. More important is the gradual and still continuing evolution of incorporating additional responsibilities within the production team. The underlying philosophy is to make better use of the available capacities, in order to achieve a more autonomous and efficient functioning of the team. Over the years, tasks like first line maintenance, quality assurance, material supply, etc. have been integrated in the VEC-teams, combined with a restructuring of the formal organisation in order to achieve closer support from the strongly reduced staff departments to the production teams. Usually, additional responsibilities for teams are assigned to a specific function within the team or to the teamleader, while the job content of the other members remains unaltered. At VCG, however, additional responsibilities for the team must be interpreted as allocated to all team members, since everybody rotates over a number of indirect jobs within the team. Rotation means more than just doing more of the same or simply job enlargement. Involvement in off-line activities supporting the team functioning also implies a true *job enrichment*.

In line with this, VCG recently started another phase in the evolution towards semi-autonomous teams, i.e. the phase of *self-management*. In this phase, each of the team members have been given the ownership of a specialised theme or topic, in correspondence with his own field of interest, capacities and competencies. The themes can vary according to specific team needs, but good examples are prevention of damages, safety and environment, follow-up of

product quality, prevention of breakdowns and short stops, etc. Every team has been given 2u a day to engage in these so-called VEC-activities. Also here, a rotation scheme is applied. Every day, someone else gets the opportunity to be relieved from the conveyor belt and to do some work on the topic he is chosen for. This allows to make better use of the available human capital, by simply addressing and stirring up sometimes hidden qualifications. In general, the self-management programme should increase the self-supporting character of the team as well as the general quality level of the team and organisation *tout court*.

Every two weeks, the conveyor belt is shut down for a *VEC-team meeting* of about 30 minutes (during the working hours). The purpose of the meeting is discussing about problems, exchanging information, etc. Since the latest phase of teamwork, the theme-owners also use the meeting to inform the others about activities and plans concerning their specific theme. Sometimes, cross-team meetings are organised between the owners of similar themes. Obviously, the team-meetings cost the company a whole lot of money, but VCG is convinced they pay off!

In general, teamwork was characterised by its *gradual and stepwise implementation*. Evolving from very narrow Tayloristic jobs to richer jobs, characterised by self-management in semi-autonomous teams, implies a long *learning process* that cannot be pushed top-down. Team members have to receive off-the-job training to enable them to jump to a subsequent stage and take on additional responsibilities. However, the time provided to reach a next step is only loosely defined, allowing for differences between teams. In fact, the team evaluates each step on a weekly basis. When a team feels confident in mastering more additional responsibilities, a screening committee is invited to repeat the evaluation. If approved, the team is awarded a green circle on its VEC team board, and may move on to a subsequent step.

In general, it is rather difficult to categorize the organisational logic of VCG or to put the plant in a pre-defined cell. In fact, complete studies and articles have been devoted to this single topic and, in fact, this argumentation is largely based on a study published by Gerpisa [8]. On the one hand, the production logic of VCG still shows some characteristics of *Fordism*, such as its traditional belt-driven assembly line and production jobs containing mainly short-cycle tasks. On the other hand, one has to bear in mind the very well implemented team concept supported by intensive rotation-schemes. This rotation includes an unusually broad range of heterogeneous, also off-line, jobs. This integration of different jobs within production functions was made possible through an impressive shift from staff departments towards lower levels of the production hierarchy. Finally, the team's ability to determine the speed of their own trajectory must be stressed.

All these characteristics of the VEC team model cannot be labelled as Fordist or machine bureaucratic at all. Support and preparation on the one hand and execution on the other hand, are brought closely together. By reducing this kind of division of labour, supporting tasks can be performed in the immediate proximity of the line. The elimination of barriers between departments as well as between production workers in order to allow a flexible allocation of the workforce are features of a *lean production* approach. The attempt by VCG to mobilise all production workers in off-line activities supporting the general functioning and autonomy of the team, even goes beyond the lean production practices. At the same time, is still far away from the innovations breaking completely with the assembly line and choosing for teams assembling complete cars rather than small parts of it (cf. experiments of Volvo-Udevalla or Saab-Kalmar). Because VCG is going further than the (Japanese) lean production processes, but not so far as the (Swedish) experiments characterised by long work cycles, Huys and Van Hootegem [8] talk about 第三方式 (third way)

We can say VCG combines some features typical for mass production in a *machine bureaucratic* environment (e.g. conveyor belt with machine-paced, short-cyclical work) with modern organisation and management principles, more fitting the *J-model* or, to a lesser extent, even the *operational adhocracy* (e.g. job enrichment in autonomous teams, self-management). Putting VCG in one of these cells would be a static solution denying the dynamics of reality. In fact, VCG is already working for ca. 20 years on *reducing vertical integration* (bringing execution and decision-making closer together) and *increasing horizontal integration* (by means of semi-autonomous teams). In general, we could say VCG is 途中 (under way) trying to move away from the traditional Tayloristic approach towards more progressive and human solutions. In some fields, more progress is made than in others, and the different parts of the organisation can be in different stages of development.

Three cases under three models?

All the cases mentioned here can be included in some of the most advanced models of the organisation of automobile industry in Europe. All of them are developing intra- and inter-organisational network forms. But they are reflecting also the differences that are more and more evident in the automobile industry in Europe.

As Boyer and Freyssenet mentioned, two new industrial models were simultaneously being developed in the Japanese automobile industry: the *Toyotan model* privileging 恒久的 (permanent) reduction of costs at constant volume 恒

and the *Hondian model* implementing a totally different profit strategy of innovation and flexibility [2]. These two models were erroneously placed under the same heading of *lean production* despite the fact that they differ significantly on essential points.

The remarkable performances of the firms which embodied these models (Toyota and Honda) did not chase however the *Sloanian model* away, Volkswagen adopted it as of 1974, and was able to exploit it profitably in the context of a renewed market. These three firms Toyota, Honda, and Volkswagen were in fact the only ones to have a break-even point that was constantly and significantly above their value added, whereas all other carmakers had experienced periods of non-profitability.

For these mentioned authors, Volkswagen followed a profit strategy based on *volume and diversity* thanks to internationalization, the buying out of other carmakers and the commonalization of car models platforms (the case of AutoEuropa is very clear on this issue). The modularisation strategy is not yet implemented in all types of products, and can be an evidence when the platforms are identical.

In fact, some authors, as Michel Freyssenet recently mentioned [6] saw the new productive model as nothing more than a variant of the old Fordist model. But, for others they considered that there had always been a plurality of models, and even others contested the very idea that there is such a thing as a model. Finally, we can find those who agreed with the idea of lean production but who felt that its variants were based on specific national environments.

The success or failure of firms' internationalisation drives, continues Freyssenet, depends on the compatibility between their model and the market and labour conditions in the various spaces they were moving into. It seems to be the case of these firms in Germany, Belgium and Portugal.

All of the cases mentioned in this article are located in different national contexts, but all of them are using intensively ICT from the shopfloor level to the design areas, and all of them are specialised in medium-high range car models, with increased technological practices based on quality control, intensive flows of information and communication, and leading networks of suppliers.

So, for the German case of Daimler-Benz we can conclude that it inscribes in the new Sloanian framework. This model (named after Alfred Sloan, under whose presidency this model was theorized and constructed at General Motors) is the model that implemented the "volume and diversity" strategy. It relies on an "enterprise government compromise" essentially established between

managers and one or several powerful and professionalized unions. It thus takes on the form of a *social compromise* wherein accepting work organization and promoting social peace is compensated by programmed growth in worker's buying power, promotions in the workplace, and the expansion of both social protection and union rights.

The *Sloanian* product policy is multi-brand, offering parallel ranges whose models of same market segment share the same platform while offering a number of versions and options. Productive organization is characterized by the centralization of strategic choices and the decentralization of their implementation within divisions; relying on subsidiaries or sub-contractors for numerous components so as to displace a part of diversity to them and to benefit lower prices due to their economies of scale obtained thanks the orders from other clients; machine polyvalence (multi-specialized) and mechanical assembly lines with buffers to saturate the production tool despite vehicle variety. The employment relationships under this technological practice model consist of applying the "enterprise government compromise" under the union's control, and in the name of polyvalent workers paid in function of job evaluation of work stations they successively have.

Since the 1960s, no firm having adopted the "quality" strategy in Europe (as, for example, BMW, Mercedes, Saab or Volvo) experienced a break-even point constantly above added value. Though their profit strategy was pertinent, their "enterprise government compromise" was not sufficiently robust. Although it was a socially favorable environment, these firms could control the supplier costs. They attempted to apply "socio-technical" approach to the labour crisis. One of the most well-known case, was the Volvo, specially in Sweden.

These experiences considerably enlarged the cycle times, introducing modular work, and systematically improved the work station ergonomics and the working conditions. In addition, the image of quality could be reinforced by publicity concerning new production methods. They were presented more dignified than the mass production methods for the demanding customer who wanted a car to become the object of special attention. Volvo went the furthest along the path of "work reform" by radically splitting from the assembly line, replacing it with assembling in fixed parallel stations, notably in its new Uddevalla plant. But both at Volvo and other firms, employment relationships and product policy were not coherently conceived of in relation to the new productive organization so as to generate as much benefit as possible in terms of personalization of response to demand (be it in the realm of delays, costs, product improvement and adaptation, and service).

The Daimler-Chrysler merger, increasingly seen as the former acquiring the

latter, and its relation with Mitsubishi compromised the productive structure to become a worldwide firm to be present within all segments of the automobile market: top-of-the-line in each segment, the first market (mass oriented and hierarchized), the second market (innovative varied and variable models). The objective was to respond to all kinds of demands, also explains the successive takeovers of Jaguar, Aston Martin and Volvo by Ford, and its proposal to purchase Land Rover. Volkswagen itself implemented a strict "volume and diversity" strategy which commonalized the platforms of its four brands of classic sedans, and now want to make them all: MPV of VW, Ford and SEAT, luxurious cars with Bentley, Lamborghini and Bugatti, recreational vehicles, heavy trucks with Scania.

If the coexistence of two markets should persist, differentiating themselves according to the world's regions or even by country, it is possible that certain firms will attempt and succeed in rendering volume, diversity, innovation, and flexibility compatible. One can acknowledge other experiences, as General Motors rendered volume and diversity compatible in the 1920s and 1930s.

To achieve this aim, General Motors was required to invent a new automobile architecture, with commonalized platforms and car models differing on the surface and the construction of new socio-productive principles: polyvalency and supplying. This means a completely new technological practice, that we could characterise as organisationally oriented moderniser, where ICT are not determinant for their change.

So if modular vehicles are more than just a way of outsourcing a maximum quantity of work, this means that a new network organisation can take place more intensively in this automobile sector. The possibility to be able to design innovative models thanks to different combinations of shared elements, is a completely different issue. As we can see from these cases, only the Daimler-Chrysler can perform this activity, once, neither AutoEuropa, nor VCG, are firms with decision on the design of new models. They depend, about that, on the owners (VW and Volvo) located elsewhere.

The *reflexive production*, with appropriate employment relationships, is a characteristic of the high-tech network organisations that developed new forms of work organisation together with networking relations with their suppliers, using intensively ICT. But this technological practice can be found in all the three case, although we can find them very different. When one is presented as a multidimensional group that influenced the re-structuring strategy, with a new worldwide focus (Daimler-Chrysler), others depend on their mother-firms. And these, one follows the organisational advantages of the Swedish socio-technical approach to re-structuring, assuming most of the lean

production processes, and the other, dependent from the VW global strategy, is implementing the Japanese strategies of organisational change, to develop an increased workers involvement in the control process. But these firms has few autonomy, although the central offices of Mercedes are located in Stuttgart, but management objectives are designed in United States.

So, in fact, the technological practice cannot be understood as a single pattern, even when we can find strong similarities, achieved from the same sector, and with the same kind of product. On the contrary, there are strong differencies based on the local ways of organising the industrial structure, that are developed under different cultures, and specially, under different corporate strategies.

Conclusion

The research focus of the Sowing project was on the analysis on how the emerging technological practices within companies were influenced by the ICT and how these technologies have been supported by the institutions of regional and national environments. In this article we tried to underline evidencies of the importance and different alternatives in terms of technological practices for the automobile sector. And we could find that even with the same type of technology, one can identify different models, different cultures, different ways of organising the industrial structure (firms, regional institutions, R&D centres) in the same industry. Technological practise cannot be regarded as a single pattern, which takes part in the global production process. The cases of Daimler-Chrysler in Germany, Volvo in Belgium and VW in Portuga demonstrates it.

These companies seemed to orient their restructuring strategies on the network organisation, together with the massive introduction of modern ICT. They have fully applied the network model, having vertically and horizontally restructured their organisation model together with the establishment of technical connections internally and externally.

In fact, all the cases mentioned here can be included in some of the most advanced models of the organisation of automobile industry in Europe. But they are reflecting also the differencies that are more and more evident in the automobile industry in Europe. Volkswagen followed a profit strategy based on *volume and diversity* thanks to internationalization, and the commonalization of car models platforms (AutoEuropa as an example). The German case of

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