Trends for the development of anthropocentric production systems in small less industrialised countries: The case of Portugal

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TRENDS FOR THE DEVELOPMENT OF ANTHROPOCENTRIC PRODUCTION SYSTEMS IN SMALL LESS INDUSTRIALISED COUNTRIES: THE CASE OF PORTUGAL [1]

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Abstract

This paper analyses the problems and trends of the introduction of anthropocentric production systems (APS) in small less industrialized member states of the European Union, specifically the case of Portugal, based on the report for the FAST-Anthropocentric Technology Assessment Project (Monitor Programme) on "Prospects and conditions for APS in Europe by the 21st century". Research teams from all countries of the European Community, as well as researchers from USA, Japan and Australia were participating in this project.

The aim of this paper is to characterize APS and to present some special considerations related to the socioeconomic factors affecting the prospects and conditions for APS in Portugal. APS is defined as a system based on the utilization of skilled human resources and flexible technology adapted to the needs of flexible and participative organization. Among socioeconomic factors, some critical aspects for the development of APS will be focused, namely technological infrastructure, management strategies, perceived impact of introduction of automated systems on the division of labor and organizational structure, educational and vocational training and social actors strategies towards industrial automation. This analysis is based on a sample of industrial firms, built up for qualitative analysis, and on case studies analysis that can be reference examples for further development of APS, and not just for economic policy purposes alone.

We have also analyzed the type of existing industrial relations, the union and employer strategies and some aspects of public policies towards the introduction of new technologies in the order to understand the extent to which there exist obstacles to and favorable conditions for the diffusion of anthropocentric systems. Finally some recommendations are presented to stress the trends for the implementation and development of anthropocentric production systems in Portugal.

This paper is broken down into the following structure:

1. Key characteristics of APS

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2. Advantages of APS

3. Conditions and prospects for APS in Portugal

4. Conclusions

1. KEY CHARACTERISTICS OF APS

Definitions of APS

Many terms are employed to illustrate the central features of new production systems: one-of-a-kind production, skill-based systems, flexible specialization, customized quality-competitive production, human centered system and anthropocentric production system (APS).

Although, the use of the APS designation is recent, a lot of their principles and ideas may be considered both as a development and integration of models recommended by social science specialists [2] since the fifties and practiced by innovative firms since the seventies [3].

APS can be defined as a production system that improves skills, participation in the decision-making processes and the quality of working life. In this system new technologies are molded to valorize specific human capacities and to meet the needs of organizational structures designed to increase the participation of people in decision-making and the control of production processes, thus leading to a better quality of working life.

However, there is no universally accepted definition. For this reason we decided to mention some of the APS definitions.

APS as a **coherent set of technological and organizational innovations** to improve productivity, quality and flexibility: "The production system that fits this condition is a computer-aided production system strongly based on skilled work and human decision-making combined with leading-edge technology. It can be called 'an anthropocentric production system." [4].

The **essential components** of these systems are:

* Flexible automation, supporting human work and decision-making

[2] cf. THORSRUD, E.: ; TRIST, E.

[3] Volvo, SAAB, Hewlett-Packard,

[4] LEHNER, F.: 1992: VII

* A decentralized organization of work, with flat hierarchies and a strong delegation of power and responsibilities, especially at shop-floor level;

* Reduced division of labor;

* Continuous, product-oriented up-skilling of people at work;

* Product-oriented integration within the broader production processes

Within this approach the combination of advanced technology and skilled work in a decentralized, product-oriented organization leads to an intelligent manufacturing system able to support high quality and technological sophistication, rapid adjustment to change as well as diversification and the efficient use of resources [5].

According to another approach, APS represents a **step in the evolutionary process of the production systems**. In this sense, a new paradigm of production systems is emerging (Piore and Sabel) which will gradually displace the old mass production system in sectors whose activity involves advanced technology. The Fordist-Tayloristic approach is becoming increasingly inadequate in view of present economic, social and cultural conditions. The ability to adapt the products to costumer requirements by increasing variety, quality and short delivery times, are becoming the most important competitive factors. APS is seen as a competitive tool for the modernization of European industry. For supporters of APS, Europe with its tradition for small batch production is in a comparatively more favorable position to improve APS than the USA, with its highly Tayloristic-Fordistic traditions (Brödner).

In this paper we consider APS to be synonymous with the concept of a human centred production system. APS is an **alternative response** but it is not "the one best way" to respond to the requirements of changing market conditions calling for flexibility, innovation, diversification, short delivery times and customisation. It is, however an adequate response to the new expectations and attitudes of people towards work.

At present there are many solutions - both technical and organisational - for improving firms' competitiveness. This is a new trend, insofar as, for some time there would appear to have been a strong tendency for production systems to converge in most of the economic activities of industrialized or industrialising countries. The Taylorist-Fordist principles were felt to be

[5] cf. LEHNER, F.: 1992: IX.

universally applicable. However, we disagree with this approach that considers APS to be new universal model displacing the old Taylorist-Fordist model. From our standpoint APS is an alternative strategy and a question of choice rather than "the one best way" of ensuring the best performance.

The technology-centered strategy is another choice for the improvement of highly automated production systems. There are underlying ideas, namely that economic superiority is based on technological sophistication in which competitiveness presupposes hierarchical and centralized organization. Technology is regarded as a mean of replacing people reduced to machine components in the automated system whose role is becoming more and more reduced through higher automation, leading to increased replacement of human skills.

There are many other possible strategies arising from different combination of the principles of two basic strategies we know as human-centered and technology-centered strategies.

Figure 1: Comparison of the technology-centered and human-centered approach

TECHNOLOGY-CENTRED APPROACH	HUMAN-CENTRED APPROACH
Introduction of new technologies with a view to reducing human roles on the shop floor, and labor costs	Introduction of new technologies as a complement to specific human capacities, aimed at increasing functional flexibility, quality of products and of working life
Replacement of skills by technology, leading to an increase in the de-skilling and de-motivation of shop floor employees.	Improvement of the quality and stability of human resources at all levels for the improved exploration of the potentials offered by new technologies
Centralized technical solutions	Decentralized technical solutions
Rigid work practices based on principles such a centralization, vertical and horizontal separation of tasks and competence specialization	Flexible work practices based on principles such as decentralization, multi-valence, vertical and horizontal integration of tasks, participation and co-operation
Rigid hierarchic and professional boundaries	Supple boundaries
Passive role at operational level: execution of simple tasks	New professionalism at operational level: autonomy to perform different, complex tasks, capacity for problem solving, creativity and autonomy, at individual or group level
Integration of units of firms by way of computer assisted centralization of information, decisions and control	Integration of parts of firms by way of training, socialization, communication-co-operation and information accessibility, participation in decision making and self-control

The human-centered approach is directed towards the development of a flexible and decentralized production system. Here the potentials of technology complement human skills and specific human abilities are valorized.

In other words technology should not replace people, but rather improves their competence and decision making capacity. Flexibility is achieved using intuition, imagination, individual and collective know-how, existing skills and working methods enriched through new knowledge and methods.

These specific human abilities related to the management of the unexpected, are based on information that cannot be formalized and on an understanding of complex and non-structured situations.

The job is designed according to **socio-technical principles**: the improvement of variety, identity, sense of fulfillment and autonomy at work. Their aims are:

- The use of skills and abilities including tacit knowledge,
- The creation of favorable conditions for development and learning,
- The improvement of collaborative work.

These principles involve the integration of conception and execution, intellectual and manual functions through work enrichment with discretion in selection of work methods (in low automated work areas) or by the integration of planning, programming, processing and maintenance tasks (in highly automated areas).

The work is structured in **work groups** with a high level of autonomy and self-control. The work group activity focuses on the main type of product, or on a small group of related products. The group tasks include planning and allocation of work: loading, setting, unloading the machines; programming, maintenance, quality and performance control. Various skills are required and job rotation among group members is used.

At **factory level** the basic principles are:

- De-centralization of the company, to form autonomous production units,
- Collaborative relationship between departments,

- Strong communication links between the groups, including informal and personal communication,

- Co-operative relationship between specialists (engineers, technician) and operators (workers).

Taking account of a desired decentralized organisational structure, requirements linked to teamwork, people's needs and motivations rather than ergonomic criteria alone, develops the technological dimension. Technology should:

- Make the best use of human beings by developing tools to support skills and competence,

- Allow group work by grouping machines and software to support planning, control and scheduling activities as a group responsibility,

- Support group autonomy by decentralized information, communication and transport systems,

The anthropocentric approach may be exemplified by ESPRIT-CIM projects 1199 (Human Centered CIM) and 534 (Development of a Flexible Automated Assembly Cell and Associated Human Factor Study), ESPRIT 2338 (Integrated Manufacturing Planning and Control System, oriented to develop a decentralized system architecture with emphasis on shop-floor scheduling) [6]. These projects have been multi-disciplinary projects covering the technical, psychological and organisational aspects, with the co-operation between engineers and specialists from different social sciences. They recognize that "the joint optimization of human and technical criteria is a pre-requisite to the development and successful implementation of technology" [7] Their aim is to improve economic results, as well as the quality of working life.

The development of an anthropocentric productive system, in accordance with human-centered principles, may be undertaken by implementing all principles in a complete system, using all the abovementioned elements, or by the introduction of some changes. The first case involves the shaping of new plants, whilst the second case requires modifications in accordance with APS principles. Such alterations may consist of the formation of

[6] KIDD, Paul: 1992. p. 37.
[7] KIDD, Paul: 1988. pp. 297-302.

working groups and/or “production islands”, task re-organization for their enrichment and de-centralization methods.

Models and methods are necessary to analyze and design integrated socio-technical systems and evaluate the relationship between people-technology-technology, based on interdisciplinary work and co-operation among technologists and social scientists. This interdisciplinary approach enables one to take into consideration the organisational structure chosen, users’ needs and motivations in the development of production systems.[8]

2. ADVANTAGES OF APS

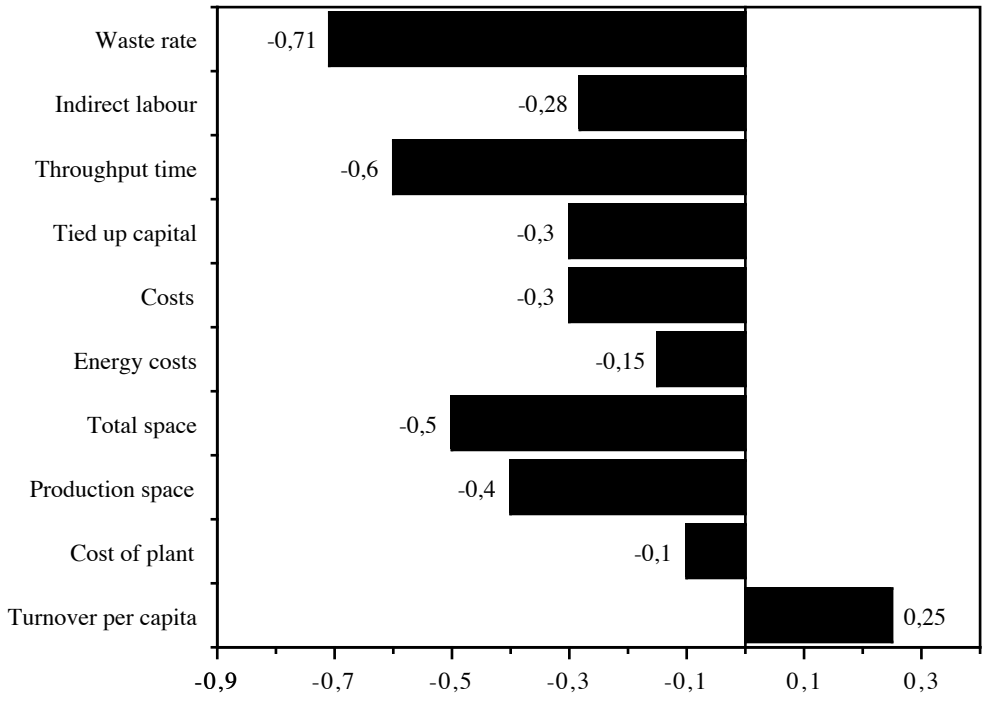
In a humanistic approach the promotion of APS is always desirable. However, we may well ask: is APS at present feasible in the context of the competitive imperatives of economic life?

The experiences reported in many studies show that the APS is not only a desirable model from a humanistic perspective, but can also lead to increased productivity, improved quality and greater effectiveness.

Market conditions have become unstable, very differentiated and extremely dynamic. Advanced technologies offer new opportunities, such as higher technical flexibility, a greater degree of quality and precision and the integration of different areas of activity. At the same time, people with a higher level of education and professional training expect jobs with enriched content besides participation possibilities in the decision-making processes. In this context the APS provides psychological, social and economic benefits. There are many case studies elaborated within the FAST Framework Programme that demonstrate the advantages of APS [9]. For example one German experience shows the following results:

Figure 2: Performance and anthropocentric production systems:

[8] KIDD, Paul: 1992. p. 37.
[9] cf. LEHNER, F.: , 1992. p. 47.



Source: Kidd, Paul: 1992. p. 47.

Some examples of Flexible Manufacturing Systems show the economic advantages of the application of APS principles:

Reduction in %	Freudenberg (D) case No. 6	Sealectro (GB) case No. 11	Felten & G. (D) case No. 19	Volvo (S) case No. 23	Lukas (GB) case No. 26
Lead times	80	50	50	80	55
Stock	15	45	50	50	50
Production costs	No data available	75	10	25	No data available

Source: Brandt, Dietrich: p. 40.

Among the **technical and economic benefits** one may consider the following:

a) improved quality (less rejects and flaws)

b) increased responsiveness,

c) shorter throughput times,

d) lower indirect costs,

e) easier planning and control of production processes,

f) simplified material flows,

g) smaller production areas

h) swifter response to quantitative and qualitative changes in demand,

i) less breakdowns,

j) increased capacity for innovation and continuous improvement.

Among the **social-human benefits** one may consider:

a) the increasing quality of working life,

b) higher job satisfaction through meaningful rewarding tasks,

c) higher degree of motivation and involvement,

d) greater personal flexibility and adaptation,

e) improved ability, creativity and skills of shop floor personnel,

f) enriched direct interpersonal communication and social relations,

g) increased collective and co-operative spirit,

h) greater capacity for collective learning of new practices.

We can thus conclude that within a flexible economy, APS may be regarded as a strategic answer to new economic requirements. Today, competitive advantages are gained from factors related to quality, flexibility, creativity and innovation.

The excellent results obtained by Japanese firms stem from organisational and human resource related factors [10]. According to Jaikumar's comparative study on FMS in the US and Japan metal sector, Japanese firms make better use of information-intensive technology than the US. firms. "With few exceptions, the flexible manufacturing systems installed in the US show an astonishing lack of flexibility. In many cases, they perform worse than the conventional technology they replace. The technology itself is not to blame; it is management that makes the difference. Compared with Japanese systems, those in US plants produce an order-of-magnitude less variety of parts" [11]. The US firms use FMS for the high-volume production of a few parts, whereas the Japanese firms use it for high-variety production of many parts at lower per unit costs.

Comparison of Japanese FMS studies in US. and Japan

Results	US.	Japan
System development time (years)	2,5 to 3	1,25 to 1,75
Number of machines per system	7	6
Types of parts produced per system	10	93
Annual volume per part	1727	258
Number of parts produced per day	88	120
Number of new parts introduced per year	1	22
Utilisation rate (two shifts)	52 %	84 %
Average metal-cutting time per day (hours)	8.3	20.2

Source: JAIKUMAR, R.: 1986. 70.

The performance disparity was mainly due to differences concerning the workforce's level of skill and type of work organisation. In US firms, management mastered the production system on the principles of scientific management. Here skilled blue-collar machinists were replaced by trained operators whose tasks were specified by management. The operators did not have the discretion to change procedures. In Japanese firms, highly

[10] Although the productive systems developed in Japan are in some key areas similar to anthropocentric system, as we shall mention later, in view of their specific features, they are regarded as "lean production".

[11] JAIKUMAR, R.: 1986. p. 69.

skilled people with multi-functional responsibilities work in small teams. Operators on the shop floor can introduce programming changes and are responsible for writing new programs.

In the "lean production" model the emphasis is on the relations between the firm and suppliers and customers. In the APS model the emphasis is above all on internal competence and the achievement of functional flexibility, qualified versatile people. In the "lean production" model, technology is accepted piecemeal whereas, in the APS model, technology is specifically adapted to peoples and organisational needs.

The so-called Japanese "lean production" model is in some aspects similar to that of APS, differences do though exist:

Comparison of APS and "lean production"

Characteristics	Lean Production	APS
Aims	Increasing productivity, industrial modernization, based on human resources and organisation	Same
Qualifications	Training	Education/training
Technology	No need for a specific technology	Technology should be specifically adapted
Organisational principles	Organisation of business , plant and shop floor	Organisation of plant and shop floor
Organisation	Work in groups, integration of groups, complex tasks, responsibility at execution level, collaboration between different departments	Same
Volume of production	Volume of production close to large batch production	Small batch production in small series close to prototype production and large series production
Industrial sectors	Automobile	Mechanical engineering and related industries
Professional relations	Leadership	Participation

Source: WOBBE, Werner: 1992., p. 49.

The advantages of APS systems are evident though this model cannot be universally applied. Many factors must be taken into account, such as the type of production, firm size, type of organisation, power relationships, management practices with regard to human resources, existing skills and social competence, etc.

The APS model may be particularly appropriate when the level of product variety is high, and the level of quantity is low (prototype and small batch

production), and/or when high standards of development and social needs are called for.

The diffusion of APS can lead to an increasing level of quality of working life of people who have jobs. But it is necessary to have awareness about the limited effect of APS in the quality of life in society as a whole.

The APS promotion does not solve the unemployment and precarious job problems. The diffusion of APS can co-exist with the increase of unemployment and with the precarious jobs.

3. CONDITIONS AND PROSPECTS FOR HUMAN-CENTRED SYSTEMS IN PORTUGUESE MANUFACTURING

As in the case of Southern Europe, it is only since the beginning of the Sixties that technological development took off in Portugal. However, this region of Europe remains one of transition, and its characteristics were maintained during the Eighties [12].

Between the 60 s and 80 s, peripheral industrialisation and technology dependency models have become as appropriate to this European region, as well as to East Asia and the Pacific, besides the Latin American region. The Portuguese manufacturing industry is characterised by the following **inherited socio-economic aspects** [13]:

- Late industrialisation (particularly in the '70s following EFTA membership).
- Specialisation, based on labour-intensive sectors using low cost labour, which allowed traditional industries (textiles, footwear, apparel, canned goods, beverages, etc.) to become competitive.
- Low degree of technology level and technological dependence of industrial firms, associated with a scarcity of senior technicians.

[12] cf. MONIZ (1986b, 1989a) and SANTOS (1983); one can be also mention the report on microelectronics in the Portuguese manufacturing made in 1983: CRAVINHO and FERNANDES (1983).

[13] Issues based on the following texts: LNETI/MIEE (1983), RAO and RODRIGUES (1983), CRAVINHO and FERNANDES (1983), OECD Report (1984), CONSTÂNCIO, PIMPÃO and CARVALHO (1984), HILL (1983), MONIZ (1986b), KOVÁCS (1987b), KOVÁCS, STEIGER-GARÇÃO and MONIZ (1987), etc.

- Lack of highly qualified manpower and adequate education and training system.

- Poorly organised and coordinated industrial system (insufficient development of inter-industry relations and of sub-contracting);

- Lack of economic dynamism, rooted in the traditional corporate model, weak entrepreneurial capability and relatively strong state paternalism;

When updating Portuguese industry, in terms of technology and organisation, these characteristics must be taken into consideration.

The following trends have been detected by recent studies and surveys on **technology** and **changes in work organisation** :

Since the late 80 s, there has been a more intensive use of new technologies within Portuguese industry. Recent survey results indicate a **more extensive diffusion of new technologies**, mainly where they have already been largely applied, especially in computer aided design, quality control, machining and administrative/financial management computerisation.

The percentage of firms using **new forms of work organisation** in an articulate way is small (some 20 percent) [14]. The most commonly used forms are job rotation and multi-skilled working groups. The new forms of work organisation to be implemented in the near future are quality control circles and task enrichment. Self-managed teams are the least favoured of these new forms.

There is **no single evolutionary trend in work organisation**. In some cases a *trend towards specialization* was observed, i.e., a rigid division between conception of tasks, programming, preparation, maintenance and performance, reveals a marked distinction between functional and workshop services. In the case of metal industry firms, skilled workers were demoted to operators (after an on-the-job fortnight training period), or hired from outside, thus bypassing existing workers.

In the textile firms analyzed, mainly in the wool and weaving sub-sector, work organization is strongly Tayloristic. Automation has reinforced the fragmented routine nature of the tasks. Workers display salary attitudes towards work, i.e., they attach greater importance to wages, job security, physical working conditions, and a good relationship with their colleagues, than initiative, responsibility or learning opportunities. They are also more

[14] MONIZ, A.B. (1989b), pp. 142.

receptive to productivity bonuses, and are not in favour of job enlargement or task enrichment.

In other cases, there is a tendency towards a *vertical and horizontal flexibility* (operators create simple programs and/or participate in the making of more complex programs) or in further cases there is a move towards *horizontal flexibility* (operators perform tasks involving maintenance, quality control, repairs). This situation may be found in small batch and prototype production. The hierarchy of attitudes is opposed to that of the Tayloristic model. Operators attach particular importance in work to initiative, responsibility, possibility of learning skills, sharing a good relationship with colleagues. These attitudes can be found where there are relatively high wages and the firm's economic situation is healthy. In this segment of enterprises the situation is more favorable for the implementation of anthropocentric automated systems.

Following data analysis of sectors receptive to automated production systems, and the underlying management aims behind this one is led to conclude that firms which are more geared to export, including the metal sector (with no Tayloristic traditions) are those that innovate technologically and organisationally. This also means that enterprises that are more integrated in global markets have greater capacity to operate in an internationalised economy. The present position of the Southern European economies is one of integration in this internationalization.

Despite the provisional nature of current assessments, it is evident that in such an area of flexible production, qualitative advances are expected in Portugal in the 90s. The automation will erode any slim advantages based on still existing low labour costs. This argument is not only founded on the final cost of production, but also very often on quality levels and their control made possible by more up to date processes. It is a foregone conclusion that "handicraft" methods will be eventually replaced by a more rationalised production system. But such methods will inevitably be important for APS integration and development.

However, the issue is what type of rationalisation. In the case of the metal sector the characteristic principles of a "craft system" have been maintained - varied tasks, initiative and autonomy of execution and the use of tacit skills - peculiar to prototype construction. Nevertheless, in some cases a change is foreseen with the separation between the spheres of programming, preparation and operation, and the polarisation of a skill structure. The awareness of such firms to the advantage of developing from a professional, no-taylorist system towards an anthropocentric system is quite important, as is recognition that the human factor is the heart of

competition. One must however, beware of any disfunctioning and inherent prejudices of Taylorist rationalisation.

Due to the type of work organisation, the labour culture, and the workers levels of skill, specially in small batch and prototype production, there are moor favorable conditions for the development of anthropocentric production systems in the metal sector than in the textile industry, where firms with a more advanced technology have a Taylorist work organisation, a workforce whose level of qualification is low and are primarily motivated by salary.

Alone with Southern Europe as a whole, the social and economic structure of Portuguese industry, peripheral industrialisation and technological dependence has prevailed over the last twenty years. This might continue to push Portugal towards a specialisation on labour-intensive sectors. Among obstacles to the development of anthropocentric automated systems, we should stress the following:

- Continued authoritarian hierarchic relations, and poor human recourses management;
- Inadequate institutional and administrative structures (non-existing or low degree of consensus relative to strategic decisions, excessive regulation, rigidity);
- Lack of skilled workforce and technicians,
- Relatively low educational level of the workforce;
- Defensive employer and union strategies, low level of trust in industrial relations, lack of dialogue.
- Strong influence of a techno centric perspective of modernization.
- Insufficient diffusion of new forms of work organisations and participate management methods.

Effective application of a global industrial strategy could solve some of these problems. The inexistence of such a strategy means adverse shortcomings in employment, training and qualification structures. Thus it is impossible to foresee a radical transformation of the labour market following dissemination of new flexible production systems.

The lacks of qualified personnel and of adequate professional training have been, and continue to be one of the most problematic factors, not only in

technological innovation but also in a more effective utilisation of transferred advanced technology.

At the same time, the Portuguese trade unions have not as yet shown much concern for the problems of introducing new technologies, and they have no strategy for tackling this issue.

One the other hand, there are also some favorable conditions for the implementation of APS systems in sectors and firms with no Tayloristic traditions. In such cases it is possible to develop existing organisational characteristics such as flexibility, co-operation and autonomy at operational level. Besides, survey results show that, work organisation is one of the critical issues facing employers and top management [15]. A substantial number of firms is trying to survive by the strategy involving the reduction of labour-cost by resorting to precarious job forms. However, there are innovative firms too, which are adopting a new form of rationalisation aimed at valorising human recourses. For these firms a flexible work organisation, higher skill levels, multivalence and adequate vocational training are strategic factors.

4. CONCLUSIONS

Diffusion of APS at European level requires changes in existing research programs. There should be a greater emphasis on the human and organisational factors rather than on technical considerations. Education and training programs should be reoriented towards human-centered strategy.

The human-centered orientation for industrial modernization can also be adopted in a less industrialised country, like Portugal. The APS is not a new specific model for advanced European countries only. This orientation can be particularly recommended in sectors and firms with no Tayloristic traditions. Whilst, in a Taylorised sectors and firms many obstacles must be overcome.

Therefore is we feel it is imperative to prepare an industrial strategy within a development plan to serve as a point of reference for economic agents' decisions and specific policies (namely for scientific & technologic, employment or vocational training policies) in order to make these policies

[15] cf.: KOVACS, I.: 1990, pp. 157-175.

coherent. A strategy designed to raise the technological level of Portuguese industry must take into account the following:

a) Modernization of traditional industries, to ensure they remain competitive and become coherent on the strength of quality requirements and flexible specialization;

b) Increase in technological level through more advanced technology transfers (and not just the more mature ones offering less risk factors), not forgetting the development of endogenous growth capability and the increase in the assimilation capability of more advanced technology, and specially of APS;

c) Participation in co-operation at EU level (ESPRIT, EUREKA, BRITE, RACE, COMMETT, etc.), in the development of new technical systems for the creation of new growth centers leading to reduced Portuguese dependency on equipment, foodstuff and energy sectors;

d) Experimentations supported by Public Programmes to promote APS in mixed capital enterprises;

e) Training programs for and dissemination of publications (books, booklets, videos, and reports) among the social partners on APS themes;

f) Training programmes for all who are involved in the labour world must include the human and social issues of production.

On the other hand, in view of the absence of a coherent financial policy supportive of research (which restricts the role of R&D government agencies), the more active groups in this area of flexible automated production. Should also to take part in European projects, where the Portuguese companies participation have been weak. It is therefore necessary to raise the level of R&D to match APS technological requirements through local development efforts. If such efforts are not combined with some commercial strategy, there is a risk of poor results.

State administration must show determination in supporting laws designed to establish a basic framework of participation and co-operation between entrepreneurs and the work force, promote programs to facilitate technical refresher and training, and also to relocate workers affected by technological advances. In the same way, experimental programmes should be introduced to innovate management techniques in mixed capital en-

terprises. Company managers and union leader feel it is indispensable to define a development plan at national level.

Implementations of structural development programmes, such as PEDIP, are, in some ways, an interesting strategy that permits the social actors to participate in most of the projects.

Finally, there is an urgent need to carry out empirical research on the socio-economic consequences of Tayloristic-technocentric systems (hidden costs of absenteeism, lack of quality, etc.), and to discover new organisational forms; specially those derived from or which facilitate implementation of anthropocentric automated production systems. Essentially, this implementation requires the knowledge of the socio-cultural reality of the industrial environment. The lack of innovative experimentations, also explains why new forms of work organisation are poorly known besides the fact that motivation and the human factor have not received the attention they deserve.

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