6th FWP : Synergies between Improvement of working conditions and EU Enterprises performance

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Risk prevention should be (wishes to be) a full partner in the development of European society in the 3rd millennium. To do so, several important observations can be made that take industrial and societal reality into account on the one hand, and the evolution of these realities that results from improvements in the bonds between industry and research that seek to maintain and develop the competitiveness of the whole of European Industry on the other hand.

The ever-stiffening competition of the world’s markets requires both multiple performance capabilities, and that industrial activities are not solely determined on the notion of cost-reducing strategies. In effect, different "parameters", based on the following key words (the performance list is not exhaustive), must be defined in the near future: performance quality, cost, delay, variety, innovation, recyclability, profitability, clean, integration, organisation, safety, security, working conditions, prevention, brand/public image, etc. Some of these measurable, or at least estimable parameters overlap or are complementary, but others are partially contradictory. Thus satisfying all of these elements represents a relatively recent balancing act - a balancing act that justifies the co-operative ventures between the industrial milieu and the sciences, with the latter including Human and Social sciences, Engineering Science, and naturally those areas science dealing with occupational prevention and more generally with improvement of working conditions.

This last comment illustrates the need for the integration of all different areas of interest in the acts of design, innovation and creations. Such an approach ensures the possibility of attaining a social and societal optimum, and avoids the use of well-oiled, stereotyped methods that depend on reflex behaviour. Self-imitation is probably an effective method of obtaining a response in the case where one exploits an existing reservoir of knowledge and/or uses. However, even if results are obtained by such means, this technique depends more on existing expertise than on a profound understanding of the process at hand, and the rapid technological changes in industrial processes that currently taking place make it necessary to re-evaluate, in concertation with those responsible for the new innovations, how things are done. In this context, it is necessary that an occupational prevention policy and improvement of working conditions (OSH\(^1\)) accepted by society - an idea that is obligatory in any civilised society - that stresses both the satisfaction of the "Client" and the "Producer" have the specific tools that it needs within the framework of the development of European Industry/Enterprise.

\(^1\) Occupational Safety and Health
Remark: time scale of the innovation process.

In the following background – where a reserve army of operators likely to fulfil the human needs of companies may well arise – certain individuals have made no bones about making use of this reservoir and the absence of full employment in order to achieve the maximisation of economical performance. As a result, the social consequences of this state of affairs are ignored whether they be in the world of work or in society at large.

Abstracted from its social context as it is, this vision of things nevertheless allows for the adoption of a framework of regulations which is ill adapted to understanding and controlling the complexity of the processes found in companies. The result is that there is either stability or regression in working conditions.

A company possesses its own regulatory systems, inertial processes comparable to the mentality of the man in the street. Hence, an initial consideration involves the notion of assimilation which is based on the success of a new concept (for example, the launch of new products on traditional markets, penetration of new markets with tried and tested products which have been merely adapted). Success can lead, where there is no rupture, to the stabilisation of modes of thought and action. The second element is linked to the notion of plurality which supposes that a new element (concept, product, process) cannot be assimilated unless it is integrated into an existing framework (generic aspect to technological rupture). The third corresponds to the notion of alignment which stipulates that the technical qualifications brought about by a change must not go beyond (training, hiring, technology etc.) the maximum cost already accepted by the company in other situations. Finally, the notion of transfer towards others (?) aims to maximise profit deriving from the initial effort involved in research and development. The time scale corresponds to about 10 – 20 years and needs to keep people in the firms in order to maintain or to develop the industrial performance: in this context, improvement of the working conditions is obviously a need for this purpose!

Then, these limits to developmental change are a part of regulatory processes allowing for adaptation. "Invention and dissemination involve two different time scales". To this end, a company needs to be able to rely on a body of associates allowing it to attain the goals imposed by competitiveness. In this regard, R. SENNET reminds us that "a regime which does not offer human beings deep reasons for interest in each other cannot preserve its legitimacy for long".
In the complex industrial environment, OSH can play many roles that depend on the nature of the society in general, its culture, and the characteristics of the enterprise itself (recent, traditional, large company, subcontractors, small business units, etc.). The type of activity (information, production, transports, etc.) must also be taken into consideration. The resulting complex structure must take into consideration the evolution of its industrial (technical innovation and changes in the organisation) partners in relation to demographics (ageing of the population, cultural modifications, migration, ...), and to sociological (communications and transportation, individualisation, safety, social acceptance of risks...) and psychological (societal image, mentality, attitudes, physical and mental loads, comfort) aspects.

All of these different elements cannot be entirely explained in the context of this initial reflection (nor will they be in a more detailed presentation given the multi-faceted nature of all of the different industrial disciplines and enterprises). Nevertheless, OSH can be developed along strong strategic lines in a generic sense. Such lines of development must be able to provide support for the industrial development of European society. As discussed above, the directions for development emerge from an existing knowledge base - how to improve the conditions of hygiene, safety and work in existing organisations. These directions will also determine the will to participate in the development of the European enterprise in the following key domains linked with innovation processes:

- mastery of Man-machine interactions
- prevention associated with environmental constraints.

Finally, in order to facilitate the reinforcement of the European economy, OSH must also rely on normalisation and certification. In a more evolved form of our future society, these operations will provide a better adapted working environment that is more close to the “zero-default” ideal.

Two pictures can be painted of the industrial society: one wherein engineers design machines and Humans must adapt to produce; and another wherein a machine is designed by Humans, with Humans and for Humans. This second futuristic vision that defines far-away images and goals to attain is built on the errors and successes of the first image. Because of this, there is a common set of problems for both concepts, and it is for this reason that the author of the current document prefers to limit the discussion to problems that are emerging from both situations.
1. Mastery of Man-Machine Interactions

In general, firms are developing their projects and production in a more and more integrated fashion, regardless of whether this concerns the design workshop, the organisation of the workplace (e.g. just-in-time processes) or communication networks. At the same time, there is a shift from production to services.

It is also becoming more and more accepted to integrate the human element at the very first stages of design. In this context, decision makers are associating technological research (where technology is supposed to invent techniques, ...), ergonomic aspects of machines, systems or human organisation, and research on human factors that play a role in the control and running of industrial processes, planning, management, communications, safety, etc.

Several related areas will arise from the current concerns of society:

1.1 - Organisation of production systems: an improved understanding of organisational know-how, the role of the Individual in production systems, communication in production systems, adaptation of production systems to new products, ...

In this relatively reduced schema, the system (hardware) is more or less imposed on us, and improvements are made based on working conditions that are better adapted to account for environmental and organisational factors. The operations to be carried out must therefore treat the operators not simply as users of the tools provided, but rather as people who participate in the improvement of working conditions in terms of the concept of how the process is used (software).

These factors can be then used to better manage aspects such as minimisation of inventories, quality, and reactivity/flexibility, that are imposed by the economical competition. Re-engineering can thus satisfy these demands by increasing the motivation of the personnel and, at the same time, by increasing mental load.

It is clear that these operations depend on new methods of making knowledge available, and on new representational and communication schemes that can be used to simultaneously alter aspects related to both production and working conditions in order to search for a global optimum in the operation of the process (remember that an innovation process necessitate between 10 and 20 years). In particular, it is important to consider problems linked to language and verbal exchanges since poor control in this area can be responsible for perturbations, or even accidents in today’s highly automated systems.
This area also includes the design of the work place, and the development of an “intelligent” organisational structure for the work itself (leading to association between the innovation processes and the OSH management system).

1.2 - Development of Safe New Production Systems that implies the development of software and safe materials, the definition of new monitoring and maintenance conditions, and the creation of safe new methods of automation from the initial stages of design. All of these developments are undertaken with the specific considerations of the mastery of the Man-Machine interaction, flexible workshops, process control, system ergonomics, alarm management, and simultaneous engineering in mind.

These different aspects all deal with the safe functioning of an installation and depend on the analysis of the modes of the appearance of faults, failures and perturbations, on risk management, and on the monitoring of the operation of industrial processes. They also deal with the new service-based society, including consultation, and the transfer of images and information to a more and more delocalised society.

Given the technical, financial and social limitations of an “auto-everything” process, it is necessary to master the combination of the intelligence of an automatic control system and human intelligence. A new science of "social engineering" that includes prevention should be created in order to develop new industrial models that are based on technical and financial knowledge, as well as on philosophies that are adapted to a new manner of distributing responsibility. If the goal of these models is to reduce the levels of complexity, they must reward types of behaviour that are adapted to both discrete processes and to continuous systems, and in particular to human decision making.

These new forms of organisation target, the necessary dialogue between the designer and the user, the competence of the operators (training,…), and the co-operation between the operator and maintenance people. They must be adapted to the culture and size of the enterprises in question.

In these areas, the processes of “safer designing” and of manufacturing are becoming more and more a collective effort, calling into play multidisciplinary operations, including computation, mechanics, automation, linguistics, psychology, ergonomics, the sociology of innovation, economics, management, … and prevention. The development of “groupware” that is used in co-operative group efforts useful to society must lead to the most delegation of responsibility as possible. It is based on the control of information and communication between partners.
In the context of the “safe” integrated design process discussed here, it is important to separate what we wish from what is possible by using not only socio-technical approaches, but also approaches based on socio-economics (micro- and macroeconomics) associating the social acceptance of risks for workers and citizens.

1.3 - Intelligent Machines.

More and more, technical research is becoming preoccupied with the development of intelligent machines designed by and for Humans, for use in robotics, interventions in hostile environments, co-operation with the user, the public, or the Individual in the work place.

The approaches discussed above targeted the decisional and operational autonomy of the machine. The basic objective is to help Humans including aged workers, which in turn leads to an interaction between Humans and the system which is based on system ergonomy and user-friendliness.

The applications in this technical branch in full development cover areas from the assisted driving of vehicles (about 50% of all occupational accidents are transportation accidents) to helping the handicapped and improving conditions in the work place.

This still-developing field must take all of the determining factors of human behaviour into account, as well as the control of cognitive and physical factors of fatigue.

2. Prevention and Environmental Constraints

2.1 - Clean and Safe Processes

Several new concerns come to light through the development of processes aimed at primarily environmental aspects. These are based on:

- repairing damage caused by the act of production,
- recycling materials,
- substitution of chemical products and materials,
- the reduction of the quantity of materials used for a given purpose,
- the capture, filtration and elimination of pollutants.
In these areas, the final consumers are still too preoccupied by their own self-interest to consider the dangerous nature and/or pollution of their products or manufacturing processes, and of their storage and transportation procedures and end use.

The public’s demands concern a quality environment in terms of chemical, biological, acoustic and other aspects. As such, enterprises must integrate a set of constraints in their economic calculations, in their organisation, and in particular, must modify their processes in order to satisfy social demands on both internal (prevention) and external (environment) levels.

From an industrial point of view, the basic demands concern the development of:
- innovative processes (that will compensate the advantages of new producers who benefit from more interesting cost conditions),
- the use of recycled material,
- new processes, the conditions of which determine the properties of the products being manufactured.

In terms of engineering science, such operations are based on the use of good process models that include knowledge from chemical engineering, combustion engineering, industrial chemistry, materials science, etc..., and on the use of new non-invasive measurement and investigative techniques (on-line control, quality control,...).

Epidemiological knowledge of the physical risks and toxicity of different substances is very important in the stimulation of research for alternative processes. This means that it is necessary to explain - as rapidly as possible - the cause-effect relationships. Also, the satisfaction of the demands in this area include the ability to perform local measurements, knowledge of the toxicology of products and materials (low doses effects, long-term effects, …), new processes and economic criteria, information of the public, …

It is on this basis that clean and safe processes must be developed. The durability of this approach must be associated with the positive image of European businesses.

2.2 - Polluted Environments

In juxtaposition to this vision of a world living next to clean, safe factories, there is the existing situation of polluted environments that has led to the creation of units for the transformation and/or elimination of toxic products. This new industrial branch (e.g. asbestos or subsidiary fibers, polyanromatic hydrocarbons, industrial waste, recycling of materials,...) requires the particular attention of those involved in health and safety, who must play an important role in the definition of such processes (coupling between environmental and OSH problems).
The idea of recyclability is associated with these preoccupations. The “recuperation” of a material presupposes that it is well-known in terms of its chemical and mechanical properties, etc... In fact, one experiences a loss of the desired properties with each step, and risks can be created by unforeseen transformations and by the eventual creation of poorly controlled waste matter.

2.3 - Evolution of Production Systems

This other part of the industrial domain is that dealing with the evolution of production systems and is associated with maintenance and with the ageing of materials - both of which are problems to be controlled though prevention.

In addition to the monitoring of process operation using continuously operated or periodic controls (non-invasive controls, sensors, robotics), methods of analysing failure modes must be developed. The “zero-fault” goal should be replaced by “fault-tolerant” systems through the use of the diversity of communication techniques, protective systems, and validation testing (from causality to low probability). In the systems engineering approach evoked above, it is also necessary to be able to simulate risks in order to identify the consequences of events that occur very suddenly.

Furthermore, and from a technical point of view, maintenance also depends on "good" training of personnel in the “cleanliness of systems”.

However, pushing systems to their mechanical limits can lead to non-linear behaviour that requires specialised modelling techniques. This can be the case in the event of constrained corrosion, and for the effects of the solicitation of strong mechanical, thermal, electromagnetic gradients on heterogeneous materials, etc. This type of “up-stream” knowledge must be able to be used in prevention.

3. Technological Modifications and Social Constraints

3.1 - Certification and Economic Development

In most of the countries in the world, “traditional” industries constitute the major part of the gross domestic product (GDP) of a nation. “High Tech” firms represent only a small portion of GDP, but are very important to the reputation, or image of a country.
There are many reasons for this, often associated with the inertia of what already exists, mental habits and barriers, the fickleness of the financial markets, as well as delays caused by normalisation, standardisation and certification of machinery, processes or products.

The goal of such technical and administrative steps is to protect the personnel involved, and it is desirable to rely of the capacities of professional evaluators who are capable of following (or even preceding) technological evolutions, even if this is only in the area of pre-normative research. Such steps have an undeniable economic impact through their direct link with the market.

The association of scientists, evaluators (OSH, environmentalists,…) and producers is one method of promoting a specific knowledge base that can be used to create an economic market through the manufacturing of high quality products in a relatively short time.

3.2 - Evaluation of Risks and Economic Development

There are typically several interacting sequences at the heart of an existing production process. Classically this series of interactions is the most fragile link in the production chain, and the one that tends to produce ruptures in the manufacturing process, safety problems, etc.

The control, evaluation, and the hierarchical organisations of risks, as well as their integration in the management framework and thus into the culture of different companies is another element in the construction of "social engineering" - a discipline that also is geared toward the development of competitiveness\(^2\). In this context, one is assured a better understanding of risks due to a better empowerment and training of individuals (cultural resources), leading to improvement of the confidence of the world of work (and the public) on the better quality of life induced by innovation.

3.3 - Occupational Health

Research in the area of occupational health and safety includes the identification of risk factors in the work place (physical, chemical and biological pollutants and dangers), the development of models that explain the cause-effect relationships and that quantify the risks in the population of exposed individuals.

\(^2\) Competitiveness hear is to be understood in its broadest sense: the reinforcement of one’s capacity to anticipate the evolution of both technology and the market place, a more important association of social partners in the search for new forms of organisation in the work place, and increase in the added-value of products.
In this sense, the knowledge thus created is used to create optimal conditions for prevention, the modification of industrial processes and/or their implementation.

Such an integrated approach is justifiable on both the macro-economic and social/political levels (from mastering of risks to the precautionary principle application?).

4. Conclusions

The ideas evoked in this essay concern the development of concerted models wherein science and technology “better negotiate” with society. In this context, the OSH system is a strategic element in technological evolution - but an element that is not to be viewed as a pretext for a given system, nor as its guarantee.

The societal problems discussed here demonstrate the need for alliances between different areas of knowledge, ranging from process engineering, through integrated manufacturing and ergonomics, to “Human Integrated Manufacturing”. Such problems will only be overcome through a total mastery (!) of the links between products and production, production and organisation, organisation and Humans, Humans and systems, and producers and consumers.

In this multidisciplinary framework, those involved in the prevention of occupational risks are well-placed to consider and to enhance the human dimensions in manufacturing and transformation processes. They can thus do more than use the knowledge created “up stream” in specific areas of research, or suggest topics for such research, they can also (and especially) work in close collaboration with those involved in research in order to more efficiently satisfy the objectives of improving the competitiveness of (European) firms.

The European OSH system is thus a useful partner in the development of the European Economy.