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# Ergonomics Contributions to Company Strategy

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## **Ergonomics Contributions to Company Strategies**

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# Ergonomics Contributions to Company Strategies



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## ABSTRACT

Presently, ergonomics is associated with occupational health and safety and related legislation, and not with business performance. Therefore, companies perceive ergonomics as a "must" and not as a "want". In order to strengthen the position of ergonomics and ergonomists, we discuss the opportunities to link ergonomics explicitly to company strategies and business goals. Conceptual models are presented and examples are given to illustrate the present and desired situation. It is concluded that ergonomics has a clear potential to contribute to business strategies and goals. In order to utilize this potential, considerable changes must take place within the ergonomics community by moving from a health ergonomics paradigm to a business ergonomics paradigm.

## Keywords

Corporate strategy, human factors, business, management, paradigm shift, future of ergonomics

## INTRODUCTION

The value of ergonomics is beyond health and safety. This discussion paper emphasizes how --while maintaining health and safety of the consumers and workers-- ergonomics can add value to a company's business strategy to create competitive products and services.

For this discussion we employ the broad description of ergonomics, proposed by the International Ergonomics Association (IEA):

*"Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance."*

This description implies that ergonomics has both a social goal (well being) and an economic goal (total system performance), that ergonomics considers both physical and psychological human aspects, and that ergonomics is looking for design solutions in both the technical and the organizational environment.

## **The problem of ergonomics**

During the past 25 years, several authors have emphasized that ergonomics has a problem to be accepted in the business society. In an essay in a management journal, the sociologist Charles Perrow [72] argued that the problem of ergonomics is that there are not many ergonomists working in companies, that they have no control over budgets and people, and that they are seen as protectors of workers, for example not blaming human errors to the workers but to the designers and managers of the systems. Hal Hendrick, the former president of the International Ergonomics Association (IEA), wondered "Why it is that organizations with their strong need to obtain employee commitment, reduce expenses, and increase productivity, are not banging down our doors for help" [40]. He suggested that there are too many examples of bad ergonomics, that ergonomists –wrongly- presume that others are convinced of the importance of ergonomics, and that the benefits of ergonomics are not well documented. Another former president of the IEA, Martin Helander, listed seven common reasons that ergonomics is not implemented [39]. He noted, among other things, that people think that ergonomics is to design chairs, ergonomics is common sense, and that organizations first design the technical system and then consider ergonomics.

In a recent study with 130 certified European ergonomists, Breedveld [14] found that in particular the last reason is a major concern to ergonomists: ergonomics is considered too late in the design process. Major design decisions have then already been made, and ergonomics can only make some late adaptations and corrections. Then, ergonomics is experienced as a time consuming and costly activity. In such situations the potential of ergonomics to contribute positively to the design is obscured.

Managers do not consider ergonomics to be a discipline that can contribute to the business strategy and to reaching business goals like quality and productivity. From a business and management perspective, ergonomics is an alien discipline that is not embedded in the organization but associated with costs, sickness absence, disorders, pain, and the labor inspectorate. Ergonomics is not generally associated with organizational effectiveness.

Managers are not to be blamed for that. A review of articles in 97 business and management journals including popular journals like *Harvard Business Review* and *Fortune*, during a 10 year period revealed that in 90 journals (93%) no ergonomics paper at all was published [24]. In only 7 journals there were 10 articles on ergonomics topics. The content of these articles confirmed to readers that ergonomics has a limited scope (physical ergonomics). It can be concluded that ergonomists hardly ever write articles in business and management journals.

Despite the fact that the ergonomics research community has demonstrated convincingly that ergonomics can improve quality and productivity (see below), ergonomics is primarily seen by the business world as a health issue. Many ergonomics researchers and practitioners work on the basis of a health and safety paradigm. In many countries ergonomics is closely linked to occupational health and safety legislation. Discussions in the USA on OSHA's 'Ergonomics Rule' gave the general public and managers the impression that ergonomics is about work-related musculoskeletal disorders, and that prevention of these disorders is a heavy financial burden for companies. This resulted in debates on the costs of ergonomics measures and on the validity of ergonomics knowledge, and in explicit negative publications about ergonomics [81].

## **Direction for a solution**

In this paper we suggest a new direction for getting ergonomics accepted in the business community to enable the use of its full potential. We argue that the present situation, where ergonomics is linked to health and safety issues and is related legislation, is not desirable, and should not be the primary basis for applying ergonomics in organizations. Applying ergonomics solely to fulfill legislation is an *extrinsic* motivation for organizations. Then ergonomics is a "must",

and thus will not be fully accepted.

We further argue that in the desired situation ergonomics contributes to the primary strategy and business goals, and is embedded (internalized) in the organization. We consider 'strategy' as a useful connection point to internalize ergonomics, because strategy has top management priority and is normally intended to be broadly communicated and implemented in the organization. By connecting ergonomics to the specific strategy and strategy implementation approaches in the organization, ergonomics can be embedded, and its full benefits and potential can be employed early in the innovation and design processes. Organizations then have an *intrinsic* motivation to apply ergonomics, and ergonomics can create opportunities for improved system performance and healthy workplaces. In this case ergonomics becomes a "want", and is much more readily accepted.

However, ergonomics contributions beyond health and safety are not really understood, and are foreign ways of thinking in the business world. Therefore we argue that the desired situation can only be realized if ergonomics can show that it can contribute to company strategies. Thus, (top) managers and other stakeholders should know about strategic opportunities provided by ergonomics to reach core business goals. Simultaneously, improvements of the employee's quality of working life can be realized.

In this paper we will explore the relationship between strategy and ergonomics by presenting a conceptual model, which is illustrated by examples. We will also discuss the role of the ergonomist to link ergonomics to strategy, and give directions for future research.

## STRATEGY AND ERGONOMICS

### What is strategy?

In order to survive, companies must prepare for the future, by addressing the following questions [58]:

- who is going to be the customer?
- what products or services should we offer to the chosen customer?
- how can we offer these product or services in a cost-efficient way?

Answers to these questions are the basis for a company's strategy. When new customer segments, new customer needs, new products or services, or new ways of producing and delivering emerge, the company may want (re)formulate and implement a (new) strategy.

STRATEGY is a slippery term that, based on the writings of Mintzberg [61], can include the following types:

1. Strategy as PLAN – A chosen course of action (designed) intended to reach a goal. This Plan may be realized or not. Strategy as a plan is forward looking.
2. Strategy as PATTERN – A trend or tendency that *emerges* from company activities. Strategy as a pattern is looking backwards in time.
3. Strategy as POSITION – A 'location' (e.g. market position) relative to other companies. A 'position' strategy could be reached by implementing a plan or as a result of a pattern of action over time.
4. Strategy as POSE – A 'fake' position held in rhetoric in order to mislead opposition or customers.
5. Strategy as PHILOSOPHY – A mental/moral 'position' as an idea or concept by which action could be guided.

Most companies have an explicit strategy to reach certain business goals.

The upper part of Figure 1 shows a simplified relationship between the formulated strategy concept, its implementation and the business goals. The strategy concept and strategy implementation can be separate entities (for example if strategy is a PLAN) or can be combined (for example if strategy is a PATTERN). In this paper, strategy is the combination of 'strategy concept' and 'strategy implementation'.

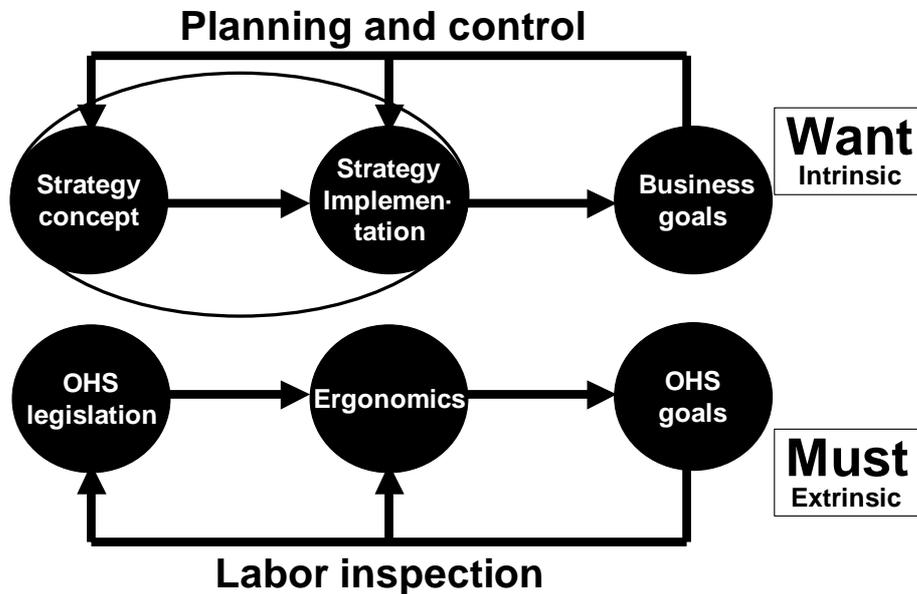


Figure 1. Upper part: The relationship between strategy (strategy concept and strategy implementation) and business goals. Lower part: The present isolated position of ergonomics. OHS = Occupational Health and Safety.

Several types of business goals can be distinguished. For the purpose of the present paper we consider three groups of primary business goals: the ultimate financial business goals (e.g. turnover, profit), and two groups of intermediate business goals to reach the financial goals: effectiveness (e.g. product quality), and efficiency (e.g. productivity).

Most organizations use the feed forward and feedback systems of planning and control cycles, including business plans, targets, evaluations, rewards, etc. to guarantee a good fit between strategy and business goals.

Ergonomics is usually not part of the primary strategy or business goals and related planning and control cycles. As argued above, ergonomics is considered as 'must', forced by legislation. This is shown in the lower part of Figure 1. In companies, ergonomics may be linked to occupational health and safety (OHS) goals, and to a company's obligation to fulfill OHS legislation, and therefore may be delegated to health and safety departments. Feedback can come from injuries, absenteeism, labor turn over, or ultimately from labor inspection.

The current trend in Western countries is to reduce OHS legislation and to stimulate voluntary action of employers and employees for improving OHS. With the current position of ergonomics linked to legislation (Figure 1), this trend can be considered as a threat. If the legal requirements are reduced, and ergonomics relies heavily on these requirements, then there is no reason to believe that companies start to formulate voluntary OHS goals and strategies, including ergonomics actions, to realize these goals. Hence, expecting that ergonomics, if framed in this way, will be a part of the voluntary strategy of a company (Figure 2) is not realistic – we call this 'dream ergonomics'.

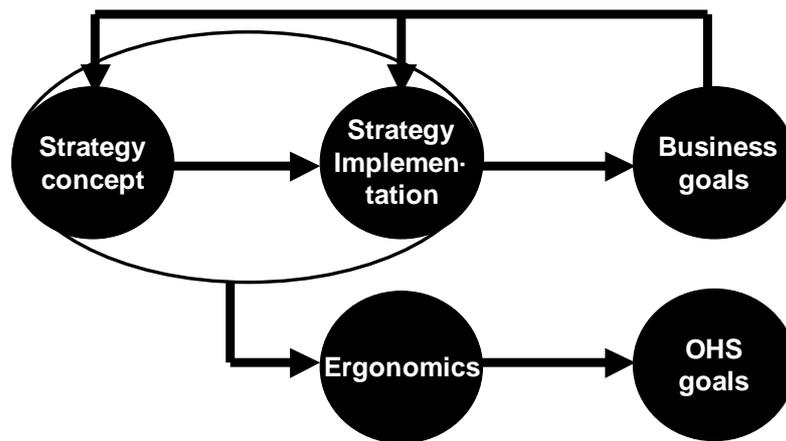


Figure 2 Dream Ergonomics: the unrealistic hope that ergonomics will be its own stream of concern inside the company.

Based on the IEA description of ergonomics, ergonomics has a potential to contribute directly to the business goals. This is shown in Figure 3 by the arrow from 'Ergonomics' to 'Business goals'.

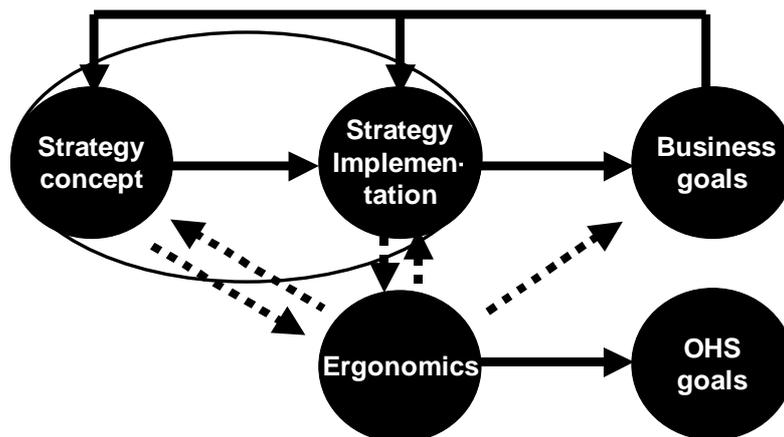


Figure 3: First step of linking ergonomics to strategy and business goals involves consideration of the relationships between ergonomics and strategic concepts, implementation, and business goals.

In order to stimulate the uptake ergonomics, without relying on OHS legislation, it seems necessary to explicitly relate ergonomics to strategy as driving forces for reaching business goals. This is shown in Figure 3 by the arrows from 'Ergonomics' to 'Strategy concept' and 'Strategy implementation'. If it can be shown that ergonomics is related to strategy, ergonomics will be considered as a tool to realize business goals as shown by the arrows from 'Strategy concept' and 'Strategy implementation' to 'Ergonomics' and from 'Ergonomics' to 'Business goals'. The trend to reduce OHS legislation is now an opportunity for ergonomics.

Therefore, the main question is how ergonomics can be linked to strategy. In order to answer that question, we first divide the general concept of strategy into more specific strategies, called here strategic arenas.

## Strategy arenas

To be able to focus more precisely on how ergonomics can be capitalized on within an organization, we split strategy into strategy arenas:

- 1) Corporate Strategy;
- 2) Business Function Strategies;
- 3) Cross-functional strategies.

Each strategic arena represents a different set of stakeholders that might have a stake in ergonomics. In the corporate strategy arena, the top management of the organization is involved, as well as external stakeholders including shareholders. Here ergonomics must show that it can add value to the corporate business strategy for realizing competitive advantage.

In the business function arena, depending on the business function, middle managers and the employees representing the business function will be primary stakeholders. Here ergonomics must show that it can support the chosen strategies, tactics and performance indicators of the functional field.

Cross functional strategies involve two or more business functions, and hence several corresponding middle managers and employees from these business functions will be primary stakeholders. Ergonomics must show here that it can add value to the cross functional strategies and tactics.

For each of these three arenas we will give examples of a strategy to which ergonomics could be linked, and we discuss opportunities for ergonomics to support the formulation or realization of strategies in these arenas.

## CORPORATE STRATEGIES AND ERGONOMICS

### Cost and differentiation strategies

According to Porter's classification of business strategies to create competitive advantage [73], two basic corporate strategies can be distinguished: a differentiation strategy and a cost strategy. In the differentiation strategy, the company produces and delivers products or services with unique features to attract consumers. In the cost-strategy, the company competes on the basis of the cost of the product or service.

In a differentiation strategy, user-centered products, created by ergonomic product design, can be such feature [25]. User-centered product design can help the company to reach competitive advantage. In a recent report on the competitiveness of UK technology companies [3], the UK government department of Trade and Industry urged companies to place people-centered design at the heart of their Research and Development and innovation activities, and promote a people centered culture throughout their organizations. Timely delivery, error free products, customer-friendly service interactions, can also create competitive advantage, with contributions from ergonomics.

#### Example: Differentiation strategy

An example of a differentiation strategy with user-friendly product is the development of ergonomics tools by AB Sandvik Saws and Tools (part of the Swedish Sandvik organization). In 1993 this company decided to have a specific ergonomic differentiation strategy to reach a worldwide leading position in professional hand tools [89]. Part of the strategy was an 11 step ergonomics product design approach, developed by Ergonomi Design Gruppen AB [11]. Hand tools developed in this way were introduced on the market as *Ergo tools*. After the introduction of the Ergo-tools, the results of AB Sandvik Saws and Tools in 1995 showed an increased market share in markets where the company had already a good position, whereas no effects were seen in new markets, including the USA. In 1999, AB Sandvik Saws and Tools was taken over by Snap-On, Inc. from the USA, and the name of the company was changed into Bahco Group AB.

In its annual report of 2001, Snap-On reports that the “new product introductions, such as (...) ergonomic Bahco hand tools, improved Snap On’s marketplace position”. The annual reports of 2002 and 2003 state that the “growing attention to ergonomics” is a “growth driver”, and that “a demonstrated innovation in ergonomics” is a distinctive competence”. In the annual report of 2004, ergonomics is positioned as one of the corporate values: “Our tools are designed with exceptional ergonomics”.

In a cost-strategy, a company competes on the basis of the cost of the product or service. By ergonomic design of the production system, including ergonomic job and workplace design, or human work elimination by mechanization or automation of inefficient, unhealthy or hazardous tasks, the costs per unit can be reduced and labor productivity increased. Reducing costs and increasing productivity is an on-going activity in most organizations.

#### **Example: productivity improvement**

An example of improvement of productivity by job and workplace design can be found at Famostar Emergency Lighting BV in The Netherlands. This company develops, assembles and sells indoor emergency lighting. The company was rapidly growing and wanted to redesign its assembly process to facilitate market growth [78]. In the old assembly process, a batch of parts were laid down on a table, and assembled and packed manually by workers who walked along the table. Finished products were placed manually on a pallet for further transportation. The batch-type of production was changed into a flow-type of production. Sitting workplaces were introduced, which allowed picking parts from boxes close to the body, and lifting equipment was installed to reduce manual lifting. Furthermore job rotation was introduced. After the changes labor productivity in terms of average number of products per person per day increased 69%. At the same time manual lifting load reduced from 129% to 51% of the maximum allowable load, the workers experienced a more complete working task, and the psychological work climate was improved. Overall, the results show that the assembly process was more productive and more human-friendly, although some nuances were also found.

#### **Resource Based View**

Even if ergonomics is not a primary tool to realize competitive advantage according to Porter’s model, ergonomics can contribute to fostering the potential of the human resources in the company. Based on the resource-based view (RBV) of the firm [7, 8] a company can outperform other companies by the way the company combines its technical, human and other resources. When people are considered to pose a key resource, it is important to use their capabilities and knowledge and to prevent its outflow by using ergonomics. The RBV attempts to reach sustained competitive advantage by choosing and developing resources that are valuable, rare, costly to imitate, and exploitable by the organization. By ergonomic job and workplace design, ergonomics can contribute to the maximization of the use of valuable, rare, costly and exploitable *human* resources, and hence to the maximization of sustained competitive advantage and to economic performance above normal.

### **BUSINESS FUNCTION STRATEGIES AND ERGONOMICS**

While there are many different business functions in a company to which ergonomics can be linked, in this paper we will briefly examine the functions of Product Design and Engineering, Production Engineering, Corporate Communications/Marketing, Human Resource Management, and Finance. In each case we examine the connection between ergonomics and the particular business function.

## **Product Design and Engineering**

Product design and engineering can benefit from the applications of ergonomics in both the design of the product for the end user and in design of a product that is easy to produce. The previously mentioned Bahco example illustrates the use of ergonomics as an avenue for gaining a unique market position – also interesting since it has potential to improve physical ergonomics for the professional user of the tool. All too often products are not designed to accommodate the physical or mental characteristics of the target customer [67]. Better design, with attention to the user, can result in more desirable products [87]. By linking CAD product design information with biomechanical models it is possible to evaluate the physical load of the user as design changes, for example in designing a car interior [52]. A product designed to be useable and useful to the customer can contribute to companies' differentiation strategy.

Design for Assembly (DfA), or Design for Manufacturability (DfM) [38], is an approach by which the ergonomics of assembly is considered in the product design stage. By considering production ergonomics in the product design phase it is possible to avoid all costs associated with corrective ergonomics processes, with little extra investment in the design phase. This objective is proving difficult to achieve although some signs of success here have been reported [62]. Ford, in its corporate ergonomics process, systematically identifies ergonomics problems observed on the floor and directs them to product design teams so the problem can be designed-out of future models [44]. Such a feedback approach can support learning amongst the design teams. Sundin et al. [83] have combined participatory ergonomics approaches with virtual visualization techniques to test and improve product designs. They claim such techniques can both avoid costly health problems in production and can lead to improved production efficiency.

## **Production Engineering**

In a recent review of 260 papers on manufacturing strategy no mention was made on how any aspect of production strategy might affect production operators [19]. Nevertheless, this review did identify a number of papers acknowledging the contribution of human resources to manufacturing performance. The production engineering business function, which may in turn include several other business functions such as logistics and pre-production engineering, determines the work tasks of production operators and its distribution over the working day – essentially defining the ergonomic conditions of the system [64].

From Adam Smith's first recognition of the strategic importance division of labor [82], through to Taylor's scientific management strategies [85] industrial work has become increasingly repetitive and monotonous. The resulting problems of demotivated and injured workers have long been known. Henry Ford, the first to apply Taylor's principles, was forced, in 1914, to adopt a 5\$ workday in order to overcome the 370% operator turnover caused by the poor working conditions in his early line productions [77]. Studies of more systems indicate increased health risk associated with serial flow production strategies [32, 69]. On the positive side, Kadefors et al. [45] found that ergonomics improved in the application of long-cycle parallelised assembly flow strategies with, it is argued, superior performance [30]. These examples illustrate how production engineering influences ergonomics through strategic design decisions.

Automation is another strategy by which performance may be increased and exposure to repetitive monotonous work decreased, apparently a double win for ergonomics and productivity. However, examination of specific implementation of automation has observed tighter coupling of operators to the machinery with increased physical risk as a result [18]. It is important therefore to attend to the tasks remaining for operators, not just the tasks that are automated away [65]. It is difficult therefore to generalize on the merits (or their lack) for a specific strategic component since the implementation of a strategy (as we point out in Figure 1) is

so important – production systems can be seen as a collection of strategic choices each of which may modify ergonomics in the resulting system [64]. Success, we believe, lies in integrating ergonomics into the design process so that solutions optimal for both productivity and well being can be developed. This integration has been difficult due, in part, to the ‘clash of perspectives’ between engineers and ergonomists [46, 47].

### **Corporate communication/Marketing**

In marketing communication there is attention to product ergonomics and production ergonomics as a potential competitive benefit that can be communicated to the customer. With respect to product ergonomics, positive product characteristics of ergonomically designed products like functionality, usability, health and comfort, can be communicated to the customer. With respect to production ergonomics, similarly to ‘fair trade’ products the communication may target the aware consumer. A barrier with respect here remains the extent to which consumers are prepared to differentiate products based on the working conditions of their manufacture, and the extent to which credible information on the working environment is available.

Ergonomics can present a part of a company’s ‘corporate social responsibility’ and ‘corporate sustainability’ platforms [37] in a society that is placing increasing demands on companies to be more than money making organizations. Thus the advertising of ergonomics as part of the ‘harmless product’ or ‘harmless production’ campaigns [84] can offer the potential consumer a better product, made in better working conditions, for a better world.

On the negative side, we see that companies try to avoid negative communication about the company and its products. Negative publicity related to poor working conditions have haunted the shoe industry, and child labor scandals have rocked the family entertainment industry.

### **Human resource management**

Good working conditions present one strategy for attracting and retaining high quality employees. The need to attract people to manual assembly jobs in Sweden was one of the driving forces of production system innovation away from traditional Tayloristic line production toward new more productive and attractive solutions [29]. Human Resources Management (HRM) departments have long been held responsible for employee welfare, even though they tend to have little responsibility for work system design. The gap between human resources and operations management (OM) has been noted and presents a challenge for the design of work systems that are motivating and productive [12].

While many HR strategies exist we mention only ‘High Performance Work Systems’ (HPWS) as one of these that incorporates elements of involvement and employee empowerment consistent with existing ‘participatory’ ergonomics approaches [68], as well as job design [22]. HPWS have shown themselves capable of increasing organizational performance [4, 20, 74, 88], but appear to operate on the HR side of the HR-OM gap. Ergonomics could make the link here.

### **Finance**

From the perspective of the finance business function, it is perhaps most obvious that poor ergonomics can lead to higher direct and indirect costs. While the direct costs due to sickness absenteeism may be known explicitly in this business function, the indirect costs due to productivity loss as a result of unfavorable working conditions, are possibly even larger than the direct costs [51, 59], but are not generally measured. Strategically, finance needs to know that returns on new investments will not be compromised by poor ergonomics.

Ergonomics can also directly contribute to a company’s financial position. Many

case studies have shown that investments in ergonomics improvements are financially beneficial on the short term [1, 9, 17, 33, 40, 41, 49, 50, 56]. Also on the long term ergonomics can have considerable financial benefits [54].

Ergonomics can further contribute the concept of 'organization's commitment to its employees' (OCE) and through that approach improve the financial performance of the organization [60].

Finance is also concerned with the company's external investors. For investors wanting sustained growth over the long term, not just high quarterly returns, ergonomics represents one way the company can demonstrate to potential investors that the company has a long term view of its processes and its profitability. Work environment reports, similar to external environmental reports, are one approach being used to demonstrate a commitment to long term profitability to investors [36]. Thus ergonomics can supply financial gains, beyond cost reduction and performance enhancement, by a strategy of attracting investors interested in long term sustained profitability. Ergonomics can, through its previously mentioned contribution to a company's 'corporate social responsibility' platform, even serve to attract investors concerned with the social effects of their investments.

While this is not a complete list of all business functions that may exist in a particular organization and to which ergonomics can be linked [25, 28, 66], these examples serve to point out the range of business functions and its stakeholders whose objectives can be furthered by the application of ergonomics.

## **CROSS FUNCTIONAL STRATEGIES AND ERGONOMICS**

We identify 'cross functional' strategies as a separate aspect of strategy due to the large scope and complex dynamics of strategic processes that span several functional domains. Concurrent engineering poses a simple example in which the activities of product and process (production) design occur simultaneously and interactively [6, 13, 57]. Concurrent engineering creates the potential to adjust the product design so as to improve ergonomics in production which can, in turn, improve system performance [38].

Most of the common and well known management models, fads and hypes fit into this cross functional category as well. Lean Production, Business Process Reengineering, and Downsizing is a group of strategies that have been critically received by some ergonomists, whereas Total Quality Management and the Service Profit Chain have received more sympathy. All of these strategies include a broader strategic concept affecting different functions in the organisation, usually accompanied by a specific set of tools to implement the strategy. For these strategies to be successful several business functions must work together to realize an effective implementation. The potential of ergonomics to contribute to each separate business functions (see above) may serve as a tool to bridge and integrate business functions.

### **Downsizing, Lean Production, Business Process Reengineering**

Studies on the ergonomics and health consequences of some negatively perceived cross-functional strategies (Lean Production, Business Process Engineering. Downsizing) have been reported in the ergonomics and OHS literature. Vahtera et al. [86] have found risk of musculoskeletal disorders to increase by 5.7 times during 'corporate downsizing'. The individuals' perception of the downsizing process itself also appears to affect health [48, 71]. Landbergis et al. [53], in their review of available literature, noted increased negative health outcomes are often associated with the adoption of Lean Manufacturing approaches. In a longitudinal study implementation of lean production was shown to result in job depression and reductions in job control and skill utilization [70].

While it is tempting to look at these results and say: 'Strategy X is bad ergonomics', this is perhaps not the right conclusion. As our model (Figure 1) points

out. strategy includes both a concept (in these cases as a strategy *plan*) and its implementation. The extent and the way to which a strategy is realized in practice may vary [2, 35, 90], with the gap between strategy and practice being apparently a more important indicator of (poor) performance than the strategy itself [79]. It is difficult therefore to determine the ergonomic consequences of production strategies directly without considering the specific implementation for each case. There may be a gap between the strategic concept and its implementation that is leading to poor ergonomics and compromising the effective realization of the strategy.

Nevertheless, one can suppose that some cross-functional strategies have better potential for good ergonomics than others. It has been suggested that some production strategies, such as business process reengineering, may provide better potential for good ergonomics than other strategies, such as lean manufacturing [10, 26]. If the potential of a strategy is to be fully realized, then it may be important to understand the various elements that are included in a particular strategic 'bundle' and how these elements may interact to affect ergonomics and consequently system outputs. We argue that failing to incorporate ergonomics in the design and implementation of a strategic package can greatly compromise the effectiveness of the system and the well-being of the work-force.

### **Total Quality Management and the Service Profit Chain**

Total Quality Management is a general term for improving business processes by incremental improvements, involving 'all' employees and 'all' business functions. For the implementation and management of this strategic concept, specific tools can be used. Many European organizations use the EFQM model (European Foundation for Quality Management), which has a Resource Based View on quality [80]. In this model 9 criteria for quality are considered including two for people (people enablers and people results). Eskildsen and Dahlgaard [31] showed that people enablers (e.g. HRM practices) leads indeed to people results (e.g., job satisfaction). We can expect that ergonomics can be readily applied as a people enabling approach, and therefore can contribute to people results and total quality. Quality has become an important competitive domain [35] that has been seen to have links to ergonomics [16, 23, 27, 44]. According to Drury [23], "Quality is a function of technological and human factors, and is greatly influenced by ergonomics in its broadest sense. Errors in the process can result in product unreliability, poor productivity or even injury to the workforce or product user". A number of empirical studies appear to confirm this view. Lin et al. [55] found that 50% of the quality variance in the production lines studied was accounted for by a combination of the time required for the task and postural deficiencies. Axelsson [5] found that jobs with poor ergonomics were 10 times more likely to have quality deficits than jobs with good ergonomics. In intervention research, Yeow and Sen [92] found a reduction of \$574,000 in rejection costs with less than \$1,100 in modifications and training which led to a 5.2% reduction in customer side deficits. Several organizational dynamics scholars have shown a renewed interest in the concept that "a happy worker is a productive worker" [34, 76, 91]. This concept may be particularly of interest for workers who are in contact with the customer during a service delivery. Heskett et al. [42] proposed the Service Profit Chain (SPC) model that relates employee satisfaction to customer satisfaction and further to financial performance of a service organization. This concept for service operations has been widely accepted (see for example [75]) and empirical studies suggest that the relationships between employee satisfaction, customer satisfaction and business performance exist if the employee-customer contact is more important [21]. Ergonomics can contribute to worker happiness and satisfaction, and therefore can contribute to the strategy concept of SPC. A recent multiple case study showed that managers in service based warehouses decided for ergonomics improvements because of the expected effect on customer satisfaction, and not because of health and safety [43].



stakeholders involved in the business planning and control, and in the language of the stakeholders: common business language, and not common health and safety language. Furthermore, the ergonomist could be active not only as an expert, but also as a 'Political Reflective Navigators', who is networking to convince stakeholders about the value of ergonomics [15].

The successful ergonomist (in research, education and practice) is aware of business strategies and business goals, knows who are main stakeholders, knows what are the benefits of ergonomics for these stakeholders, knows how ergonomics can be implemented to realize the benefits, can communicate with the stakeholders in their own language and networks. In other words the ergonomist is a real business partner.

It will take a long time before the situation depicted in Figure 4 is realized on a large scale. However, we believe that explicit linking of ergonomics to the strategy and business goals is the only promising way to realize growth and impact of the ergonomics discipline and its ergonomists in the business world.

Related to the model of Figure 4, two main research questions can be formulated:

1. How can ergonomics best be embedded into business strategies?
2. What is the contribution of embedded ergonomics to realizing business goals, while maintaining OHS goals?

Within these two main questions, many sub-questions can be formulated, for example related to specific strategies, implementations, business goals, and industries.

## CONCLUSIONS

Ergonomics can contribute to many different company strategies and can support the objectives of different business functions. The proposed linking ergonomics explicitly to specific business strategies and business goals, as suggested by the IEA description of ergonomics, remains a great challenge for the ergonomics discipline. For many ergonomists it means a paradigm shift, which requires a repositioning from health ergonomics to business ergonomics. By contributing to the shared goals of business performance, ergonomists will also be better able to reach their traditional health objectives.

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