Ergonomics and sustainability – challenges from global supply chains

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Abstract. The development of globalised supply chains is a major challenge for sustainability. For several years, there has been discussion within the profession whether and how ergonomics and human factors can play a role. Based on our research, we have identified five major challenges from global supply chains especially related to the social aspects of sustainability: (1) criteria for social sustainability, (2) the role of key performance indicators in the management of supply chains, (3) the constant changes in supply chains, (4) the challenge in establishing participation, and (5) the development of agency and regulatory mechanisms. There are obviously no clear and simple solutions to these challenges. One possible avenue for progress might lie in acquiring a greater understanding of the challenges from global supply chains and developing a strategy which combines social and long-term business sustainability. Starting from such a basis, the next step would be to find ways for the ergonomics and human factors community to create international collaboration which can impact specific global supply chains.

Keywords: Sustainability criteria; organisational change; participation; regulation

1. Introduction

One of the important trends in globalisation is the development of ever more complex international supply chains. Each unit controls only a minor part of the production of a final product, and activities are frequently reallocated to other units often placed in other countries. This development is a major challenge to sustainability. The more complex the chain, the more difficult it is to control the activities, which may leave regulatory gaps between different units in the chain [3]. The problem with the long and complex supply chain is further increased if pure cost reduction is the only driver for the supply chain. In this case, the likely result is negative impact on the sustainability of the environment, the social conditions at work, in the local community, and long-term business development. There is therefore a need to develop a stakeholder-oriented approach as an alternative to the dominant shareholder approach. Central in a stakeholder approach is integration of sustainability concerns in the development of global supply chains, and the question is whether and how ergonomics and human factors can play a role in this integration [47]. The challenge is to establish a valuable contribution which can build on the ethics of ergonomics, but also address and analyse the diffi-

culties created by the organisational realities in the practical world.

This paper discusses the challenges from global supply chains for the sustainability of ergonomics and human factors. We analyse the main challenges and discuss possible strategies for ergonomists for meeting these challenges.

2. Supply chains

In short, a supply (or value) chain can be defined as '...each step in the process required to produce a final product or service… Each step in the value chain involves receiving inputs, processing them, and then passing them on to the next unit in the chain, with value being added in the process. Separate units of the value chain may be within the same company (in-house) or in different ones (outsourced). Similarly they may be on the same site or in another location' [20]. Supply chains are normally based on a principal–agent relationship. To accomplish specified tasks, the downstream contractor (the principal) makes an agreement with the supplier (the agent). The agreement is typically based on a contract including agreement on the control mechanism(s) to be used. They typically focus on outcomes (price, quantity, quality, delivery

time), but also aspects related to the production process might be involved (e.g. quality control procedures to be followed).

Based on our research [12;14;15;24] and many years of collaboration with Danish enterprises, we have identified five major challenges from global supply chains especially related to the social aspects of sustainability, which we discuss in this paper:
1. Criteria for social sustainability
2. Key performance indicators (KPIs)
3. Constant organisational changes
4. Participatory approaches
5. Agency and regulatory mechanisms.

3. Criteria for social sustainability

Within ergonomics, it is evident that workers must be protected from occupational risks and have the right to experience well-being at work. But it is difficult to implement this normative value position in the practical functioning of a globalised supply chain.

To assess the level of sustainability, two definitions need to be specified [26]: firstly, the 'area of protection' has to be identified, and secondly, more specific criteria are needed in combination with a scale linked to each of them for assessing the present status. Focusing on social sustainability, the area of protection might be defined by the definition of health given by WHO: 'Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity' [46]. This broad definition opens up for several more specific criteria. These criteria and corresponding indicators are interwoven with the social and political situation in the country, region or culture. Two examples can illustrate this point. Well-being is closely related to the experience of the individual reflecting their expectations from the situation. Consequently, it is difficult to establish an 'objective' global indicator to be used in supply chains passing through different nations and cultures. Another example is child labour. In the European Union, child labour is official considered harmful for the development of the well-being of children. But in other cultures, the income from child labour constitutes an important contribution to the survival of the family, and a simple ban on child labour may be harmful to both the child and the family. There are therefore basic demands for the protection of children expressed by the UN [40], but the huge differ-

ences in the conditions for children at the national level make big differences in the way child labour should be handled. In some countries, it may be better to make systems which ban hazardous work for children [22], but which, for other types of work, provide benefits such healthy meals, educational programmes and health care programmes linked to the employment, rather than completely preventing children working.

Because it is difficult to establish a valid link between indicators, criteria and areas of protection, it is also difficult to establish a valid assessment of social sustainability in a globalised supply chain.

4. Key performance indicators

Key performance indicators (KPIs) are the central management instrument in the production units involved in supply chains. In a supply chain of independent enterprises, the KPIs are part of the formal contract, while in the multinationals they are embedded in internal – often contract-based – management of subsidiaries. Usually, only a small number of KPIs are at stake, with price, ability to deliver on time, and quality, as the most typical ones. A strategy for developing human-factor-oriented KPIs might be desirable, but also difficult to implement. Kristensen [29] has argued that the negotiating process behind defining KPIs opens up for local actors and their interests. Production managers in a subsidiary can follow a strategy of being the innovative production unit in the multinational enterprise. From this position, they might argue for specific KPIs related to human factors. This might open up for KPIs supporting social sustainability, such as skill development and employee participation.

But whether that happens is very much up to the downstream end-users (the principals), because it is difficult for upstream agents in the chain to influence the downstream principals. This problem is worsened by the lack of valid and simple KPIs for human factors that could be used globally across a whole supply chain.

5. The constant change

If a company in a supply chain wants to establish programmes that focus on ergonomics and thus on the social aspects of sustainability, the constant change many organisations encounter in globalised

supply chains is a serious threat to such ambitions. These changes have several roots: 1) Depending on the relationships between the enterprises in the chain, there might be frequent changes in suppliers and thereby replacement of units in the chain. 2) There are often changes in products and systems both up- and downstream in the chain resulting in organisational changes. 3) Subsidiaries of multinational corporations are often subject to changes in management, organisation and production philosophy, which require subsequent organisational change.

Experience from studies of change management shows that while getting new ideas on how to conduct work activities is rather easy, it is difficult to implement and install such ideas as normal practice [18;28]. The Unfreeze–Change–Refreeze approach to change [31] to introduce new practices is often considered too time-consuming and requires too much persistence from management.

The result is that most changes are carried out with a narrow top-down approach whether they are changes in the individual units in the supply chain or changes in the configuration of the whole chain [7]. Such changes may hamper the possibilities for implementation of ergonomic improvements, and even where improvements are successfully implemented, the changes may make the improvements more or less redundant because new changes remove the reason for the ergonomic improvement.

6. Participatory approaches

Participation has been a key point in ergonomics for years [21], and it is widely recognised that successful ergonomics interventions require the participation of employees, local management and other stakeholders. Effective participation meets many challenges in practice. There are important issues about the level of participation, the qualifications for participation, the power balance, and many more. It is thus no simple matter to achieve successful participation; it often fails, and much effort both in practice and in research has been put into the development of methods for participatory ergonomics [30;42]. A relatively large number of issues can be involved in participatory ergonomics and Haines et al. [11] (see also a review by van Eerd et al. [42]) have summarised these issues in nine criteria. We compare these criteria for the traditional organisation and global supply chains in Table 1. The comparison indicates that global supply chains create new constraints for participation, and eight of the nine criteria will meet various forms of additional constraints from global supply chains.

Table 1.
Comparison of the criteria for participatory ergonomics for traditional and global supply chain organisations

Criteria (Haines et al., 2002)	Content	Traditional organisation	Units in global supply chain
Mix of participants	From rank and file, to managers and specialists	Most participants in-house on same location	Key participants especially decision-makers and specialists located elsewhere, often in other countries
Requirement	Compulsory/voluntary	No particular difference	No particular difference
Involvement	Direct/delegated	Often direct	Direct is difficult due to difference in location
Decision-making	Delegation/consultation	All levels of participation possible	Delegation only possible for limited number of local issues
Remit	Involvement in process elements (PDCA)	Full process possible	Involvement in cross organisational boundaries difficult
Focus	Issue for intervention (from tools to organisation)	All issues possible	Involvement mainly possible for issues decided locally
Level of influence	Group, department, entire organisation	All levels possible	Involvement mainly possible for issues decided locally
Permanence	On-going/temporary	Participation on permanent basis possible	Permanent participation constrained by change of participants in supply chain
Role of ergonomist	Facilitator/expert	All roles possible	With limitations in interpersonal contact expert role more likely

The main problem is the geographical separation. Participation is most often facilitated by interpersonal contact where the actors involved communicate directly with each other. That is obviously difficult in a global supply chain. There is especially a separation between the actual producers (operators and local management) and the actors involved in strategy decision-making, which might be crucial for

local latitude. Local management, employee representatives and experts (for example within ergonomics and HR) will therefore have limited access to these key decision-making arenas [16].

Trust and more generally social capital [1] have only been touched upon very rarely in the literature about participatory ergonomics, but it seems evident that participation requires trust between the actors involved. Especially employees need to trust the basic intentions of management and ergonomic experts if they are to engage in participatory programmes [38]. The issue of trust seems to be of particular importance in relation to global value chains. Social capital between the actors gets challenged due to the frequent changes, the geographical distance, and the competition between the various units. Local actors will be dependent on, but at the same time have limited access to, distant decision-makers. They are therefore likely to scrutinise every move these actors make and as they try to decide whether they are to be trusted [38]. The level of trust will therefore be decisive for the local actor's decision to engage in participation. Suspicion towards distant top management and experts is especially likely when there is risk of the relocation of activities in the supply chain or important decisions are made without consultation with the local unit.

Social capital in cyberspace and virtual teams have been discussed in the literature [6;32;37]. This discussion has mainly concerned the identification of ways to increase social capital across physical borders and with groups who have well-defined joint work tasks, such as research or other virtual teams. It appears therefore to be possible to find ways to develop some degree of social capital, but it requires frequent contact and shared tasks. It is different with participation in ergonomic improvements in the workplace. Operators and first line managers do not have regular contact – not even on the internet – with experts and senior managers, and they do not have shared tasks, shared goals or mutual trust.

7. Development of agency and regulatory mechanisms

Some global supply chains are controlled by one large multinational corporation, which can take action on sustainability issues. For corporations that produce consumer goods, it might be especially important to take questions of image into account [13]. In situations without risk to image and no one

organisation dominating the chain, it will be difficult to make the issue of sustainability play any role in the decision-making process. In this case, an external agent is needed, but it is difficult to identify agents that are able to influence global supply chains. Such supply chains are anarchistic with no controlling centre, which makes it very difficult to control any sustainability strategy for the chain. This problem is also highlighted in the supply chain literature, e.g. in relation to product safety [33].

One of the consequences of globalisation which especially thrives in global value chains is that the most powerful actors in the value chain can move activities to locations with more favourable business conditions. Some actors may move activities to locations with less regulation of health and safety and other working conditions, and some governments may attempt to be more competitive by reducing the regulation of health and safety. The result is social dumping. This is one of the mechanisms behind deregulation, which is widely accepted as a consequence of globalisation [2;3] because it is difficult for individual countries to sustain regulations which make the national economy less competitive. The deregulation trend is significant but does not necessarily imply a race towards the bottom [41] because in some cases deregulation may have a positive impact on economic growth. Occupational health and safety is one of the issues which has been a target for deregulation and with more negative than positive consequences [35;36;43].

Even in cases where actors in global supply chains do not pursue a strategy of social dumping, the existence of the long and sophisticated global chain creates a risk of a regulation vacuum [3] because the exchange from one link in the chain to the next inevitably creates uncertainty and a possible lack of regulation. This problem is worsened in the case of health and safety because central decision-makers will often be located in other countries than the production units with the health and safety problems, and they try to control the value chain by KPIs which do not including human factors.

Furthermore, traditional regulation is often weak in addressing problems in one enterprise caused by decisions taken in other enterprises in the supply chain. [12;45] and the international regulation of client–supplier relationships is non-existent.

However, there are three international options which may open perspectives for transnational regulation. The first one is the establishment of international agreements and standards. Discussion has taken place at the World Trade Organization (WTO)

on measures against social and environmental dumping, but so far with little success. Another international organisation with perhaps more success is the International Labour Organization, which runs the international programme 'Decent work' and has a long tradition of preparing international labour standards that set minimum levels on a range of topics and which are being signed by still more countries, albeit in a long and rather slow process. However, the only instrument to control compliance with labour standards is the general public because there are no international enforcement agencies at hand. The most successful attempt in transnational regulation is at the European level. The European Union introduced the open market in 1986 and, to avoid social dumping, the Union introduced health and safety regulation with the 1989 framework directive which covers all member countries in the EU [44].

The second option is the application of international standards certified by an independent third party. The ever more complex value chains make it important to secure delivery from one link in the chain to the next. International certification is therefore becoming more and more important. It started with the quality standard ISO 9000 series in the early nineties, was followed by the environmental standard (ISO 14000), and in recent years by the OHSAS 18000 standard [5]. Although it is not an ISO standard, this latter has gained ground as a *de facto* international standard used by many firms all over the globe to document their health and safety management system [17]. Although there are a number of problems with such management standards, among others related to participation and paper systems versus real improvements [4;9], they do also have the possibility of becoming platforms for improvements [17].

Value chains dominated by multinationals often set their own standards and they may impose a cross national control [45], but such in-house standards are often focused on a rather narrow agenda on safety and accident prevention [8;19].

The third option is the growing interest in corporate social responsibility (CSR). One of the consequences of globalisation and IT-technology is the global flow of information and the possibility of very fast media focus on ethical problems, such as child labour or hazardous working conditions. More and more firms, especially multinational corporations, are therefore paying attention to CSR. They decide on ethical values, make CSR reports and make CSR demands on their suppliers. CSR has the

potential to cover health and safety issues and this possibility is being [10] supported by the UN Global Compact [39] as well as an international standard on CSR (ISO 26000) [23]. In the longer term, these approaches may prove to be valuable contributions to the regulation of global value chains.

8. Discussion

We have now pointed out five general challenges for ergonomics posed by global supply chains. These challenges require the development of new practices for the ergonomics community. The traditional micro ergonomics which focuses on concrete local problems in research or practice is still necessary, but in many cases will have limited impact on a global value chain. Macro-ergonomics with a broader focus on the whole organisation and production system may have more to offer, but also has difficulties in finding ways to work across borders.

The overall approach for the ergonomist must take its point of departure in the general discussion of sustainability of global supply chains. It is now being recognised in business strategy that competitive power today is not so much about the competitiveness of the individual firm, but a question of the ability for all the enterprises in a value chain to compete on a number of dimensions, among which price competition does not necessarily play the dominant role [27;34]. The ability to secure rapid innovation, high quality, and delivery on time, are often just as important. To achieve these qualities, a stronger integration in the value chain is necessary as each link depends on the other links to innovate, produce quality and secure delivery. Integration in the value chain therefore requires social relations with humans collaborating across organisational and physical borders.

This development towards integration is also the chance for ergonomics. The development of good and productive social relations requires workers and managers who are free from occupational hazards and engaged in their work. It is, in fact, the very essence of ergonomics to help achieve such an objective. So it is a question of finding ways for both micro- and macro-ergonomics to contribute to healthy workplaces and integration across borders. We will suggest three possible strategies which may facilitate such a development.

First, generally recognised standards for good ergonomic practice need to be developed for applica-

tion in globalised supply chains. If, for instance, we take the two challenges of constant change and the need for participation, there is a need to develop additional criteria for the involvement of workers and first line managers in change processes and ergonomics improvements that fit the chain perspective. Another example might be standards for product and process design where ergonomics potentially plays an important role – also to secure product safety [33]. The question is how to work with design across organisational borders where designers are located in one or more geographical locations far away from the final application of the design result. We are not thinking of new ISO standards, but standards for good practice which have proved to work in the real world and are supported by research results. Such best practice standards can be used as part of the implementation of occupational health and safety management systems in accordance with, for example OHSAS 18001, and they can be used in the work with documentation of CSR.

Secondly, ergonomists must support local managers and workers in discussions of possible KPIs based on human factors. They need to be included among standard KPIs to gain sufficient priority in corporation headquarters or the stronger downstream customers in the supply chain. The traditional strength of KPIs is their simplicity. Sales or costs per working hour and customer's complaints per sold product are easy to compute. A similar simplicity is required for human factors. One common KPI is accident rates, but they are stochastic values with random variations especially at smaller workplaces, and the human factors scope is limited. Another often used KPI is sickness absenteeism, which has a certain value, but is also a rather generalised measure. A more innovative KPI might be, for instance, the rate of employee improvement suggestions [29].

But it is not easy for local units in the chain to influence powerful actors far away. Here, diplomatic and political competences are important. One possible point of departure might be to link up with CSR activities and management systems and simply report such KPIs locally and at the same time argue for a more global application of the KPI.

Thirdly, the development of multidisciplinary international networks could open new options. As the supply chain gets more integrated, it will also be more legitimate to develop links with the partners in the supply chain. That can be done for functional business reasons as the people involved in ordering, delivering and receiving material or non-material goods in the chain become more dependent on each

other. But waiting to be invited does not help. The ergonomist has to identify the possibilities for networking in the different parts of the chain and then initiate contacts. These links would most often be created on the internet with limited possibilities of meeting face to face, but as the literature indicates [6] it is possible to create sufficient social capital to work together at a virtual level. Links to other ergonomists would be important, but even better would be to create links with occupational health and safety professionals who will probably have more local contacts, and perhaps best of all with designers, production engineers, and workers' representatives. Through links to such groups, it might be possible to overcome some of the problems created by global supply chains and initiate sustainable ergonomic improvements.

However, our three suggested strategies will meet difficulties in the traditional principal–agent relationship in supply chains. It has been demonstrated [25], for instance, that in relations between enterprises with large differences in resources the competences to ensure social sustainability might not be present in the small subcontractor. It is therefore important to support the development away from principal–agent relationships towards network relations, where supply chain actors collaborate on a broader scale than just fulfilling contract requirements. Such a perspective has also proven relevant for product safety [33].

9. Conclusion

The aim of this paper is to point out important issues which need to be addressed if we are to achieve progress in the discussion of sustainable ergonomics. There are obviously no clear and simple solutions to the challenges from global supply chains. One possible avenue for progress might therefore be first to acquire a greater understanding of the challenges from global supply chains, and second to study examples of supply chains where interesting initiatives have taken place, and on this basis identify and develop strategies that combine social and long-term business sustainability. Starting from such a basis, the next step could be to find ways for the ergonomics and human factors community to create international collaboration which can influence specific global supply chains.

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