

THE FUTURE SWEDISH SHOP-FLOOR OPERATOR - INTERVIEWS WITH PRODUCTION MANAGERS

Magnus Holm¹, Göran Adamson¹, Lihui Wang², Philip Moore³

¹*University of Skövde, Skövde, Sweden*

²*KTH Royal Institute of Technology, Stockholm, Sweden*

³*Falmouth University, Falmouth, England*

magnus.holm@his.se

Abstract: This paper is based on a study in which production and HR managers at six Swedish manufacturing industries have been interviewed about the role of the shop-floor operator, taking off in today's situation in trying to identify the future one. As well as the production methods and the machines etc. in the production system continuously evolve, so does the environment of the shop-floor operator. Increasing complexity in the production systems raises demands on the operators' ability to handle ICT-tools to gain decision support and knowledge needed in the future shop-floor environment.

Keywords: Shop-floor operator, Future production

1. INTRODUCTION

Sweden is a strongly industrialised nation with a high national trade surplus for the past decades. International competition is constantly increasing, demanding a proactive approach to maintain a leading position as an export intensive nation. Sweden's manufacturing companies are facing big challenges in their further development. These challenges include increasing the knowledge content in the production, which emphasize the importance of developing employees' achievements and increasing production flexibility and productivity. Cooperation between highly skilled employees and production systems with a high degree of automation will be essential when complexity in future production systems will increase. Increasing complexity demands for technical supporting systems to help the operators to cope with an information intensive working environment. The companies themselves have identified an enhanced need of technical competence for future shop-floor operators (Teknikföretagen 2011; Teknikföretagen 2013). The effectiveness of production is essential to the future competitiveness of a manufacturing company and the shop-floor operators have an important role to play (Fath *et al.* 2010; Grane *et al.* 2012; Karlsson *et al.* 2013).

Eight production and HR managers at six Swedish manufacturing companies have been interviewed in this work. These six companies cut and process metals or woods and the size of them stretches from a small company having 60 employees up to a global company having more than 1000 employees. All six companies engage shop-floor operators in machining as well as assembly processes. The aims of our work are firstly to get the managers views of how the demands on the shop-floor operators have evolved until today and secondly what competences and demands, technical and non-technical, the shop-floor operators will have to master in 5-10 years. The scope of does not include what role altering management strategies has played/will play for the shop-floor operator. All quotations in Section 3 are cited directly from answers during the interviews. The identity of the interviewees and their companies has been anonymised.

The rest of this paper is organised as follows. Section 2 presents a literature review focusing on the evolution of the Swedish shop-floor operators until present date. Section 3 presents views of the future Swedish shop-floor operators from interviews and literature. Section 4 discusses the output from the interviews and concludes the paper.

2. EVOLUTION OF SWEDISH SHOP-FLOOR OPERATOR

The working environment faced by the shop-floor operators is influenced by external variables set by demands from the market in combination with internal stochastic variables, such as fixture shortages, missing or broken tools, express orders, down-time for machines and changes in the number of available operators. Such stochastically changing conditions require a shop-floor to be able to handle and act in an information intensive environment with an increased degree of uncertainty. These external variables negatively affecting the production cannot be handled using neither traditional planning systems nor ordinary control systems due to lacking capability of handling such events (Xu *et al.* 2011).

Yesterday's shop-floor operator was more or less stationed at one machine focusing on one task. The shop-floor operator of today is facing increased responsibilities and scope demanding wide-ranging skills in an environment where the difference between blue and white collar duties/responsibilities becomes less distinct (Dencker *et al.* 2009). There is no universal definition of a shop-floor operator. An early description of the work performed by shop-floor operators is presented by Sheridan (1992). He modelled the work of the operator in five steps:

1. Plan
2. Teach
3. Monitor
4. Intervene
5. Learn

These five steps have been further developed by Fasth *et al.* (2010). The role of the operator is described through tasks in an automated production environment. These different tasks give the operator possibility to learn and continuously improve, which are essential for the future shop-floor operators. Competence and learning are important aspects to be further included in the working environment of the operator (Grane *et al.* 2012).

Changing conditions in the manufacturing industry of course also affect the working environment of the shop-floor operators. The inconsistency of management strategies has affected all employees in one way or another. In the early 20th century Taylor presented his ideas on *scientific management*, a concept for increasing efficiency within industry. Taylor thought that the operator needed structure and strict guidance to achieve high productivity. The operator was seen almost as a machine. Scientific management obtained a breakthrough in Sweden in the 1920s, forming a new era for Swedish industry and its operators (Börnfeldt, 2006; Björkman 2002). As a further development from Taylor's scientific management, Henry Ford's ideas emerged on how production should be arranged and managed, i.e. Fordism. He strove to reduce the amount of work needed within production through the increased amount of work performed by machines and through the introduction of assembly lines. Specific knowledge was not asked for among the shop-floor operators and all decisions were made by the managers. During the 1950s the MTM-concept (Method Time Management) was introduced. It focused on standardised tasks and calculated the time needed for different movements and operations on the shop-floor (Sandkull and Johansson, 2000; Börnfeldt, 2006). The working environment for, and demands on, the Swedish shop-floor operator at the first half of the 20th century are illustrated in Fig. 1.

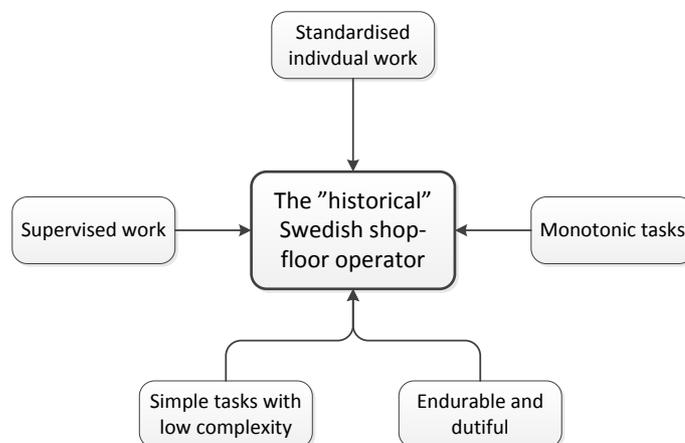


Fig. 1. Working environment of, and demands on, the Swedish shop-floor operator until mid 20th century.

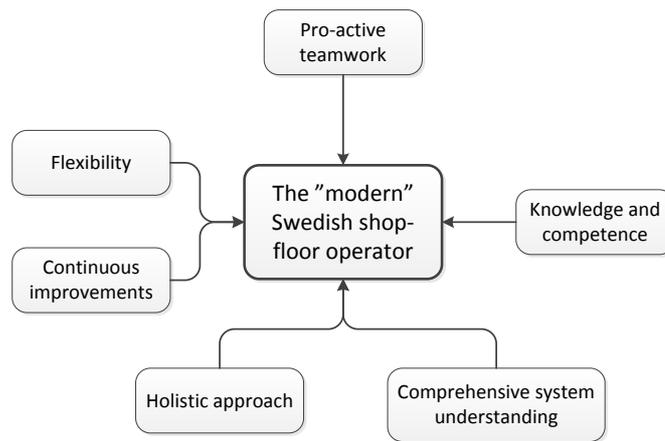


Fig. 2. The present working environment of and demands on the Swedish shop-floor operator.

During the 1980s management ideas and production approaches from Toyota (TPS - Toyota Production System) were spread over the world, also reaching Sweden. TPS together with TQM (Total Quality Management) focused on flexibility, quality and customer needs. To be able to reach these new criteria more focus was set on the shop-floor operators in performing continuous improvements and eliminating wastes in the production system. Lean production requires shop-floor operators who are versatile, disciplined, flexible and responsible. Lean production principles have had and still have a big impact on Swedish production companies (Liker, 2004; Hellsten and Klefsjö, 2000; Abraham and Johansson, 2009; Johansson *et al.*, 2013). The present working environment for, and demands on, the Swedish shop-floor operator are illustrated in Fig. 2.

3. VIEWS OF FUTURE SWEDISH SHOP-FLOOR OPERATOR

ProAct is a research project aiming at the shop-floor operator (Dencker *et al.*, 2009). It focuses on the importance of establishing/creating a proactive working environment for shop-floor operators. Dencker *et al.* concluded that operators having proactive behaviour will contribute to higher competitiveness through flexibility gains, and also a reduction of the total lead time for assembly operations. Design of a proactive assembly system is further discussed by Fasth *et al.* (2010). The potential of shop-floor operators is utilised using criteria from and interactions between the areas: automation, information and competence of the operators. The “operator of the future” or at least an approach trying to find its definition and requirements is discussed by Grane *et al.* (2012). The tasks and needs of the future operator were investigated through workshops in which several Swedish process and manufacturing industries and system developers were engaged. The single most important variable found in the work was information interpretation. Harlin *et al.* (2011) emphasised the importance for industry to develop both the individual operator as well as the whole team. The team will have more responsibilities and an increasing number of tasks in a working environment having more complexity compared to today. Future shop-floor operators have to be able to correctly interpret their working environment in order to act as a part of it. Harlin *et al.* (2011) also discussed the future shop-floors’ need of information and how to support decision making among its operators. Grane *et al.* (2012) discussed the technical aids and support that the future shop-floor operators are expected to use. An operator has great potential to adapt to different situations (Payne *et al.* 1993). But with dynamically changing demands and stochastic events, it is not possible for an operator to make correct decisions and prioritisations at all times since he does not possess neither all the production information in real-time nor the ability to process or evaluate it. This pinpoints the need of technical supporting systems on shop floors.

Harlin *et al.* (2011) modelled the four core quality areas for developing industrial work (see Fig. 3). This model has been used as a framework during the interviews. The citations below in this section are from the interviews.



Fig. 3. The four core quality areas for developing industrial work (Harlin *et al.*, 2011).

3.1 Development area: Individual – Team

All interviewees use team-based work on the shop-floor. The operators change workplace within their teams during the working hours to achieve good ergonomics and to increase the variation of the work content. This rotation though requires that the operators are able to handle several work stations and still maintain high quality output. Common to all interviewees is that they all believe that teamwork will continue to have a leading role on the shop-floor. The shop-floor teams will challenge their colleagues in other teams through extended responsibilities and expand their tasks thanks to new and extended competence. Some of the interviewees pointed out that the teams' total competence must be assured since its members may change over time. Structured work is needed to be able to identify possible missing competence in the teams, and to ensure that these are met with adequate training.

In some of the companies a trend away from several similar tasks in a big working area towards unique and qualified tasks in a smaller area is identified. These smaller areas could be seen as smaller factories within the factory, in which the team has full responsibility. The work content is then expanded to include, beside normal production tasks, also measuring, analysing, preventive maintenance and error handling to optimise production output.

“It is popular to give the operators and the team more responsibilities. This is both positive and negative. The organisation must have a maturity to handle this to have a positive output. Man is lazy; it is the way it is. You cannot just give full responsibility to the team and expect that every problem will be solved.”

One of the major differences compared to an individual approach is that teamwork provides more possibilities for individual responsibilities. More responsibilities will develop both the individual and the team but it will be limited due to the individual operator's competence. The interviews indicate that the operators own interest and experience are the two single most important variables affecting the level of individual responsibility.

3.2 Skills development

The required basic educational level for most interviewees when employing a shop-floor operator today is a degree from high school (3 years) preferable with a technical orientation. Other issues on their “wish list” are competence about NC-processes, automation and material knowledge (how the material reacts in the

process). But as important as these requirements is the personality of the operator. Lack of momentum and commitment can never be compensated by technical competence.

On a shop-floor having more and more advanced technology, technical excellence will become more vital. The interviewees listed the following as important attributes for the operator of the future: well educated, creative, dexterity, logical, skilled in languages, technical excellence, flexibility, awareness, commitment, innovation, technical interest, cultural understanding, team player, momentum, accuracy and a mathematical mind. Even though the list of requirements is long some interviewees are reluctant to distinguish, when asked, what on the list are demands and what could be seen as wishes. The larger companies tend to have more on the wish list in contrast to the smaller companies where the competence of the shop-floor operator is seen as a critical variable having more on the demand side of the list.

“We used to hire shop-floor operators having good knowledge about the material used in the process and then we taught them the technical parts. In the future it will be more important to hire people with technical skills and then teach them about the material used. Best of course would be if they know both from the start”.

3.3 Improvement and development work

The interviewees agree with Harlin (2011) when it is stated that acceptance and understanding among all employees are key issues for stimulating improvement and development work. Engaging the operators in the investment/improvement process and listening to their ideas and knowledge are important factors for continuous improvement and development.

“We engage the operators in all improvement and development projects. It is obvious why. They are the ones who will work with the machine/process.”

The interviewees emphasized the importance of having short decision processes so that the commitment of the shop-floor operator is not lost. The larger the company, the longer a decision usually takes is a tendency identified during the interviews. On the other hand it is also found that a larger company has usually got more resources, regarding both economy and competence.

Several of the interviewees highlighted the importance of a more customer focused improvement culture in the future. The shop-floor operator must understand what quality the customer requests. Experienced operators with high competence often work more efficient, and respond in a consistent way to incoming stochastic events. The interviewees identified the challenge to transfer this way of working fast and efficient to new operators, through developing standardised ways of working.

“In the future we have to get the operators to understand the advantages with a standardised way of working.”

3.4 Management and communication

Creating commitment and inclusion among the operators are seen as keys for future success by all interviewees. One common way of doing this is to visualise production data and results in real-time on the shop-floor. According to Harlin *et al.* (2011) one of the future challenges is to support decision making by having the right information at the right time at the right location. The interviewees predict that the visualisation of production data using scoreboards will remain, as it presents information in a good and comprehensive way. But the technical evolution will offer new ways of presenting information in real-time. Using mobile phones by operators on the shop-floor is a sensitive matter for many companies. Today mobile phones are usually banned on the shop-floor but in the future some of the interviewees see these as a tool instead. It will be a matter of trust.

All the interviewees emphasized the importance of social interaction on the shop-floor. The operators must interact and discuss. One of the interviewees described a previous problem which they managed to solve using an active management approach.

“There used to be fights between different departments, machining and assembly. They always blamed each other for the problems they faced. To solve this we arranged improvement groups with participants from both departments. We wanted them to be one team with one focus: The product shipped to the customer.”

3.5 Shop-floor supporting systems

All the interviewees expected that different technical tools will be important to help the operators to make production more effective and increase product quality and production economy in the future. The companies are all engaged in projects today on how to bring tomorrow’s technology to the shop-floor. Augmented reality is one technology mentioned by several. New kinds of screens and visualisation techniques are investigated. Some are looking at how to integrate operators’ daily tasks with robots. Generally the timeline is expected to be 10 years before these new technologies find their ways to the shop-floor.

Several of the interviewees expected that an increased level of shop-floor-operator-technology will help to recruit young people in the future.

“Young people do not perceive industry as an attractive place to work. We are still seen as boring. How do we want it to be in the future? I think it would be really good if we could create a working environment looking more like a video game!”

The interviewees discussed about the ability to design working environment as a “production game”, where the operator’s work could be like playing a computer game. When the work is finished and he leaves for home the operator would gain credits by e.g. product quality during the day. One responder discussed the machine interfaces. They usually look the same as 30-40 years ago; today the lamps and buttons are on a touchscreen but in reality not much has changed. Why not adapt to new ways of communication and again connect this to the “production game”. Let the operators gain credits when decreasing changeover times etc. Of course, much of the mentioned technologies are just ideas and a lot of resources are needed to realise them, but the interviewees emphasized that industry must use this new technology to be able to offer an attractive work environment in the future and find ways of working to attract the operators of the future.

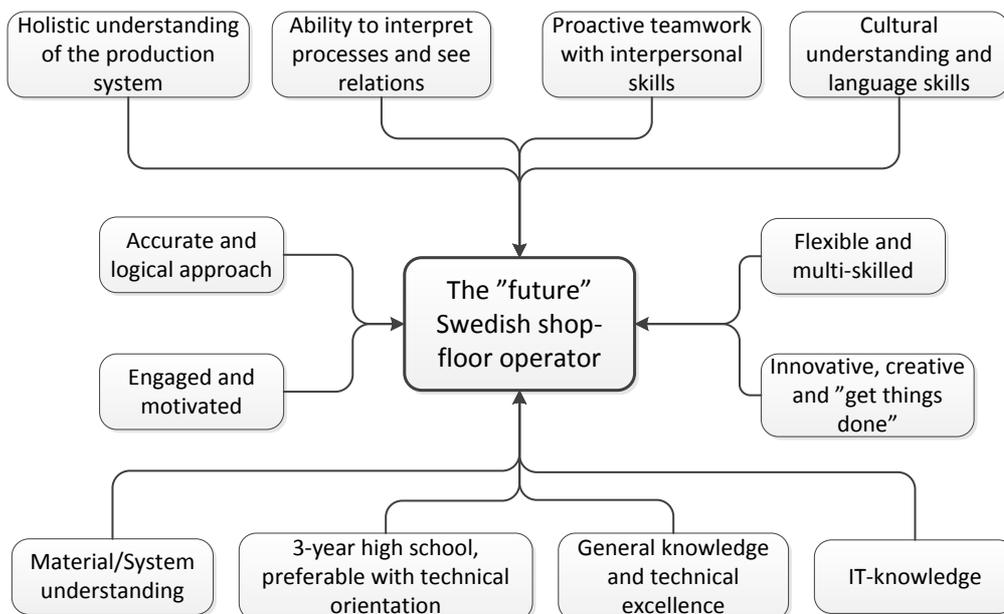


Fig. 4. Demands to meet for the future Swedish shop-floor operator.

4. DISCUSSIONS AND CONCLUSIONS

Fig. 4 depicts the demands to meet for the future Swedish shop-floor operator according to the interviewees. The number of demands to meet has been drastically increased and most of them can be defined as non-technical or soft. The soft skills are modelled in the squares to the right, left and above, the hard skills are modelled below in Fig. 4. One of these skills might need some extra explanation. Having completed a 3-year high school program, preferable in technical orientation, is seen as important by the interviewees to be able to meet the other demands on the shop-floor operators.

This soft focus of the future raises a problem identified during the interviews. The companies today are not used to develop these soft skills among their employees. One way of achieving these soft skills would be for the companies to increase cooperation with society in general and specifically the educational systems.

The interviews have confirmed the model by Harlin *et al.* (2011), but at the same time pointed at another area not included in the model; technical supporting systems. Therefore this area is added to the model (Fig. 5). According to the interviews, the model of the future Swedish shop-floor operator environment should also include technical supporting systems.

All of the interviewees are positive to new technical supporting systems on the shop-floor which will help the operators to make the right decisions in complex situations. There is however a potential risk — the operators feel that the systems are controlling them and this will decrease their commitment. At shop-floor user level the shop-floor decision support system need to have capability to be individualised (Holm *et al.* 2014). A pervading opinion throughout the interviews is the need of standardised work, which might be contradictory to operators' engagement, innovation and attraction to the working environment. How to enable these areas without negatively affecting each other is outside the scope of the interviews, but an interesting aim for future research.

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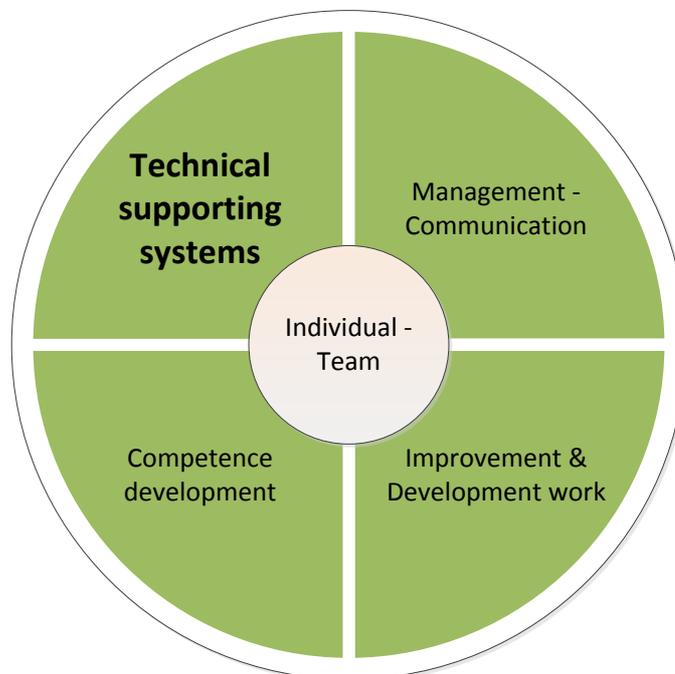


Fig. 5. Updated model for core quality areas when developing industrial work.

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