The operator of the future – a key to competitive industry in a future information society

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ABSTRACT

Increased global competition and forthcoming demographic changes is expected for the Swedish industry. The process and manufacturing industry needs to develop solutions that can provide increased flexibility and production efficiency. A key for the future competitiveness is the operator of the future who works closest to the value adding processes. In the project “The operator of the future”, “Framtidsoperatören” in Swedish, the overall aim is to increase the competiveness of Swedish industry by developing an advanced toolbox that meets future needs. In a pre-study, the tasks and needs of the operator of the future were investigated through workshops with 25 representatives from 15 Swedish process and manufacturing industries and system developers. The results had similarities across industries and suggest solutions that support communication, control and constant learning. The tools should be intuitive and situation adapted with use of strengthened senses. These results give the direction for a continued development of a future toolbox. Through a combination of new supporting technologies and new ways of collaboration the operators of the future might find their work more interesting, stimulating, and developing, leading to enhanced competiveness of Swedish industry.

Keywords: industry operator, future tools, competitive production.

1. INTRODUCTION

Increased global competition and forthcoming demographic changes is expected for the Swedish industry. The process and manufacturing industry needs to develop solutions that can provide increased flexibility and production efficiency. Moreover, the industry needs to attract young and competent people and concurrently meet the demands of a broader demography. A competitive edge of the present Swedish industry is a well-developed information technology and a decentralized decision-making to highly competent industry operators. This increases the power of action and makes fast customer adaptions possible. An advanced global development towards an improved information society could be seen as a challenge with great possibilities. The Swedish industry has the possibility to further develop the present advantages in knowledge and technical solutions. A key for the future competitiveness is the operator of the future who works closest to the value adding processes.

A visionary study of the future factory describes a need of new radical products and production solutions [1]. Furthermore, they describe a need towards a higher operator participation, decision-making and creativity. In youth’s description of a dream factory, “utopia”, the work includes creative tasks that demands continuous learning and development [2]. The youth’s also wished for challenging but not physically demanding tasks and preferred working in teams. In a description of what should be the “good work”, knowledge and control were two of the keywords mentioned [3]. They specified that the industry operators should get the competence needed to be in control over their own work areas. Moreover, they should get a general competence development that enables flexibility and movement between work areas. New types of technologies and work situations also require transformed knowledge from somewhat obsolete physical knowledge towards more abstract knowledge [4]. Another important aspect that continuously should be in focus in work place development is the need of health and safety. Noort and McCarthy [5] note that a safe work environment could be a prerequisite for the recruitment of skilled workers in the future. Health and safety is also one of the strong incentives for automation [6]. However, automation is not the solution to every problem. The level of automation needs to be appropriate to give an optimal contribution and support manufacturing competiveness [7]. They conclude that both too low and too high automation levels can affect manufacturing negatively. It is important to find a balance and use automation where it supports the most. A low competence level could for example be compensated by higher levels of automation or increased information support and the other way around [8]. Another important issue in production development is to keep ergonomic and environmental aspects in mind during the development process and not only focus the manufacturing gains [9]. The operator's safety and health are important for future values, as already mentioned. In the future, communication systems are believed to increase productivity, quality of work and cooperation between industry operators [10]. They further discuss Virtual Reality (VR) as a forthcoming technology that could be used to visualize and control production processes. In future production systems with high automation levels and advanced technology the demands for high quality and adequate presentation of information will increase [11]. Information to the industry operators could be presented through visualization but also through other senses. Visualization requires visual focus and for warning and alerts auditory or haptic information could be more effective. With haptic we mean the sense of touch. Moreover, redundant information through multiple senses may substitute for one another when fidelity is poor [12] and better match real-world interaction [13]. A challenge with new techniques using several senses concurrently is to find a way of communicating information that supports rather than burdens the user [14]. They concluded that an addition of haptic information could support interaction in highly visually demanding environments while extensive information could be confusing and too much to process. When technology develops it is important to keep in mind that the operator of the future might have a developed knowledge but the same limited resources, both physical and cognitive, as today. The technology should be developed to support the user and not the other way around. A challenge for the future is to develop a work environment with tools that suits a broad spectrum of users with different capabilities.

The operator of the future needs an advanced toolbox that makes possible a rapid change with increased flexibility and maintained quality. In the project "The operator of the future", "Framtidsoperatören" in Swedish, the overall aim is to increase the competiveness of Swedish industry by developing an advanced toolbox that meets future challenges. In a pre-study, the objective was to compile a first idea of the needs that the new toolbox should support.

2. METHOD

The tasks and needs of the operator of the future were investigated through workshops with 25 representatives (mainly managers, experts and engineers) from 15 Swedish process and manufacturing industries and system developers. The selection of companies represented several branches such as mining industry, iron and steel industry, automotive industry, defence industry, packaging industry, energy industry and drug industry. The workshops were divided into two parts. First, the tasks of the operator of the future were focused. Second, the needs to fulfil the tasks were focused. In each part the industry representatives got time to discuss the theme in focus and write down suggestions on sticky notes. The results from each company were presented and motivated to the whole group and the sticky notes were placed on a large whiteboard. When all sticky notes were presented and placed on the whiteboard every representative was welcome to move the sticky notes around and place them into groups (Fig. 1). This was done freely without any suggestions or restrictions. When groups of suggestions had been formed the representatives should agree on a keyword describing each group.

Fig. 1: The sticky notes describing future needs and tasks were grouped and the groups labelled by suitable keywords.

3. RESULTS AND DISCUSSION

2.1. Tasks

The keywords used when describing the tasks of the operator of the future were: interpretation, system control, communication, analysis, adjustments, cooperation, competence, reflection, expanded work tasks, knowledge, planning, operate/oversee, maintenance, development, responsibility and quality. Some of these keywords will be further explained based on the sticky notes contents and the discussions formed around them.

Interpretation: An important task was the ability and possibility to interpret processes. The operator of the future needs to understand the process and should be able to discover and understand signs or clues of importance. They should also find relationships in complex processes. A task for the operator of the future will be to oversee and follow the process continuously and be able to spot deviations from optimal production levels. If the process deviates the operator should be able to find out what has happened, the causes and also decide what should be adjusted.

System control: The operator of the future should be in control over the production system. The operator should be able to measure, follow up and interpret ongoing processes. They must also be able to change priorities and foresee course of events. Instructions must be continuously updated. The processes should be optimized and adaptive with alarms that remind the operator of maintenance work.

Communication: The communication should be effective and support the operator tasks. It should be clear whom to contact and how in different situations. This raised the question of what other functions are connected to the operator as well as who has the mandate to act and take decisions. The communication should support contact with these surrounding functions and persons with mandate. The communication should also support target achievements, learning and competence development. The operators should also communicate and assist each other. The communication should also support contact with suppliers. The communication should also work well between the operator and machine.

Analysis: One important task was to be able to analyze data and find causes. Analyses are important to be able to develop processes, products and resources.

Adjustments: More than just analyzing causes the operator of the future should also be able to make the correct adjustments. The operator should be a problem solver that also reports, repairs and follows up.

Expanded work tasks: The operator of the future will need front-edge competence as well as a general knowledge. The operator should be able to prioritize and solve problems efficiently and correctly. At the same time the operator should be able to assist a colleague or even substitute a colleague. The knowledge needs to be flexible to meet the expanded work tasks.

Operate/oversee: These tasks will need to develop towards a flexible work situation with non-stationary operators. The operators should be able to operate and oversee a process at distance and on the move.

Responsibility: The representatives believed the operator roles will involve a higher responsibility taking in the future. They considered the waiting for decisions being time-consuming and therefore also expensive. A higher responsibility would also increase the value of the work and a was expected to attract competent persons. The future responsibilities involved system control, constant improvements in systems, machines, methods, logistics and ergonomics, developments towards increased ergonomic, economic and environmental gains, and process optimizations.

2.2 Needs

The keywords used when describing the needs of the operator of the future were: technology, interpretation of information, organisation, capacity, competence, information, common user interfaces, body of knowledge, means of communication, training, safe environments, no physical contact and documentation. Some of these keywords will be further explained based on the sticky notes contents and the discussions formed around them.

Technology: The needs of new technical solutions were obvious. The technical tools should be simple to use, overview, understand and control. New advanced technologies were also discussed and solutions such as handheld computers and information goggles. These technical solutions should assist in personal communications but also connect machines and provide collected information. Several systems should meet in control units. These should have user interfaces that “all” operators could use and understand. Moreover, the techniques should provide flexibility in interaction and for example be able to use without the hands.

Interpretation of information: The operator of the future needs to be able to interpret her or his work environment to be an active part of it. The operator needs to be able to collect and sort out right information for a specific task. Information needs to be searchable and important information for a specific situation should have higher priority, It will also be important to have solutions that enables simulations befor real implemenations.

Organisation: The operator of the future will need a coaching and supportive leadership. There will be a need for supporting and rewarding systems that encourage and creates a sense of meaning and belonging. The operator of the future will need to take responsibility and also possess the mandatory in taking decisions. The organisation should support flexibility and movement between work environments and also provide areas for face-to-face meetings.

Capacity and competence: The operator of the future needs to be motivated and needs to be a good team player. She or he has a curiosity and interest to develop and learn. The operator of the future needs to take resposibility for and control own work areas.

Information: One need mentioned was real-time information and the right information presented at the right moment. The information needs to be sortable and easy to read and understand. A common user interface would support a flexibility for operators to change information areas but still be able to interpret the information.

Common user interfaces: The representatives saw a future in which stationary, complex and diverging user interafces would be a problem. They discussed new general controls such as computer game consols. With a common user interface it would also be easier to chare tasks and move freely. The word comon did also meen real-word matching. They mentioned the importance of a sense of “feeling” in distant controling.

Body of knowledge: With expanded work tasks the knowledge demands will increase. All knowledge could not and should not be kept within the operators. A necessity for flexibility are documantation of knowledge in some form of bank of knowledge. They also discussed forum for communications and simulators.

Means of comunication: One need was to be able to communicate with other operators, leaders and suppliers, but also to make non work related communications possible. The communications should be possible at distance and on the move. Other means of communications than verbal should be provided. In text, voice messages, whit boards, pictures, movies, haptic pokes are some examples.

Training: There will be a need for adapted education and trainining environments, such as simulators. It was aslo mentioned that the education should be continouos and there must be time alloted for training.

No physical contact: In some work situations there might be unsafe to have physical contact with a machine and distant control of robots are better solutions. During distant control the use of senses become important. With no direct contact visual, auditory and haptic information should be tarnsformed and presented to the operator in some way. In some situations such as cold climates or dirty environments that demands gloves manual interaction with instruments may be complicated and demand large buttons. Several representatives mentioned voice control as a solution.

4. GENERAL DISCUSSION

The workshop participants saw similar needs across branches. Of course, there were some individual suggestions with branch specific needs. However, our opinion was that most needs and suggestions were general and was raised by several different company representatives independently. The general needs were focused in this project. To sum up, the representatives saw that the operator of the future needs smart solutions that support communication, control and constant learning. They saw a need of tools that supports collaborative work and thinking in order to provide the operator of the future with extended knowledge and a possibility to move in time and space. These findings highly correspond with previous future predictions [2] and the idea of the “good work” [3]. The workshop participants also foresaw how the communication for the operators can be more flexible in the future by using different techniques and senses in an augmented or real environment. The new tools that were discussed in the workshops were formulated as able to strengthen the senses providing a possibility to see, hear and sense hidden information. As mentioned, technologies that use several of our senses are available today, providing promising possibilities [10, 12, 13]. An intuitive tool with situation-adapted information would make foreseeing decision-making possible. The workshop participants also saw that the operator of the future will need power and relevant support to make necessary decisions and changes. This is congruent with the conclusion that the industrial work organisations should support the autonomy and competence of the operators so they can control their own work areas [3]. Fast decisions demand quick communications with the right decision basis available at the right time. The new tools that were discussed therefore included support to the operators’ production control and detailed information in order to facilitate decision-making.

5. CONCLUSION

Of course some of the discussions in and results from the workshops can appear obvious; it is not the first time similar visions and ideas are raised. Still, they are important to continuously discuss and up-date. As long as technology develops new possibilities will form. In this project the operator were focused. The workshops clearly showed that the industry and human work science needs a continued development. Many future needs were raised left to solve. This pre-study is important as a first step in a development of a new toolbox that meets those future needs. Such a toolbox, would increase production efficiency and quality and make the operators closest to the value adding processes more involved and motivated. The operators of the future would find their jobs more interesting, stimulating, and developing. The toolbox would give added strength to the operators of the future making them the key to enhanced competiveness of Swedish industry.

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