

ICT USAGE AND BENEFITS IN SWEDISH MANUFACTURING AND PROCESS COMPANIES

Malin Karlsson¹, Anders Gustafsson², Camilla Grane², Johan Stahre¹

¹*Production system, Chalmers University of Technology*

²*Human work science, Luleå University of Technology*

malin.karlsson@chalmers.se

Abstract: Information and communication technology (ICT) tools could be used to enable the operators to perform their tasks as efficiently as possible. This paper investigates ICT use among Swedish industry operators in six companies representing both manufacturing and mining industry. It was concluded that the availability and usage of these tools is lower in industry than at leisure time. Many operators saw possible benefits with having more ICT tools available in their work. The results suggest both efficiency and economical gains through an increased usage of ICT tools.

Keywords: ICT usage, ICT maturity, Operator, Swedish industry.

1. INTRODUCTION

The operators working in or close to the production can substantially affect the performance of the production and hence also the results of the company through their work. This implies that it is valuable to enable operators to perform their tasks as efficient as possible. In a workshop with Swedish industry representatives (Grane et al., 2012), a common view was that efficiency could be met by providing the right information at the spot and provide technical solutions that support communication and constant learning. During costful production stops, fast communication can be crucial. Communication could for example provide support from a colleague or important information from a related production unit. One way to improve information and communication efficiency could be to enable fast interaction from a distance through information and communication technology (ICT) tools. There has been a strong development of ICT in the last decades. The usage of ICT tools has increased dramatically in the end of this period (Campbell, 2007). However, it has been noted that the industry has not adopted the new technology in as great extent as the society at large. Karlsson et al. (2013) investigated ICT use at three Swedish manufacturing companies and discusses that ICT usage seems higher at leisure time than at work but suggest further research. This paper investigates the use of ICT tools in Swedish industry compared to the personal/home usage.

The usage of mobile phones is rather high in Sweden. Around 2% of the respondents in a large annual survey by *Post- och Telestyrelsen* answered that they do not have a mobile phone, as a comparison the estimated number for most European countries (EU 27) is 7% (Annafari et al., 2013). The study showed that it was likelier that a person aged between 16 and 24 or above 65 years did not own a mobile phone than an average person. Although, the access to mobile phones is high for all age groups it was indicated that elderly persons, 40 or above, were less likely to send text messages or MMS (Axelsson, 2010). When it comes to ICT usage at work, Chesley (2010) found that perceived ICT usefulness was higher among frequent users. This is in line with findings from Vozikis et al. (2010), who saw that users of ICT had a more positive view of new technology. Kyriakidou et al.

(2013) proposed ICT access, use and skills as factors that could be used for estimating ICT maturity. In this paper, the factors ICT access and use is investigated.

This paper presents an exploratory study of the use and possible benefits from using ICT-tools in manufacturing and mining contexts from an operator perspective. The purpose was to investigate industry operators ICT use at work compared to their ICT use at home. Moreover, the study investigated the industry operators' perceived benefit of ICT at work and whether it was related to their age or their ICT use on leisure time.

2. METHOD

Exploratory studies have been carried out in six large Swedish manufacturing and mining companies, divided into nine cases. Operators, in these companies, were asked to fill out a questionnaire regarding personal background, ICT usage and desired use at work. The answers were analyzed both in aggregated form and with regard to different categories. Complimentary interviews were made with a few operators.

2.1. PARTICIPANTS

142 industry operators participated in the questionnaire, (Table 1). Of these industry operators, 66 represented five manufacturing cases ($M = 13$, $SD = 4$), and 76 represented four mining cases (both above and under ground, $M = 19$, $SD = 7$). The participants represented different age categories, a few operators did not fill in age or sex. In the selection of companies different context were included, from underground mining to clean rooms. Different operator roles were also represented including operators working in control room or in field, with monitoring, assembly or maintenance work. The selected companies were located in both small and large communities, from the north to the south of Sweden. All industry operators working at the visited location during visits had an equal opportunity to contribute to the results. No specific selection of participants was made by the company or researchers. Contribution was voluntary and a few declined participation.

Table 1 Number of questionnaire participants including age and sex.

Age group	Participants	Men	Women	Unknown sex
18-25	24	20	4	0
26-35	22	16	5	1
36-45	35	24	8	3
46-55	44	31	6	7
56+	15	11	2	2
Unknown age	2	0	0	2
Total	142	102	25	15

2.2. QUESTIONNAIRE

The questionnaire consisted of six questions. The operators were asked to circle the alternatives best suited for each question. The background questions asked regarded sex, age group and description of their roles at work. The respondents were asked to mark which if any ICT tools they use at leisure time respectively at work. They were also asked to fill out if they thought it would be useful, at work, to be able to send; picture, text, movie or position, it was possible to give a free text answer.

2.3. OBSERVATION AND INTERVIEWS

Semi- structured interviews were conducted with some operators and production technicians from each department. Operators were also observed during their actual work. The intention was to understand/chart the current work procedures and in what way new ICT tools could add value to their work.

2.4. QUESTIONNAIRE

The questionnaires were analysed with descriptive statistics for all respondents and between the two different industry types: manufacturing and mining. The answers were also correlated to the respondents age.

Furthermore, the results were correlated between use at leisure time, work and perceived usefulness. SPSS was used in the analysis and the significance level was set to 0.05.

3. RESULTS

3.1. AVAILABILITY OF ICT TOOLS AT WORK

At the time of the questionnaire none of the companies visited provided their operators with mobile ICT tools, such as smart or mobile phones. One company provided mobile tablets. The tablets were rarely used. According to the operators, the tablets were heavy to use because the interaction interface was not adjusted to tablet size but to normal control room monitors. This made it easier to walk to the control room and use those computers rather than using tablets at the spot. At two companies handheld computers were available. At one of them the handheld computer was used for a specific maintenance task and at another company the computer was connected to the machines and were used to scan product information from barcodes. These handhelds were used as they were integrated into the work tasks. Portable telephones or com radios were available in several cases. Though, personal phones were not the standard within the manufacturing companies where the operators at a shift shared any available telephones. Com radios was used in the mining industries, with one exception; it was an obligatory equipment for work under ground. Com radios were also used for a specific task, in one of the manufacturing companies, where extensive communication was needed. Cameras existed at many companies but were not used very often since they are placed in an office or similar and not where the operators work, sometimes they lacked batteries.

In most companies the operators are not provided with mobile phones or other means to enable sending text or pictures. To handle this, in several companies some operators used their private mobile phones when allowed and possible to contact each another. Sometimes it was also used to take pictures and send to other operators or technicians.

The production technicians and managers met in the manufacturing companies all had access to smart phones, most of them also had access to a personal computer and in many cases these were portable

3.2. USAGE OF ICT TOOLS AT WORK AND LEISURE TIME

For most communication means the number of users was lower at work compared to at leisure time, phone calls, Email, SMS, MMS (Fig. 1). Social media is a grouped merged from using at least one of either Facebook, Instagram or Viber.

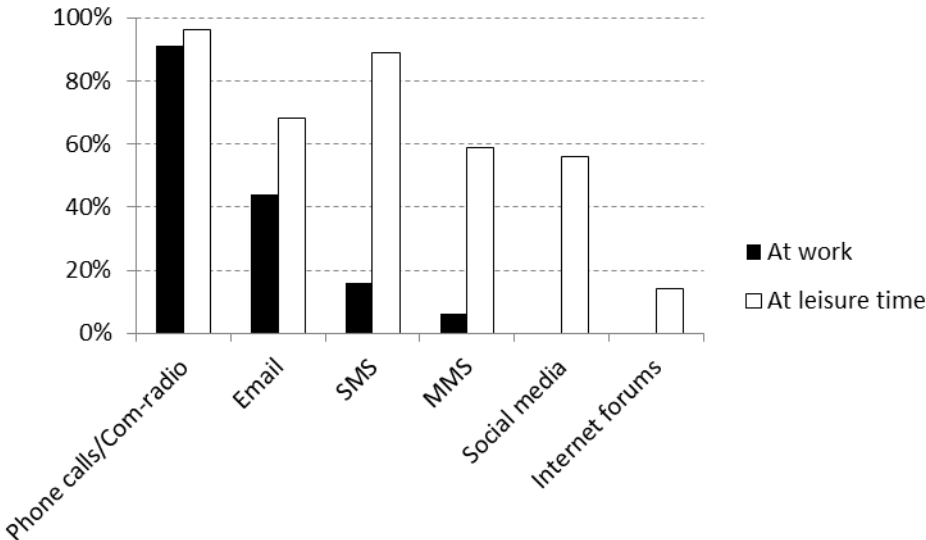


Fig. 1 The share of operators using ICT at work and at leisure time.

Comparison between age groups. Jonckheere's test revealed significant trends in the data. The younger age, the more likely operators were to use social media ($J=5.91$, $p=0.000$), MMS ($J=3.97$, $p=0.000$) and SMS ($J=2.36$, $p=0.18$) at leisure time.

3.3. PERCEIVED BENEFIT OF ICT TOOLS AT WORK

Many operators marked that it is or would be beneficial for them in their work to be able to use the tools listed in Fig. 2. The highest scoring tools were sending text and pictures.

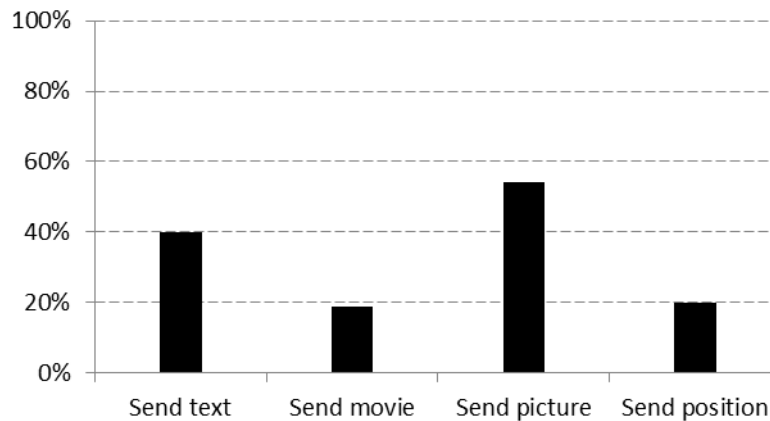


Fig. 2 Share of operators perceiving benefit of ICT tools at work.

Comparing industry type. Sending text, movies and pictures were considered to be beneficial to the same extent in both the mining and manufacturing industries. However, there was a significant difference between perceived benefit of sending position ($Z=2.96$, $p=.003$) when comparing manufacturing (9%) to mining industry (29%).

Comparing age groups. Table 2 shows perceived benefit of ICT tools when extracting age groups. Jonckheere's test revealed a significant trend in the data. The younger age, the more likely operators were to see benefit of sending movies ($J=2.15$, $p=.03$). There were also indications that the same goes for sending position ($J=1.876$, $p=.074$) and images ($J=1.739$, $p=.082$)

Table 2 Perceived benefit of ICT tools at work, age groups compared.

Age group	Send text	Send movie	Send picture	Send position
18-25	41,7%	33,3%	66,7%	20,8%
26-35	31,8%	18,2%	50,0%	31,8%
36-45	51,4%	20,0%	57,1%	25,7%
46-55	34,1%	13,6%	50,0%	13,6%
56-äldre	33,3%	6,7%	33,3%	6,7%

Comparing leisure use. There was a significant correlation between sending MMS (picture and text) at leisure time and seeing benefits in sending pictures at work ($\chi^2(1) = 4.9$, $p < .05$). No association was found between sending SMS (only text) at leisure time and seeing benefits of sending texts at work ($\chi^2(1) = 1.27$, $p = .26$). Since sending movie and position had no naturally corresponding communication counterpart at leisure time the perceived benefit was also compared to use of social media (in this case Facebook, Viber and Instagram). Use of social media had a significant correlation with perceived benefit of sending pictures ($\chi^2(1) = 10,8$, $p < .01$) and movies ($\chi^2(1) = 11,80$, $p < .01$). No such correlation was found between use of social media at leisure time and perceived benefit of sending text ($\chi^2(1) = 2.18$, $p = .14$) and positions ($\chi^2(1) = 0,06$, $p = .81$) at work.

Type of benefits. Through interviews with respondents some benefits was exemplified. Text messages could ease communication with several operators and over time. One example was communication of events between shifts. Benefit with sending movies was most apparent in shared work instructions but could also be helpful when describing a problem. Images was describes as beneficial when sharing a problem view. A shared problem view could save both time and effort since the operators would not need to walk to the problem to take part of it. Position was mostly expressed as beneficial in case of accidents in the mining industry. However, it was also described as helpful in describing the position of a problem.

4. DISCUSSION

4.1. AVAILABILITY OF ICT TOOLS AT WORK

The availability of ICT-tools (especially mobile) at the companies was low. The operators were in most cases not provided with means possible to use for other things than calling. It was indicated that the managers and production technicians at least in the manufacturing companies had greater access to mobile phones. This was not observed in the mining companies; a possible reason is that there presently is no connectivity in the mines.

4.2. USAGE OF ICT TOOLS AT WORK AND AT LEISURE TIME

As indicated earlier (Karlsson 2013), the results showed that the use of mobile ICT-tools is greater at leisure time than at work. Presently, the most common communication means are portable phones and com radios. None of the operators who participated in the study was provided with mobile phones or possibility to send pictures or text without using a stationary computer. Some of the operators who saw a great benefit of being able to mobile contact other operators or managers use their own mobile phones. However, this is not possible in all companies due to restrictions. Several companies have prohibitions on taking photos at their production plants.

4.3. PERCEIVED BENEFIT OF ICT TOOLS AT WORK

As an example, 54% saw benefit of sending pictures at work, when comparing this to the only 5% that actually uses MMS a big gap is seen, and this 5% use their own devices in many cases. The benefits are there but the functionality is not provided by the companies yet.

Similar results was found when comparing operators perceived benefits between industry type, with the exception of sending position, which was higher in mining industry. This is most likely due to the larger distances evident in the mining industry. It can be argued, since similar results were found, that operators in manufacturing and mining industry have similar overall needs.

4.4. ICT MATURITY

The companies ICT maturity with regard to the operators can be evaluated after the model used by Kyriakidou et al et al. (2013) with access, use and skill. The first factor, access is according to previous discussions low or non-existing. The use is hard to determine since no tools are available in the companies. However, the use of mobile ICT tools seems to be rather high at home. This also makes it likely that operators would use the tools at work if beneficial. The skill level in using ICT-tools has not been investigated in this paper.

The companies are overall having a low ICT maturity due to the low access and hence usage. Though, the operators are regarded as having a high degree of ICT maturity. The difference in maturity implies that the technology and the operators are ready for more ICT tools.

4.5. GENERABILITY

The results in this study represent six large manufacturing and mining companies in Sweden. The selection of companies and the similarities between companies suggest that the results are not exclusive to a particular industry. The exceptions were com-radio use and perceived benefit of sending position that both were more common in the mining industries than in manufacturing. As mentioned earlier, this could be due to the underground context and long distances. The results may also apply for other industries with similar contexts. The results in this study could not be generalized to Swedish work places in general and there are also other types of industries that might get different results. It could be assumed that ICT developers, as an example, attract operators with a high interest in ICT technology that might make them more open to ICT usage at work. Similarly, the results could not be generalized worldwide. The results would probably be different in countries with lower ICT maturity in general.

4.6. FUTURE TRENDS

From the trend of younger operators seeing more benefits of ICT tools than older, it can be guessed that the overall perceived benefits will increase among all groups as time passes. Overall, the younger the operators, the more ICT usage were found (Social media, MMS, SMS) and the more perceived benefits were found (sending

text, image and video). But it's not just the younger operators that see benefits of ICT tools. Even in the 56+ group; a third saw benefits of sending images. This would indicate relatively ICT mature operators and even more so in the future.

If companies are to adopt mobile tools in an attempt to reap the benefits of having mobile ICT tools a few things have to be resolved. Internet access or solutions not constantly dependent on it have to be given. The companies also need to consider how to solve their safety precautions regarding photo prohibitions.

5. CONCLUSIONS

ICT maturity in Swedish industry could be regarded as low when it comes to sending multimedia information at work. The reason was mainly due to low access. However, ICT maturity among Swedish industry operators could be regarded as high (especially for young workers) since many operators saw possible benefits with having more ICT tools available in their work, additionally, for most communication means the use was higher at leisure time than at work. ICT tools could reduce unnecessary walking time and ease problem solving. Therefore, the results suggest both efficiency and economical gains through an increased usage of ICT tools.

6. ACKNOWLEDGEMENT

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