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The success of DSS in a police organization

An evaluation study

Master thesis, 15 ECTS, Department of Informatics.

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Abstract

Decision support systems (DSS) are widely used in both public and private sectors. The objective of our research is to provide knowledge about the actual use and impact of DSS in police organizations. The system that is evaluated in this study is a DSS, recently developed and implemented in the Police organization in Skåne. There is hardly any evaluation done on these systems when used in this particular context.

This evaluation will be based on the information system success model of DeLone and McLean (1992). Both quantitative and qualitative methods are used to measure the interrelated success factors of the model.

Our findings show that system quality, information quality, user satisfaction, individual impact and organizational impact are at satisfying levels. The use of the system in general is low and more depended on external factors rather than system quality, information quality and satisfaction. We arrived at the overall conclusions that the DSS can be considered quite successful but on the other hand there is still room for improvement until it becomes fully functional.

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Content

| | |
|---|----|
| Acknowledgments | 2 |
| 1. Introduction | 6 |
| 1.1. Problem area and research question | 7 |
| 1.2. Objective | 7 |
| 1.3. Delimitations | 7 |
| 2. Literature review | 8 |
| 2.1. Decision Support Systems | 8 |
| 2.1.1. Decision making and the decision-making process | 8 |
| 2.1.2. DSS definition | 9 |
| 2.1.3. DSS and context | 10 |
| 2.1.4. Benefits of DSS | 11 |
| 2.2. Information technology within police organizations | 12 |
| 2.2.1. Crime analysis | 13 |
| 2.3. Evaluation of DSS | 14 |
| 2.3.1. The Information System Success model | 15 |
| 2.4. Summary | 19 |
| 3. Research method | 20 |
| 3.1. Choice of method | 20 |
| 3.2. Data collection | 21 |
| 3.2.1. Literature review | 21 |
| 3.2.2. Interview | 21 |
| 3.2.3. Survey | 22 |
| 3.3. Data analyses | 26 |
| 3.3.1. Interview analyses | 26 |
| 3.3.2. Survey analysis | 26 |
| 3.4. Methodological critical reflections | 27 |
| 3.4.1. Reliability | 27 |
| 3.4.2. Validity | 29 |
| 3.4.3. Ethical issues | 29 |
| 4. Empirical material | 31 |
| 4.1. The police in Sweden | 31 |
| 4.1.1. The Police in Skåne | 32 |
| 4.1.2. System for Measurement and Follow up (SMF) | 32 |
| 4.2. Empirical results | 34 |

| | |
|---|----|
| 4.2.1. Interview | 34 |
| 4.2.2. The survey | 36 |
| 5. Analysis..... | 42 |
| 5.1. System quality | 42 |
| 5.2. Information quality | 43 |
| 5.3. System use | 45 |
| 5.4. Satisfaction..... | 47 |
| 5.5. Individual impact..... | 48 |
| 5.6. Organizational impact | 51 |
| 5.7. Summary..... | 52 |
| 6. Conclusions | 54 |
| Appendix A: Interview guide..... | 56 |
| Appendix B: Transcription | 57 |
| Appendix C: Creation of the survey..... | 64 |
| Appendix D: Questionnaire | 65 |
| Appendix E: Survey analyses | 71 |
| References..... | 82 |

Figure list

| | |
|--|-----|
| Figure 2.1: Conceptual model of DSS | 10 |
| Figure 2.2: DeLone and McLean IS Success Model | 16 |
| Figure 4.1: Police Organization in Sweden | 311 |
| Figure 4.2: Postion vs Age..... | 36 |
| Figure 4.3: Access level..... | 377 |
| Figure 4.4: Position | 377 |
| Figure 4.5: Log in..... | 388 |
| Figure 4.6: Frequency of use..... | 388 |
| Figure 4.7: Time of use..... | 388 |
| Figure 4.8: Frequency of use vs. Access | 393 |
| Figure 4.9: Time of use vs. Access | 393 |

Table list

| | |
|--|----|
| Table 3.1: Alpha internal reliabilities | 28 |
| Table 4.1: System quality | 37 |
| Table 4.2: Information quality | 37 |
| Table 4.3: User satisfaction..... | 39 |
| Table 4.4: Individual impact. | 40 |
| Table 4.5: Correlation of the Latent Variables | 40 |

1. Introduction

Decision Support Systems (DSS) have primarily been created to help managers in the organizations to make better decisions. The main aim of the systems has been to improve the quality of the decision (outcome) and as well the decision making process. (Turban et al., 2007)

Pick (2008) describes how DSS today are found in a wide range of applications and they vary from simple spreadsheet, goal seeking and scenario analyses to geographical information system and knowledge management systems. DSS are also widely spread within both the private and public sector and examples can be found in banking, health care, government, private organizations etc. (Turban et al., 2007). The police organization, as a non-profit one, is one case within the government where the system is used (Stair & Reynolds, 2008).

Oatly et al. (2006) describe how the police organization has been in need of functional software to support the employees in their work. An essential part of their work is to know where and when to allocate resources (Johnson et al., 2007). Decisions have to be taken on different time frames by different people towards different priority areas. Decisions can be made on a short notice, for example the deployment of patrols needs to be changed as a response to altered circumstances. On the other hand, long term decisions are made on strategic level and mostly concern the type of actions to be followed in different areas and in the future. (Hirschfield, 2001) However, making decisions can often be problematic as most police data is spread over different sources. To access it the employees need to know in which sources to search and how to access the appropriate data they are looking for. (Oatly et al., 2006) Crime statistics and research have always been in need of a great amount of data to calculate crime prediction, trends and patterns (Dzemydiene & Rudzkiene, 2002).

DSS have the possibility to collect information from many different sources and provide summaries and generalizations, which can reduce the problem with data overload. The system can also provide visualizations of the aggregated information in logic ways. By using DSS it becomes easier to analyze crime data and make good presentations. (Dzemydiene & Rudzkiene, 2002) By analysing the historical data, which can sometimes follow a specific trend and pattern, the decision makers can make decisions on what actions to take next in order to prevent potential crimes from happening (Dzemydiene & Rudzkiene, 2002). They can drill down in the system and have the possibility to identify trends and reassign officers at locations where crime is predicted to happen (Moran & McCarty, 2008).

Large obstacles have however been discussed related to the implementation of information systems in general within police organizations. A lot of factors such as failure to redesign work processes, failure to understand the strength and weakness of the systems, unclear and undefined objectives, lack of organizational support and hence no acceptance and alignment between the organizational goals and system objectives can negatively affect the success that a system has in the organization. (Daves et al., 2003, SEARCH, 2001b cited in Davis & Jackson, 2005, p. 37-38)

1.1. Problem area and research question

Most of the research studies have been focused on the design, development and implementation of different decision support technologies in police organizations with the aim to support them during their work to better fight crime. Examples of these systems are data mining, GIS and data warehouse (Boba, 2005). On the other hand, as far as we know, little evaluation research has been conducted about the success of DSS within these organizations. This leads to a lack of knowledge about the actual use and impact that DSS are having on both the users and the organization.

We find it interesting to do an evaluation study on the success of these systems when used in the context of the police organizations. Our case will be a DSS which is being used in the police organization of Skåne in Sweden, and is known as System for Measurement and Follow up (SMF). The system has been developed in order to be a support for the decision making with the objective to enhance crime analysis, internal governance and management of the organization.

The research question for this study is:

- *How successful is the Decision Support System in the police organization in Skåne?*

1.2. Objective

The objective of our research is to provide knowledge about the actual use and impact of DSS in police organizations. By evaluating the success of a specific DSS in the police organization of Skåne, we can provide the Information System (IS) researchers with some understanding and insight of the overall impact of DSS when used in police organizations.

For the practitioners the evaluation can provide guidance in future improvements of the system in order to more appropriately meet the needs and goals of the particular organization. It can also serve as a guideline to other departments which are planning to implement similar systems.

1.3. Delimitations

The evaluation of the DSS in the police organization will be based on the success factors that DeLone & McLean (1992) have proposed in their IS success model. We will not discuss or study the technical details of the system as we are limited by time.

2. Literature review

This chapter is the theoretical base of our study and a description of DSS, the way these systems are related to the decision making process, the different context where decision making take place and the potential benefits of the systems will be introduced. The second subchapter gives an introduction to information technology within the police and the function and use of crime analysis to evaluate the efforts of the police organization. The last subchapter presents a brief description of the importance of evaluation. Finally an extensive description of the IS success model of DeLone and McLean which is a well known model of IS evaluation will follow.

2.1. Decision Support Systems

According to Turban et al. (2007) DSS have an explicit linkage with decision making. For this reason before giving a description about this system it is very important to understand the decision-making process and the steps involved.

2.1.1. Decision making and the decision-making process

Decision making is considered as one of the main activities within an organization, especially at management level. It is the process where decision makers decide on a course of action to follow in different situations. The success of a decision depends to some extent on the quality of the data on which they rely. Issues which depict good quality are for example completeness, update, accuracy, accessibility of the data and reliability. (Beynon-Davies, 2002)

The process of decision making can be studied apart from the actual decision (outcome). The decision makers may come up with solutions, but none may be implemented. (March & Olsen, 1979) A lot of time is spent analyzing the environment in order to identify possible problems or opportunities to handle. Although the time spent during this decision making process can differ from one organization to another, as well as from one individual to another, the process of decision making can still be generalized in four main steps: intelligence, design, choice and implementation. (Simon, 1977)

The intelligence phase is the first phase of the decision-making process where the decision-makers find new problems/opportunities by searching and evaluating the environment. The phase can be divided into problem/opportunity identification, classification, decomposition and ownership. (Turban et al., 2007)

In the design phase a model is constructed in order to get a better understanding of the problem, and for each problem the respective objective to reach is set up. For the solution of the problem different alternatives are generated and the results of each of them are measured and forecasted. (Turban et al., 2007)

The choice phase consists of choosing one of the evaluated alternatives generated in the design phase. Thereafter one solution is recommended for the problem. Finally the

implementation phase comes when the selected solution is put into life. Successful implementation of the solution will hopefully bring along successful solution to the problem. (Turban et al., 2007)

However the decision process, according to Simon (1977), is more complex than the linear sequence which is supposed. Many of the phases interweave with each other in different point of times during the decision making process. Sometimes there is no clear definition between the design and the choice phase, and also the design phase may be often combined with the intelligence phase.

The whole process of the decision making requires relevant data, information and knowledge which are often combined with computerized systems in order to produce better outcomes, in this case better decisions. One of these systems which support the organizations during this process is known as DSS. (Turban et al., 2007)

2.1.2. DSS definition

DSS is considered to be an umbrella term which includes any computerized system that can support an organization during their decision making processes. It can range from a knowledge management system, a support system for marketing, to an expert system. (Turban et al., 2007)

DSS are mostly used in the managerial level to support the decision makers who handle semi-structured and unstructured problems. Both these situations are often supported by combining standard solutions and human judgment. It is build to support the four phases of the decision making process with the main aim of enhancing the quality of the decisions. (Turban et al., 2007)

To solve problems, DSS needs data which can come from different sources such as: databases, internet, internal network and other computerized systems. The data is the basic component of the DSS architecture (Figure 2.1). A database management system (DBMS) is needed to access the database and at the same time update it. Additionally, DSS includes models, such as statistical, mathematical and financial, which can be standard and customized in order to manipulate the data. The model management software (MMS) coordinates and controls the models which are being executed in DSS. Usually DSS have an easy user interface where the users can communicate with the system and at the same time having the possibility to include their own views and experiences. (Turban et al. 2007, Stair & Reynolds 2008)

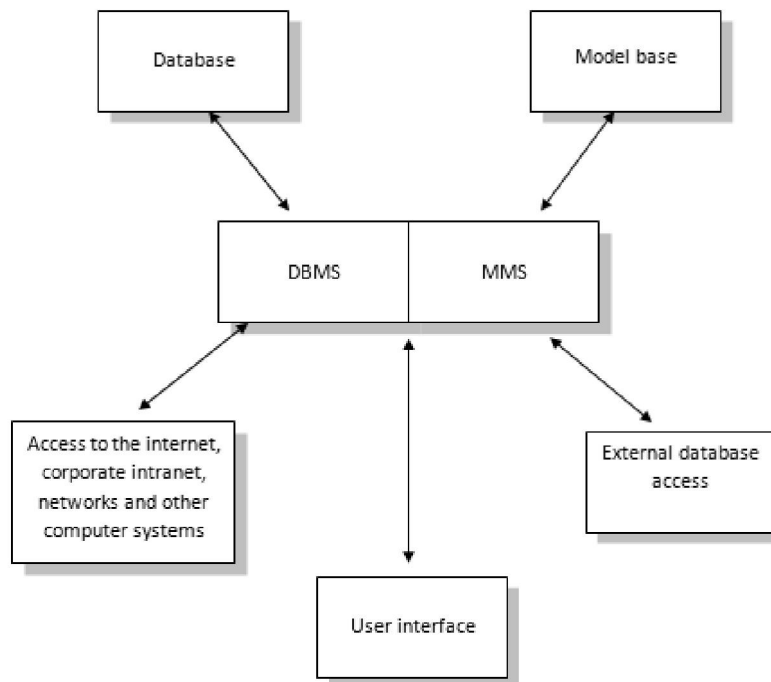


Figure 2.1: Conceptual model of DSS (Stair & Reynolds, 2008, p.274)

2.1.3. DSS and context

During the implementation process of DSS it is important to understand the context in which the system is going to function in order to obtain the full benefits of it. DSS must be designed, constructed and implemented in such a way that it supports the complexity of the decision making in the organizations. (Hall, 2008)

Holsapple and Whinston (1996 cited in Hall, 2008, p.87) describe the different contexts which influence the decision making process. The management level is the place where decisions are made. Often it influences the character of the decision as being unique or routine. The authors describe how routine or functional decisions are made at operational and lower management level where the problems usually are structured, and easy to handle. The middle management level takes decisions about problems which are found to be similar to previous ones so that their solution is more or less known. The strategic decisions are difficult as they are not routine decisions and are considered to be more subjective. However, there is also the cross context level where decisions are not made only within the management level but they take place across the different levels. (Hall, 2008)

The way the organization or the department manages their staff may have an influence on the context of decision making. When a group of decision makers make a decision they are not affecting only their own department but the whole organization as well. The context and the type of decision make the decision process complex and difficult. This should be taken into consideration when building DSS. (Hall, 2008)

2.1.4. Benefits of DSS

The linkage that DSS have with the decision process makes it unique from other information systems. Its main role is not to replace the decision-maker but instead to improve and enhance the decision process. (Alavi & Henderson, 1981)

“Generally the benefit of a DSS is a better decision, a better decision making process or both” (Pick, 2008, p.720).

A better decision can, according to Pick (2008), after it is implemented, result in managing the resources more efficiently, minimizing the costs and the risks, increasing the profits and improving customer service. These benefits can have an effect of greater reliability which indirectly depicts the way the decision process is enhanced and improved. Also another positive effect which comes along with the use of DSS is that it can increase the user's confidence in the decisions made and also enhance their understanding of different problems. (Pick, 2008)

Although in some cases DSS does not affect the quality of the decision, the use of the system can result in a better documented decision process, reduced time of making decisions, less expenses and in additional benefits when the decision is finally implemented. (Pick, 2008)

DSS can support all the phases of a decision process (Pick, 2008). Decision support technologies such as: Executive Information System, Management Information System, Data Mining, On-Line Analytical Processing can support the intelligence phase during the search, scanning, evaluation and monitoring of both internal and external information. DSS provides standard models for the design phase and assists in the generation of different alternatives sometimes coupled with the human expertise and Expert Systems. With the use of the system the decision maker may have the possibility to consider more alternatives than it was possible without the system. In the choice phase the system performs goal-seeking and what- if analyses in order to obtain the best possible alternative. Finally in the implementation phase, DSS can be used to explain the decisions taken and also to track their progress. The use of a DSS in the beginning of the process can also influence the process positively and provide benefits in the implementation phase. (Turban et al., 2007) Although DSS have been build to support all phases of decision process, it is noticed that its main focus have been the design and choice phase (Ang et al., 1995).

According to Pick (2008) it is very important to assess and identify the benefits of DSS after its implementation. The benefits need to be evident in order to reduce the non-use risk of the system and at the same time to help in the future improvement of DSS (Pick, 2008).

Udo and Guimaraes (1994) conducted a search across different studies about the benefits of DSS and by means of an empirical study they received different ideas and point of views for its benefits. They concluded that increased productivity, improved communication, decision quality, time saving, cost reduction, overall satisfaction, cost effectiveness and competitive edge are the main eight DSS benefits which a company should look for.

2.2. Information technology within police organizations

The IT maturity within the criminal justice system is very uneven (Dunworth, 2005). The technological development is very important for the police. By introducing new technology their IT support can be improved and this can result in more effective handling of cases, more material can be analysed and communication within the community can be enhanced. The new technology can even open up new ways of preventing and analyzing crimes. (Rikspolisstyrelsen, 2009)

The choice of IT is highly individual and is based on the different needs and goals of the police. Police departments are most often oriented by a need to gain a deeper knowledge regarding crime problems. The choice to initiate changes of IT within the organisation falls most often in one or several of the following four categories: to obtain a better understanding of problems, to work for an enhancement of strategic and tactical planning and decision making, to minimize operating costs or to handle daily operations in a more effective way. (Dunworth, 2005) Davis and Jackson (2005) describe however several obstacles during the acquiring or replacing of the IT systems within police organizations. The fact that there exist a wide range of available technologies can lead to difficulties for the organization in choosing the information system solution for their needs. Sometimes the users are unfamiliar with computer systems and are intimidated by the fact that they are not capable of using them. Another possible obstacle can be a slow diffusion of system information throughout the police organization because of low IT knowledge at different departments. (Seaskate Inc., 1998 cited in Davis & Jackson, 2005, p.36)

Earlier software vendors sold the same applications that were used in other domains to the police departments with few changes. This made the police departments change their way of doing things in order to adapt to the new implemented systems. (Seaskate Inc., 1998 cited in Davis & Jackson, 2005, p. 37) Until today many systems have however been in-house developments and there is a lack of academic literature in the field (Adderley & Musgrove, 2001). These systems have been created when the police cannot find the software meeting their own requirements and consequentially they are created in-house or experts are hired to develop them. (Boba, 2005)

Davis and Jackson (2005) describe several factors of how IT can affect the work of an organization and how these factors also can be applicable to the context of police organizations. The factors described are:

- Effects on organizational activities
- Workforce effects
- Management effects
- Financial effects
- Organizational effects

Davis and Jackson (2005) explain how the main objective, when deploying IT in the police, is often to affect the way the organization is carrying out its tasks. This can include both an enhanced process of how established activities are performed and as well making possible new ways of working. Mobile data terminals can for instance make information available to the police in the field, which changes the way the employees access information within the organization.

The workforce requirements of an organisation can extensively change when a new system is implemented. It can result both in a lower demand for certain types of employees and also a demand for other types of employees to carry out task required by the new system. (Davis & Jackson, 2005)

IT system can have significant impact as well on management and decision making. By giving managers more accurate and timely information they can be able to make better decisions. However, this can sometimes create problems due to the large amount of data. If information is presented in an inappropriate format the decision making can be slowed down and the process would consequently be less effective. (Davis & Jackson, 2005)

Davis and Jackson (2005) describe how most of the new systems require a large initial investment from the organization. The systems might as well have financial effects on the whole operating lifetime. The workforce and management effects can also, positively or negatively influence the organisational budget. (Davis & Jackson, 2005)

Davis and Jackson (2005) describe how new IT system also can affect the processes and structures of an organization. Sometimes this can be the reason for IT deployment and in other cases it can happen unintentionally.

2.2.1. Crime analysis

It has become very important for the police to be able to evaluate their efforts in an effective way. One aspect of this is to understand the success level of initiatives taken with the objective to prevent crime. In the last couple of years the interest for this kind of analysis has risen to a large extent. (Boba, 2005) Crime analysis is according to Reuland (1977, cited in Dunworth, 2005, p. 8) serving four explicit functions in the criminal justice system. It is assisting investigations and apprehending offenders, preventing crime, supporting resource allocation and meeting the administrative needs of the organization. Another important aspect is, according to Boba (2005), the overall effectiveness of the police organization. The crime analysts help the police department to use their resources in a more effective way by doing analysis of their internal organizational procedures. In the last decade the crime analysis has had an extensive development and today there are very few police departments without crime analysis capabilities. (Dunworth, 2005)

Crime analysis is not a linear process but can, according to Dunworth (2005), be described in five steps: data collection, data collation and analysis, dissemination and feedback.

In the phase of data collection data are collected from various sources e.g. crime reports, officer investigations, evidence technician reports and criminal history records. Some information is also likely to be obtained from non-police sources like social service agencies, courts, city planners, schools and utility companies. (Dunworth, 2005)

Before data are transformed into a useful format for analysis, it often has to go through the three steps of data collation. The first step, cleaning, is used to correct mistakes and inconsistency. The second, geo-coding include the merging of crime analysis data together with geographic data with the objective to make the data ready for spatial analysis. The last step contains the creation of new variables in order to obtain more effective analysis, e.g. categories of crime. (Boba, 2005) During the analysis the analyst search to detect descriptive

patterns or other activities that can give an understanding of where future crimes possible will occur, e.g. with the use of crime mapping.

The dissemination phase involves the preparation of data given to the internal and external users (Dunworth, 2005). It is important that the findings from the analysis are communicated to the audience in the most suitable form. The way findings are presented may strongly vary between a presentation for the police management and a presentation for the media. (Boba, 2005)

In the feedback phase the crime analyst get feedback on the information that has been given to the police (Dunworth, 2005). It is valuable for the crime analysts to be provided with this kind of information since it can help to enhance the process. The feedback can e.g. include the quality of reports, the type of analyzed data and the usefulness of the information for decision making. (Boba, 2005)

2.3. Evaluation of DSS

The evaluation process is mostly needed during the post-process of implementing new information systems, such as DSS, in order for the organization to fully understand its outcome. Evaluating a system is very important for the organization as it assess its effectiveness and suggests further system improvements to better meet the organizational needs and goals. (Davis & Jackson, 2005)

There are two main kinds of evaluation which are known as summative and formative evaluation. Formative evaluation is performed during the development process of a system in different stages and points of time. It includes the periods of time which range from the creation of the prototypes to the final system product. Sometimes it can take place even during the maintenance and the upgrade period of the system. On the other hand, summative evaluation is conducted after the development has finished and the system has started to be used by its intended users. The system is evaluated regarding its efficiency, how it meets the users' needs for which it has been built and the impact that the use of the system is having on the organization. (Rhee & Rao 2008, Sharp et al. 2007)

Pick (2008) argues that it is easier to evaluate DSS after implementation. In addition Udo and Guimaraes (1994) argue that the evaluation of DSS to be more complex than all the other information systems because of the qualitative nature that the variables of individual and organization impact have. In many evaluations these impacts seem to have been underestimated because of the difficulty in measuring them (Udo & Guimaraes, 1994). In addition, Adelman (1992) describes the importance of determining the criteria before starting the evaluation process.

There are different methods of DSS evaluation and it is the evaluators' responsibility to determine the most suitable strategy. Adelman (1992) suggests the three-facet approach for the evaluation process which includes the technical, empirical and subjective aspect.

Technical evaluation means evaluating the system in two views: internal perspective by looking through algorithms and heuristics and external perspective by evaluating its input and output. Empirical evaluation measures the performance of the overall system in different terms, such as time, speed, improvement in decision process and so on. While in the

subjective evaluation, which is considered of high importance, the evaluator makes use of the questionnaires in order to get the opinions, thoughts and perceptions that the users have about the system. User satisfaction is considered a very important criterion to be measured during the evaluation but still it is considered insufficient. A high satisfaction about the interaction with the system does not necessarily imply that the organization is obtaining benefits from it. Other criteria which should be included are the quality of the decisions made and the effectiveness of the system. (Adelman, 1992)

It can be difficult, during the evaluation process, to prove if the decisions taken are correct or not and other difficulties may as well rise in assessing their quality. One way of measuring these issues indirectly is by means of the technical evaluation. The DSS evaluator should also keep in mind that the increased performance of the decision makers is not only due to the DSS, but other factors may also influence which need to be addressed and studied. (Rhee & Rao, 2008)

Different measures have been used to assess the success of IS during the years. Research studies have been reviewed and DeLone & McLean (1992) concluded that the success of a system is considered as a multidimensional construct which is difficult to define and measure. For this reason they presented their model which could be used in evaluating the success of different information systems. This model has been cited in nearly 285 papers in journals during the period 1993 to 2002 being the dominant IS success model. They have noticed that a lot of researchers have used it as a framework to develop their own variables and others have performed empirical measurement by citing this model and testing it. (DeLone & McLean 1992, 2003) We found this model appropriate for our evaluation study as according to Roldán and Leal (2003, p.69) the contributions of this model are:

“According to Ballantine et al. (1996) and Seddon (1997), DeLone and McLean’s work makes several important contributions to the understanding of IS success. Firstly, it consolidates previous research. Secondly, it provides a scheme for classifying the different measures of IS success that have been proposed in the literature into six dimensions. Thirdly, it suggests a model of temporal and causal interdependencies between the identified categories. Fourthly, it makes the first moves to identify different stakeholder groups in the process. Fifthly, it has been considered an appropriate base for further empirical and theoretical research. Sixthly, it has met general acceptance in the IS community.”

2.3.1. The Information System Success model

In order to organize the diverse research done on the success factors of the information systems during the years, DeLone and McLean (1992) came up with a model which presented a more integrated and comprehensive view of the success factors (Figure 2.2) In their model they showed that IS success measure does not depend only on one factor but on many of them which are interrelated to each-other. This model consists of six dimensions: system quality, information quality, use, user satisfaction, individual impact and organizational impact. (DeLone & McLean, 1992)

When the system is created it is mostly characterized by system and information quality. The system is used by the users who can be satisfied or not with it and during its use the system can have an impact on them. This impact in total will bring along the organizational impact.

System quality is regarded and classified in terms of technical level and the information quality in terms of semantic level. On the other hand, use, user satisfaction, individual and organizational impacts are considered to evaluate the effectiveness of the system. (DeLone & McLean 1992, 2003)

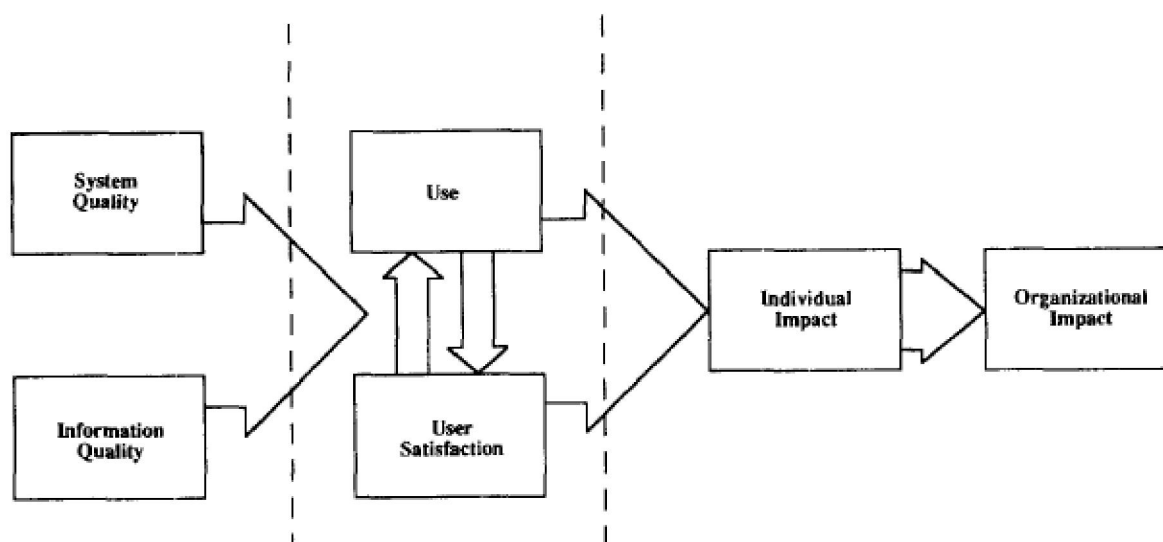


Figure 2.2: DeLone and McLean IS Success Model (DeLone & Mclean, 1992, p. 87)

Besides suggesting a process model, they also showed that system quality and information quality alone and/or together can effect use and user satisfaction. Additionally, use and user satisfaction can effect positively or negatively each other. Both use and user satisfaction lead to an individual impact which in turn leads to organizational impact. Researchers should choose carefully the items for each of the six categories in order to measure the overall success. (DeLone & McLean, 1992)

After 10 years, DeLone and McLean revised their work and presented a new updated model in 2003. They included an additional dimension 'service quality' and also combined together the individual impact and the organizational impact in a new factor named 'net benefits'. In addition, the 'intention to use' was added to the use dimension to complement it better. (DeLone & McLean, 2003)

In this study, we have chosen to conduct evaluation research using the DeLone & McLean model of the year 1992, because it has been frequently tested through the years by many researchers as mentioned in DeLone and McLean (2003). In addition, besides the other success factors, we find it important to see how the system usage has affected the users in their work and the whole police organization. Therefore the individual impact of DSS should be measured separately from the organization impact.

According to DeLone and McLean (2003) it is the responsibility of the researcher to choose the items which will best measure the success factors depending on the context where the

information system is operating. For this reason the authors found that these factors have been measured by means of different items in different studies.

Seddon (1997) describes how *system quality* is concerned with issues such as if there are 'bugs' in the system, user interface, ease of use and sometimes even quality and maintenance of program codes. On the other hand, DeLone and McLean (1992), consider system quality as the desired characteristics of the information system, which main aim is the production of information in order to be used by the users and decision makers. DeLone and McLean (1992) searched and studied around 12 research studies which were focused on measuring the system quality. They realized that researchers have measured it differently by using and testing different items. They mentioned for example the study of Belardo et al. (1982) in which items like reliability, ease of use, ease of learning and response time were used in order to measure the system quality.

The item of learnability measures how easy it is to learn to use a system. Usually, people want to start working with a system in order to accomplish their tasks without wasting too much time learning it. Although the system may include many functionalities which can be very useful to the users, it can be ignored by them as they can be unable or are not ready to spend too much time learning it. (Sharp et al., 2007)

The next measurable item in this factor is the response time which is considered an important aspect of usability as it refers to the time the system takes to answer to a user's query. Generally, the response should be as fast as possible, otherwise the users can get frustrated. When the response time is low the users should be provided with a feedback of what the system is doing. In this way they will be assured that the system is still working, so it doesn't have any problem; by knowing how long it will take the system to reply the user can manage his time in working on other things; it provides the user to see something so that he/she will not be totally frustrated. It is recommended that those operations which take more than 10 seconds, a percentage progress indicator should be displayed in the screen. (Nielsen, 1993)

In the Doll and Torkzadeh (1988) study, an instrument was constructed to cover the aspect of the system quality by one scale measure and it was mostly focused on the ease of use. If the users find a system or an application easy to be used, they may become advanced users and can fully use all the functionalities offered by the system. In this way, the productivity will be improved and the decision makers will have the possibility to study and search for additional alternatives during the decision making process. (Doll & Torkzadeh, 1988)

Information quality refers to the quality of the information which the system produces. It is considered an important factor when the system being evaluated involves the production of information to be used during the decision making process. (Seddon, 1997) In addition, Rai et al. (2002) discuss the information quality as the one which is related to the content, accuracy and format.

Allwood (1998) argues that it is important that users have access to appropriate information in order to solve their tasks. If the information is not relevant enough it can be hard to understand and this may lead to frustration. Furthermore sufficient accuracy is very important for the users in order for them to trust the information in the system and the relation between accuracy and the decision level is important. (Lucey, 2005)

Sharp et al. (2007) discuss how the presentation of information greatly can affect the way the users regard the easiness of assessing information in the system. The authors also describe the way the information needs to be presented in the appropriate format in order for the users to understand the underlying meaning of the information they are studying.

Lucey (2005) discusses the importance of having a regular time in producing the information needed for the users. With delays potential vital information can turn into worthless paper. The author argues that it is important that regularly produced information is created at a frequency that suits the decision or the activities which are involved.

Information quality has been measured in numerous researches by means of: timeliness, completeness, consistency, accuracy and relevance (DeLone & McLean, 2003). According to Seddon and Kiew (1994) information quality measurements consist of the relevance, accuracy, format and timeliness. On the other hand, Doll and Torkzadeh (1988) have tested and constructed an instrument including accuracy, content, format and timeliness which have shown to have adequate reliability and validity.

IS use means using the system for everyday work and tasks purposes (Seddon, 1997). According to DeLone and McLean (2003) the main aim is to determine if the system is being fully functional used for the purposes which it has been built.

Based on DeLone and McLean (2003) system use has been measured in terms of frequency of use, time of use, number of access, dependency and usage pattern. Seddon (1997) also describes the items which can be used in order to measure IS use. He considers the time spent in using the system, frequency of use, number of users. He proposes that there can only be one variable taking the values: use and non-use. Practically, Barki and Huff (1985) measured in their study one aspect of DSS success by considering its relative frequency use when the decision makers were making decisions.

User satisfaction has been defined by Bailey and Pearson (1983, p.531) as “*satisfaction in a given situation is the sum of one’s feelings and attitudes toward a variety of factors affecting that situation*”.

In addition, satisfaction is described by Nielsen (1993) in terms of how pleasant it is to use a particular system. The author describes that the simplest way possible to measure the system's satisfaction is by asking users directly how they perceive the use of the system. When a reply is obtained only from a single user it is considered a subjective satisfaction, but on the other hand getting the average of a number of individual user's opinions can create a more objective opinion. Usually to measure the system satisfaction the users are asked to rate the system on 1-5 or 1-7 Likert scale questions. The final rating is obtained by simply calculating the mean of the individual rates e.g. in a scale of 1-5 a rating above 3 shows an average satisfaction of the users. (Nielsen, 1993)

A great amount of research about user satisfaction has been performed in the past. User satisfaction, in the DeLone and McLean (1992) model, is measured indirectly through the variables of system quality, information quality and IS use. (Rai et al., 2002) Baroudi and Orlikowski (1988) have developed a 13-scale measure of user satisfaction. They also discuss the use of only one scale measure in the cases when an overall user satisfaction is desired.

Additionally, Alavi and Henderson (1981) measured the DSS user satisfaction by considering its overall satisfaction.

DeLone and McLean (1992, p.69) define *individual impact* as:

“an indication that an information system has given a user a better understanding of the decision context, has improved his or her decision making productivity, has produced a change in user activity, or has changed the decision maker’s perception of the importance or usefulness of the information system”.

DeLone and McLean (1992, 2003) have found out that a lot of researchers have measured the individual impact using different measurements such as the average time to take a decision, the confidence in making decisions, user productivity, task efficiency, decision-making performance, quality and effectiveness of work.

Goodhue and Thompson (1995) proposed two main questions in order to measure the individual impact. These questions were related to the impact of the computer system on their effectiveness, productivity and performance in their work.

DeLone and McLean (1992) refer to *organizational impact* as the factor which measures the impact that the use of the system has on the overall performance of the organization, if it has been improved or even changed. Different cases and field studies have used variables like economic performance, return on assets, profitability, cost effectiveness etc. (DeLone & McLean 1992) In addition, Hamilton et al. (1981) discuss in their study that the profits of an organization can be improved by the use of the information systems.

2.4. Summary

We decided to start this chapter with a description of DSS, its benefits and its relation to the decision making process in order to introduce a general knowledge about the kind of system that is going to be evaluated. DSS are used in many domains but this study will be focused on a special context in which it is used and that is the police organization. To get a deeper understanding of the real use and impact of DSS, in other words its success, it is necessary to know the context in which DSS are functioning. For this reason, the second section of the literature review gives an overview of information technology within police organizations, and the main tasks and work of the police.

The focus of this evaluation study is the success of DSS in the police organization. We find the model of DeLone and McLean (1992) as a more complete model in assessing the system success as it covers the different perspective of the IS success. We are going to measure the six success factors that the model presents: system quality, information quality, use, user satisfaction, individual impact and organizational impact. A description of these different success factors has been given together with previous research studies. On the basis of research studies done we will try to collect the appropriate data in order to measure the success factors.

3. Research method

In this chapter we discuss the choice of method followed by describing the data collection and analysis and finally critical methodological reflections.

3.1. Choice of method

In this study we conducted a summative evaluation of the success of SMF in order to understand its use and impact on the organization. The research question and the choice of model used in the study, have been guiding us in the choice of the method and approach. When conducting evaluation research it is important to choose a research strategy and a method that are appropriate for the objective of the evaluation. It is also important that the researcher gains a deep knowledge in the area of study in order to carry out the process (Robson, 2002)

Robson (2002) argues that doing evaluation is a complex process where it can be beneficial to use both qualitative and quantitative data. For this reason and in order to fully cover all the aspects and dimensions of the success model of DeLone and McLean we combined both qualitative and quantitative approach by conducting a survey and an interview. The survey's intention was to measure the first five success factors of the model and the intention of the interview was to measure the last sixth factor of DeLone and McLean model.

The main purpose of quantitative research is the quantification of collected data. It is a way of depicting a relationship between theory and research. (Bryman 2008) By means of a quantitative approach we will measure five dimensions of the DeLone & McLean model which are system quality, information quality, use, user satisfaction and individual impact. In our study we considered a survey to be most appropriate and relevant in order to measure the five success factors. By getting the opinions and thoughts of the system users through the survey, conclusions can be drawn about the real use of the system, user satisfaction and impact. The survey involved the use of a questionnaire and was addressed to all the potential users of the system inside the police organization of Skåne. It was classified as a more appropriate method for these factors as it would provide a large amount of data in a short period of time.

DeLone& McLean (1992) describe that the organizational impact is measured by the cost effectiveness, profitability, and overall performance of the organization. Based on this we thought that the simple users of the organization will not have the adequate knowledge to answer these kinds of questions. Davis and Jackson (2005) describe the difficulties in evaluating the benefits and costs related to the systems in the crime area as they cannot be expressed in monetary terms. Furthermore, they suggest that a qualitative study would be appropriate to measure the potential positive impacts and some of the potential cost. To comply with these suggestions, an interview with the key persons was found to be suitable in order to get the right information about the overall impact on the organization by using this kind of system. So, by means of the interview we got the answers, by people who have estimated it, about the impact that the system is having on the organization. Creswell (2007) discusses that the qualitative research is used when a problem or issue needs to be explored

and we need to get a detailed understanding about this issue. Another reason for using the approach is that it takes into consideration the particular context the individual is working in (Jacobsen, 2002).

In our study we are using the approach of completeness in combining the two methods. According to Bryman (2008), this approach is suitable when the gaps of one method (i.e. quantitative) can be filled by another (i.e. qualitative). In this case, the survey was used to measure five of the success factors, while the interview was conducted to obtain the answer to the last success factor. So, both the survey and interview complemented each other to measure all the factors of DeLone and McLean model in order to give answer to our research question. We believe that the combination of the two methods will increase the quality of the research because it will reduce the uncertainty about the results and at the same time it will enhance the reliability. Jacobsen (2002) describes how the use of qualitative research has its strength in internal validity and a weakness in external validity. With quantitative method it is the opposite. For that reason, the author argues that the methods are complementary and not competing.

3.2. Data collection

This study started with an introduction meeting with our contacts in the police in Skåne. The initial contact was established by e-mail after we had read an interesting article regarding the way they are working with Business Intelligence to prevent crime. A meeting was organized in order for us to get an idea of how they were working with their particular system, its objectives and usage within the organization. During this meeting the purpose of the study was established.

3.2.1. Literature review

The main aim of literature review was to develop a framework, based on DeLone and McLean (1992) model of IS success, which would support and at the same time be used in the empirical study. It was also a way to make sure that we became aware and gained knowledge of contemporary research in the field. Academic search engines, databases and journals related to issues of our field of interest were identified and used. Different words were combined in the search such as DSS and crime prevention/analysis or evaluation/success factors in order to find the appropriate material.

3.2.2. Interview

The main aim of the interview was to fill the gaps not covered by the survey. The interview was carried out with the purpose of collecting information related to the organizational impact of the system and also to get an overall understanding of the respondents' experiences of the system. The interview was conducted before the creation of the survey in order for us to have the time and knowledge to create a questionnaire suitable for the users of the system.

Kvale (2009) argues that the main aim of the qualitative research interview is to understand the interviewees' point of views and also to unfold the meaning of their experiences. The interview was carried out with our two contact persons in the police, who have been responsible for the development and maintenance of the system. Group interviews are, according to Jacobsen (2002), suitable when the main aim is to get the experiences of individuals in a particular context. The author suggests that the situation may lead to a thought

process where the individual begins to process their experiences during the interview and help each other to understand what has happened. This is, according to the author, an effective way of understanding why a person has a certain opinion about a particular issue. In our case the respondents believed that they would complement each other in a positive manner and therefore the interview was conducted with them both at the same time. When they had a discussion with us, during the interview, they even had a conversation with each other by affirming or supporting what they were saying. In this way, we believe, more points of view were unfolded.

The *interview questions* were divided into two main parts. The first part of the interview was focused in getting a general picture of systems used in the police organization, with particular focus on the DSS we are investigating. This was done in order to obtain knowledge to create the survey. In the second part of the interview, questions were constructed in order to receive answers concerning the last dimension of the IS model, the organizational impact. (Appendix A) These questions were based on items to be measured, listed in DeLone & McLean (1992).

The interview we conducted was semi-structured. As described by Bryman (2008) a semi-structured interview refers to a series of questions where the sequence however can vary and it is possible to add or reduce questions if needed. We had a list of questions in an interview guide that we wanted to cover during the interview. We had the possibility to change the order of the pre-prepared questions when it was necessary as well as when questions came up to clarify answers or situations which were not clear to us.

Usually methods used to document interviews for later analysis, include audio and video recording, note taking and remembering. In order not to forget important findings, not to lose concentration, not to lose the flow of the interview, interviewers often choose to the recording method. (Kvale 2009) We used an audio recorder during the interview and made some short notes when it was necessary.

3.2.3. Survey

Given the DeLone and McLean (1992) model the aim of the questions in the survey was to measure its first five success factors. Each factor was measured by one or several items. Most of the items, as it will be shown below, have been based on previous researches which main focus was to measure and test this model.

Creation of the survey

Some of the items used in the survey were based on other questions which have been used, tested and validated by other researchers during their own studies (Appendix C). As Bryman (2008) argues, this opens on to questions which have been pilot tested and also allows the researchers to make comparisons with other studies performed.

Starting the questionnaire with demographic questions will put the obtained results into context (Sharp et al., 2007). For this reason we decided to start the survey with some questions about the age, gender, work position and the level of access the users had in the system. In this way, an overall understanding of our target population would be obtained.

There were two break points in the questionnaire. One was that the surveyed employees should not answer the following questions if they never had accessed the system. On the other hand, the system has two main access levels. The users who have view access level cannot

make changes in the system, but can have a look at the information they want, while the user with analyses access level have the possibility to make further analyses in the system and also to make changes in it. (Simonsson, 2007) For this reason, the second break point made a division between the viewers and the analysts. Those who have view access level should not answer the last five questions. Everyone was free to give comments at the end of the questionnaire.

The format of answers used in this survey was mostly Likert scale. Sharp et al. (2007) describe that the main aim of Likert scale is to get the ideas, opinions, beliefs and attitudes of the users towards a specific product. Therefore, this is a good way to capture the opinions of the real users on the system that is being evaluated. On the other hand, we have to recognize that the success factors are being perceptually measured as they are based on the users' ideas and thoughts. Different users may express divergent ideas and feelings for its characteristics.

To measure the *system quality* two of the questions in the survey were based on the instrument created by Doll and Torkzadeh (1988) which covered the issues of the ease of use and learning and have been tested and validated. Also, looking through the list of the items to be measured in the DeLone and McLean (1992) study, which was categorized by the six dimensions, we chose to measure the response time of the system. Therefore the three items used to measure this factor were:

SQ1: Is SMF easy to use?

SQ2: Is SMF easy to learn?

SQ3: Are you satisfied with the response time of the system? (E.g. the time it takes to get an answer to the question)

All the questions were measured with a 5-point scale where the items about ease of use and learning ranged from 'very difficult' to 'very easy'. The higher items scores show higher ease of use for the system. In the response time, the range of answers varies from 'never' to 'always' and the higher scores show low response time for the system resulting in a higher system quality. (Appendix D)

To evaluate the *information quality* of a system, Doll and Torkzadeh (1988) have proposed four main aspects to be measured: content, accuracy, format, and timeliness. To include each of them, they have constructed an instrument, known as the user satisfaction instrument, which has been tested to be reliable and valid. In our study, we have used some of the items created by Doll and Torkzadeh (1988) with few changes. For the evaluation of the content we used two questions, one question for the accuracy, two questions for the format and one question to measure the timeliness.

CONTENT

IQ1: Does the system have the type of information you need?

IQ2: Does the system provide sufficient information?

ACCURACY

IQ3: Are you satisfied with the overall accuracy of the system?

FORMAT

IQ4: Is the output you get presented in a useful format? (eg. charts, tables, graphs)?

IQ5: Is the information presented in a clear and understandable way?

TIMELINESS

IQ6: Does the system provide up-to-date information?

Nearly all the 5-scale questions ranged from 'never' to 'always'. Only the question that dealt with the evaluation of the accuracy ranged from 'not at all satisfied' to 'completely satisfied'. Higher items scores show higher information quality. (Appendix D)

The two key questions used to measure the *system use*, were based on a study of Seddon (1997). He proposed an instrument where the use can be measured by simply questioning the users about their frequency of use. Before measuring the usage frequency, we decided to use a binary question which consisted of two alternatives: use and non-use which as mentioned above was as well the first breaking point question.

U1: Have you ever logged into SMF?

U2: How often do you use SMF?

U3: How much time do you spend when using the system?

The U2 and U3 items were not Likert scale but they consisted of different alternatives from which the respondents could choose. (Appendix D)

The assessment of the *user satisfaction* was performed according to Rai et al. (2002), who measured it by one single item. Main focus of this item is to measure the overall and global satisfaction of the users and not aimed specifically to areas of content and discontent. Also, the fact that user satisfaction in the DeLone and McLean (1992) model is indirectly measured by the other factors implies that only one-single item is considered sufficient to measure it (Rai et al., 2002). Using only one item would help us to keep a short and effective questionnaire for our target group.

US1: How do you rate your satisfaction with SMF?

The 5-point scale item ranged from 'not at all satisfied' to 'completely satisfied'. The higher scores show higher user satisfaction. (Appendix D)

To measure the *individual impact* we constructed an instrument of 8 items. The questions were based on the items that DeLone & Mclean (1992) had listed in their study in order to measure the individual impact. In this way, we could get the opinions of the users and the impact that this system had on them. We tried to focus on the performance and quality of their work and decisions. The first three questions were for both the analyst and the view access level respondents, while the last 5 items were only for the analyst in order to get a deeper understanding of how SMF helped them during their analyses and decision making process.

- I1: By using the system, you get a better understanding of important trends.
- I2: By using the system you improve the quality of your work.
- I3: You rate SMF an important tool in your work.
- I4: The identification of problems/opportunities been improved by using the system.
- I5: The possibility to do more in depth analysis been improved by using the system.
- I6: SMF is a valuable tool to produce decision support.
- I7: The use of the system has reduced the time it takes to create the foundation for decision making.
- I8: SMF is an important support in decision-making.

All the answers ranged from 'strongly disagree' to 'strongly agree'. The higher the score, the greater the impact on the users is (Appendix D).

Population

The selection of the survey sample was difficult due to police rules and regulations. It was not possible for us to get a list of the names of the system users. For this reason the survey was created in a program that the police possessed. A notifying e-mail, by means of their internal network, was sent to the potential users in the police organization in Skåne asking them to participate in the survey by sending a link from where they could access the survey. All the answers given by them were immediately recorded in the survey program. The users had approximately one week time to answer to the survey. Everyone had the same opportunity to complete the survey as it was available to all during one week. On the other hand, we cannot say that the answers we got were a good or bad representation of the organization. As the e-mails were sent to all potential users it was impossible for us to control who was going to answer the survey.

Pilot study

Pilot study is an important step during the survey creation as it can be tested in advance before it reaches the real respondents. It identifies errors and mistakes which have to do with the layout, presentations and other issues related to the understanding of the questions. It allows the researchers to correct mistakes before starting the real survey. A pilot study is not only aimed at new instruments but also to old ones which have been previously used and tested. (Litwin, 1995)

Although the questions of this study were tested and validated in other researches, a pilot study was performed. Before translating the survey to Swedish, we conducted the first pilot study with two friends of ours to check if the questions were clear and understandable and if the items scales were correctly defined. During this phase, a few changes were made, especially in the questions which were found to have similar meanings and some changes in the naming of the scales.

Litwin (1995) describes that it is possible to conduct research even when the respondents do not know the language in which you are conducting it. He argues that one way is to translate the survey to the mother language of the respondents. Our contact persons in the police organization of Skåne informed us that several respondents were not fluent in English, so we

decided to translate the survey to Swedish. In this way, we were convinced that the users would understand the questions and hopefully give clear answers.

The pilot study should use people who are similar to those who will be the final respondents (Fink, 1995). After the translation to Swedish a second phase of the pilot study was performed with our two contacts in the police organization that were responsible for the system project. After they had reviewed the survey, they made suggestions how to simplify the language and slightly changing the questions to be more understandable.

3.3. Data analyses

Data was collected by both qualitative and quantitative methods and separately analysed. This section will start with the analyses of the interview followed by the survey.

3.3.1. Interview analyses

Transcribing

Transcribing is preparing the interview material for the next step of analysis, which means the conversion from oral to written mode (Kvale, 2009). We made the transcription of the interview as soon as possible after the interview in order not to forget themes and issues that had come up. Oates (2006) puts forward one rewarding aspect of transcribing which is to bring the research back to the interview and it is possible to start thinking about the collected data.

Kvale (2009) argues that it is important that the researcher describes explicitly how the transcripts were made. Our transcribing was made word by word, but not containing multiple dimensions such as emphasis in intonation, pauses and expressed emotion.

Coding and analyzing

After the interview was transcribed, we started to go through the data in order to distinguish significant patterns. We also wrote down thoughts, which came up, when processing the data. In the first analysis of the qualitative data we were inspired by two methods, described by Kvale (1997), concentration and categorization of the meaning. Concentration of the meaning refers to the task, when the words of the interviewee, are formulated more concisely. Long statements are cut down and the significant meaning of what was said is rephrased into fewer words. Categorization of the meanings, on the other hand, refers to the coding of the material into categories. These categories can be pre-made but also be constructed after the interview is inspired by the theory or the interviewees for instance. (Kvale, 1997)

3.3.2. Survey analysis

367 usable questionnaires out of 3500 potential ones were obtained resulting in a response rate of nearly 10%. Simonsson (2009a) describes that this is a common response rate when surveys are conducted within the police organization of Skåne.

Cleaning of the data

When the answers of the questionnaire were obtained, the process of cleaning the data started. As mentioned before, there were two breaking points in the survey. These did or did not allow

the respondents to continue with the following questions. In order to increase the reliability of the survey, the respondents who have not provided an answer to these breaking point questions were not considered. Looking through the data, it was observed that there were some respondents who had answered to the survey but from their comments we understood that they did not have any idea about the system being surveyed. These cases were also excluded from the file.

Besides the breaking point questions, some other questions were left unanswered. Bryman (2008) discusses the reasons for missing data being due to accidents or due to respondents not wanting to answer the question. In the cases when the respondents gave two answers to one question, we considered the answers invalid and reported it as a missing value.

Totally there were 381 cases. During the cleaning process 14 cases were deleted resulting in 367 usable questionnaires.

Coding

Coding is the process which takes place before the data analyzing starts. Numbers were assigned to the answers of the surveys in order to make it easier to identify patterns among the variables (Czaja & Blair, 1995) It is important even for the missing data to be tagged with a number which does not show anything and it is not considered a true figure (Bryman, 2008). For this reason, all the data obtained through the survey were coded by numbers and the missing data were coded by putting the value 0 which was declared in the software being used for the analyzing.

Analyzing

The analysis of the data was conducted by means of the SPSS software which is specialized in statistics. A test of inter-consistency reliability was performed for three of the latent variables which used a group of multiple-scales items and which showed an inter-reliability coefficient higher than the recommended level of 0.8 (Bryman & Bell, 2007). Graphs and pie charts were used to analyze who our respondents were and their general characteristics. The descriptive statistics was conducted and the means, standard deviation, maximum and minimum values were calculated for most of the items and indirectly for the success factors (latent variables) of the DeLone & McLean model. This was realized by performing the summaries and the averages of the multiple-scale items correspondent to each latent variable. At the same time, cross-tabs and dependency tests were conducted to test any possible dependency among the variables. In order to see how the success factors were related and how they could affect each other, a matrix of correlation among them has been constructed.

3.4. Methodological critical reflections

3.4.1. Reliability

An important aspect of reliability is that another observer would be able to do the same interpretation of the same data if the research would to be repeated again. It is important that there is only one single valid explanation. By some qualitative researchers, the concept has been divided into internal and external reliability. Internal reliability refers to the extent that different researchers identify similar constructs as the original researchers. External reliability

is more demanding and is referring to the overall replication when a research study is carried out in re-study exercises. (Seale, 1999)

We have tried to describe our research process as detailed as possible. We described all the technologies and techniques used and other circumstances which may have affected the research. By being accurate in our description, we believe that both the internal and the external reliability have been enhanced and made easier for the research to be repeated.

Reliability is a particularly important issue when doing quantitative research (Bryman, 2008). In quantitative methodologies reliability refers to the testing of the instrument of the survey and how productive they are (Litwin, 1995).

According to Litwin (1995), internal consistency is an indicator which determines how well a group of items is measuring the same issue. The data is considered to be more reliable when a group of items are used to evaluate a specific behavior or factor. Cronbach's coefficient alpha is used to measure the internal consistency reliability of the items which construct one single factor. It shows how well the items complement each-other in measuring the different aspect of the same variable or factor. (Litwin, 1995)

For the use and the user satisfaction factors in our case the Cronbach's alpha is not applicable, because according to Gliem and Gliem (2003) the former is measured only by a single item and the latter is measured by items which are neither dichotomous nor multiple-scales and their answer format is different from each other. In addition according to Bryman and Bell (2007) the Cronbach's alpha is used when the items scores are aggregated to form the overall score.

As there were three main factors which were measured by groups of Likert scale items, the internal consistency reliability test was conducted and the Cronbach's coefficient alpha was used (Table 3.1). All of the factors showed a reliability alpha greater than 0.8 which according to Bryman and Bell (2007) indicate adequate internal consistency.

Table 3.1: Alpha internal reliabilities

| Factor | Cronbach's alpha | Number of items |
|---------------------|-------------------------|------------------------|
| System Quality | 0.843 | 3 |
| Information Quality | 0.911 | 6 |
| Individual Impact | 0.957 | 8 |

Some of the questions in the interview, formulated to gain understanding the organizational impact of the system, were also inspired by topics used in the model of DeLone and McLean (1992) which might influence them to an enhanced reliability.

3.4.2. Validity

Validity is related to the integrity of the conclusions which are drawn in a research and can be divided into different types such as internal and external validity (Bryman, 2008). In order to enhance the internal validity, it is important to encourage methodological awareness in order to give assurance that the findings of the research are presented in the best possible way (Seale, 1999). It has been important for us, in every aspect of our study, to have a logical design and to be comprehensible to all future readers. We have tried to be very careful in designing the research and have critically discussed problems encountered in our work, both between ourselves and also with our contacts within the police.

According to Litwin (1995), validity in a survey is assessing the fact of how well the survey really is measuring in comparison with what it is expected to measure. We did a pilot study in order to handle this. It has been performed in two phases. In the first phase, simple face validity was conducted. Litwin (1995) describes face validity as a process where the questionnaire is shown to casual individuals such as relatives and friends to see if they think that everything is all right and understandable. In the first phase our friends were involved and in the second phase our contacts in the police tested it to see if the question used in the survey were appropriate and correct.

External validity refers to the probability that the causal propositions are likely to hold true even in other settings and this is an aspect of the generalizing of the findings. Seale (1999) describes generalization as an important part during research studies. The quantitative research studies a large sample of data, because of the inability to study all, and after taking in consideration probabilities, variances and other factors, the researchers come up with results which can be generalized within broader aspects. (Seale, 1999) This was one of the reasons why a survey was chosen as part of this research. With the help of the survey, many people have been reached and their opinion and thoughts have been collected.

It can sometimes however be difficult to generalize over the findings when the researchers only have the possibility to study single cases and cannot study a fairly large number of studies to draw general conclusions. It is up to the reader to make judgments over the research studies in order to transfer those results and findings to the own situation and make the appropriate generalization. Seale (1999) Therefore, to raise the external validity in this study, we have given detailed and necessary information concerning how the research has been conducted in order for the reader to judge where these findings are applicable.

3.4.3. Ethical issues

Ethical issues are concerned with the perspective of right and proper conduct. It is an important aspect in research that continuously accompanies the researcher in their studies. By acting in an ethical way it is possible for us as researchers to influence our environment in a good way. Another reason for acting in an ethical way is that we and our colleagues can be assured that we will gain a more accurate and original result. (Israel & Hay, 2006) While doing this research, ethical aspects were considered throughout the whole process. We were mainly focused on two important ethical issues related to this study: informed consent and confidentiality. The work was conducted in a manner trying not to cause problems or put the participants in difficulties.

Before starting the interview, the respondents were informed about the objectives and purpose of the research, the demands and the possible outcomes. They also gained information about the way the research was going to be conducted, about the tools, models and techniques that were to be used. Also the respondents of the survey were given a brief description of the study before answering the questions. According to Israel and Hay (2006), the approval should not be focused only in the beginning but also during the whole ongoing process, if something unexpected should happen. We have tried to keep this in mind and paid special attention to changes that could influence the attitudes of participants towards taking part in the research.

Another ethical aspect of social science research is the confidentiality of the participants in the research. Israel and Hay (2006) argue that sometimes confidentiality is a signed agreement but as well other agreements can take place in a more informal way. The survey started with an introduction part where the respondents were assured about the confidentiality and the protection of their privacy. Together with this information, they were provided with an email address in case they wanted clarification about anything related to the survey.

4. Empirical material

This chapter presents a short introduction about the police organization in Sweden followed by a more specific and detail description of the organization in the region of Skåne. This organization has developed a DSS, which we will describe as it is the system we are going to evaluate in our study. The chapter also gives a presentation of the interview and survey results.

4.1. The police in Sweden

The main aim of the Swedish judicial system is the legal security and the security of the individual in front of the law. The objective of the criminal and social policy is to reduce crimes and consequently to increase public security. For the police in particular the objectives are to reduce crime opportunities, to increase the quality of crime investigations and to prosecute more crimes than is possible today. (Polisen, 2008a)



Figure 4.1: Police Organization in Sweden (Polismyndigheten Skåne, 2008a, p.6)

The National Police Board (NPB) is the link between the Swedish Government and the police authorities (Figure 4.1) and is a supervising central authority (Polisen, 2008a).The Swedish

National Laboratory of Forensic Science is working as an impartial expert body in investigations of criminal matters and is subordinated the NPB (Polisen, 2008b). The National Security Service works towards the protection of the national security and against terrorism (Polisen, 2008c). The National Criminal Police (C.I.D.) works on providing investigation and criminal intelligence support on crimes on a nationwide or international level (Polisen, 2008 d). In Sweden each county constitutes a police district and the police authority is responsible for the daily police activities within the district. (Polisen, 2008e)

4.1.1. The Police in Skåne

To conduct this study we collaborated with the police in Skåne. This is the third largest police authority in Sweden and they have approximately 3 240 employees, of which around 2 340 are police officers and around 900 civil servants. (Polisen, 2008f) Around 37% of the police officers and 70% of the civil servants are women, which gives a total of 37 % women in the police authority in Skåne. (Polisen, 2009)

The police in Skåne are divided into five municipalities having at least one police station. The organization has two county wide departments and also the staff functions connected to the Chief Police Commissioner. (Polisen, 2008f) The County criminological department, one of the two county-wide departments, is responsible for the work against organized and serious crimes. The department is also responsible for matters of international character and to give support to local police forces within Skåne. (Polisen, 2008g) The other county department, the County operative department, is responsible for a diverse range of police functions in the county. Inspectors on duty lead and direct the emergency personnel and are responsible for e.g. the police contact center, the mounted police and the traffic section. (Polisen, 2008h) The staff of the Chief Commissioner is responsible for a variety of county-wide functions. One area is the internal support that is the police authority's overall administrative body. It includes issues relating to economy, business, IT, personnel, premises and training. (Polisen, 2008i)

The police work in Skåne falls into three areas; the police in the field, criminal investigations and crime prevention. The police in the field are supervised by a communication center and are trained to handle situations that happen in their daily work. (Polisen, 2008j) The police investigation activities are aimed at both investigating and detecting crime. The resources are directed to be available on time and location where the work will be performed. (Polisen, 2008k) Crime prevention aims to prevent crime, criminal activity or public disturbance. The police need to have knowledge of where and when crime may occur. It is important for the police force to cooperate with other organization in the society in order to gain good result. (Polisen, 2008l)

4.1.2. System for Measurement and Follow up (SMF)

The system started as a single application based on the system RAR (a system for crime statistics where all reported crimes are filed) created with the software Qlikview. The system was used by crime analysts to forecast when and where crime occurs. The police understood that there was a lot of time that could be saved by introducing the system to a broader user group. This information had earlier not been easily accessible to everyone and when presented evoked positive response. It became possible to gain information rapidly and directly and

experts were no longer required to help create these reports. During the year of 2006 the system expanded further. There was a need to follow up with information from other systems and also to be able to take the system down on individual level. The project started with the system COPS, which is a central operative planning system for the police, and was followed afterwards by three other systems. (Polismyndigheten Skåne, 2008b)

SMF is today connected to five of the system of the Police (Figure 4.2). It is RAR, COPS, DUR (a computer system for investigations containing information of interrogations, protocols etc.), STORM (the system for tasking and operational resource management) and AGRESSO (which contains the economic transactions). (Simonsson, 2007) More system can be connected to SMF if the police force in Skåne gets permission from the Data Inspection Board, the National Police Board and other concerned authorities. (Larsson, 2008)

Objective of the system

The main objective of the system was to create better decision support for the management of the organisation. Management at all levels were in need of a better decisions support in order to improve internal governance. This was done by the creation of an easily accessible and standardized tools for the collection of statistics which could be used for command and control, planning and monitoring. Earlier there had not existed any tool for this kind of information abstraction. (Simonsson, 2007)

Description of the system

The information in SMF is collected from sources (RAR, COPS, DUR, STORM, AGRESSO) with the use of text files. They are stored in different places and are saved as separate text files. The script in Qlikview decides where the information should be collected from and it is then stored in certain locations until a new transformation occurs and then the previous session will be erased. Every search is in this way unique. The text files collected by Qlikview are transformed to Qlikview files, which means that they become compressed in order not take up much space. (Simonsson, 2007) The system does step by step associative connections on the processed information. It makes it easy to see connections between data, even though they consist of information that traditionally is not combinable. The collected information can be visualised by different means, it could be e.g. diagram or tables. The applications exist in two formats, "view" and "analyze". The view applications are available to all employees through the intranet. Changes of layout made by the users are only temporary and after finished session everything returns to the original settings. (Simonsson, 2007)

A viewer can, by logging into the system, find out e.g. where and when crimes have occurred. They can also get a forecast on the context in which probable future crimes are going to occur. With accessibility to this information it is possible for the viewer to plan work in a smarter way. It is also possible to see where, when and how accidents have occurred. From this information the viewers can choose a mode of actions to take concerning traffic monitoring. The analyze users have the same access to information as the view users but in addition they can get further information to make analyses possible. In crime analyst, the application makes it possible e.g. to approximate e.g. the age of the offender and the victim. The analyst working with HR can e.g. get information about the amount of people working in a particular moment and what they have been working with. It is also possible to get an update on the production and compare individual achievements. (Simonsson, 2009 b)

The analyze applications are only accessible by certain employee when in depth analysis are to be carried out. (Simonsson, 2007) About 50 persons have access and the possibility to these analyses in the system. (Simonsson, 2009 c) In the analyze applications the users have the possibility to change its layout according to their own preferences, but this does not change the basic script.

The training on the system was half a day for all staff. The analyst however had an additional teaching in 2 days, one day with help from QlikTech. (Simonsson, 2007)

4.2. Empirical results

In this part of the chapter the interview conducted with our two contacts in the police organization in Skåne will be presented. It will be followed by the survey and comments given.

4.2.1. Interview

The interview made with our two respondents has been summarized and categorized into the main themes that they covered.

The role of IT in the police

The respondents describe how IT has a very important role in the police organization today. They explain how the entire organization has a separate organization mainly for this purpose with around 200 people maintaining and conducting IT issues. Within the police organization in total there exist around 1500 systems where some are old and some new, with different programming languages creating in this way a complex IT platform with many different sources of information storage. They describe how the organization today cannot function without the IT systems as they are the bases for crime analyses.

The system and its development

The reason for the development of this particular system was due to a need to overlook data in an easy way. The system was invented in Skåne for its own use and until today has not yet been spread further. However, the system had existed a while in the police network before it was possible to use. The reason was a lack of hardware, not yet developed, to support the system abilities. The system is today connected to different information sources and displays data in an easy way. The users have the opportunity to customize their own pages by choosing colors, numbers, formats, graphs etc.

The use and users of this system

In Skåne there are about 3500 users, which are able to use the system. The users are divided by level of access: view users and analyze user. In the view level of access the users may get only an idea about what is going on, while in the analyze level the users can perform analyses. They respondents guess that around 50 people use the system for analyzing at least a couple of times a week. They are unaware of the frequency of use of the viewers. Even though only 50 people have followed one-day training they believe that the users have found the system very easy. They describe the existence of a problem when the meaning of the data is not known. If the data cannot be interpreted by the users then they might not be able to use them, especially when doing analyses. Also, it may lead to be difficulties if the users are not familiar with the codes that are used in the system.

Future challenges

The applications are spread over different parts of the organization. The respondents describe how they are planning to add new systems and the first priority is the connection of the economic system Agresso. By the system supplier they have now learned to build applications independently and do not consider it to be a problem. They describe that it is possible to quickly make applications when needed and reusing the old ones.

The organization is also trying to connect the crime investigation area in a better way to human resources and to the economic field in order to have a better overview. They describe e.g. how the economic control needs to know where money comes from and on the other hand the investigation area should have knowledge about the cost issues. It has however been difficult to combine these different kinds of data.

They describe how it could be possible to spread the system to other police departments within Sweden in only three days. The police estimate that they could save 10 million kronor every year by doing this, and that it could be done in a very short time. They also describe that the system is constructed in such a way that it is possible to be used by other non-police organizations.

They describe how their difficulties concerning the system are not technical problems but rather decisions. The technology has become so advanced that it is no longer a problem. There are no problems with security and the system is perhaps more secured than it needs to be. The respondents believe that the users think that the security is a problem because the system is being so fast and easy.

Impact on the organization

The respondents believe it is difficult to evaluate the impacts of the system on the overall organization, since they have different fields of work. When comparing crime investigation, HR and the economic department they believe that the impact on the economic department is the most difficult to be estimated today. SMF is for the moment of the same importance as other systems at the economic department, but easier in use.

They describe that the system has an enormous impact on HR. The calculated saving each year by the use of the system is comparable with the work of 8-10 people and the annual cost of employing 10 people is around 5 million Swedish kronor. They estimate that this is around what the system has cost until now, so in one year they have already gained the cost of the investments of the system.

The respondents describe that it is hard to estimate the cost-benefit of the system related to crime investigations. With the system they have however a better control over the personnel and are able to measure what the individual produces and that they have recently been able to connect it to the salary development. They describe how it probably will take 5, 10 or probably 20 years before the system has a great impact on the organization but they still think that they have had an increase, about 5-15% of production in some areas. They argue that by means of the system people in the organization have a better way of making qualified predictions of how many crimes there will be in different places and times. It is important that they do not cut down the quality and this is something they believe they will first see in some years of use. They also express that with the system all employees in the organization have a better knowledge of crime development. They describe that there are a lot of factors affecting crime development. By measuring some of them they can make an effort in changing the

crime curves. This is something that is possible to do very quickly with the system. The respondents describe how the analyses earlier were more like guesses and that they now have more factual basis. Another aspect of the system is that there is the possibility to use key numbers in a better way and also to comment on them. If they do not understand the numbers, by means of the system, they can drill down and go deeper in details. They have had difficulties in evaluating their resource allocation, but now by looking on all the information they have, they can make better plans which is very important for the police.

4.2.2. The survey

Of the population of 3500 potential users, 367 usable questionnaires were obtained, which is a response rate of nearly 10%. 7% of the respondents were police and 22.9% of them were civil (Appendix E).

This sample contained a larger proportion of males 76.8% in comparison with females 27.5% (Appendix E). This is slightly different compared to the real numbers of 63% men and 37% women. 71.

The respondents' age ranged from less than 29 years old to more than 60 years. The majority are within the category 50-59 which is then followed by the 40-49 age group (Appendix E). These categories are mostly found in the research and administrative positions (Figure 4.2).

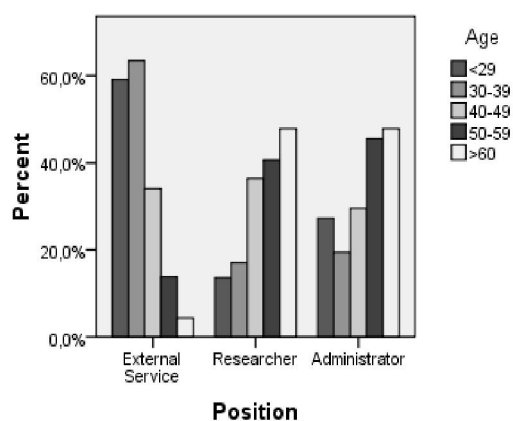


Figure 4.2: Position vs. Age

Of those who answered the survey, 18.1% have an analyze level and 81.9% have a view access level (Figure 4.3). Based on position there is nearly an equal distribution between external service, researcher and administrator (Figure 4.4).

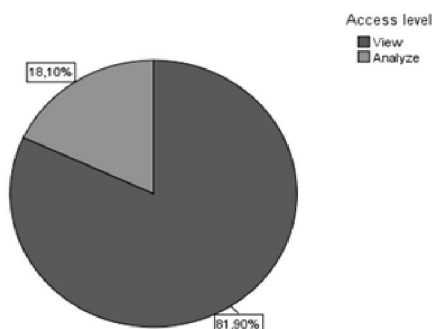


Figure 4.3: Access level

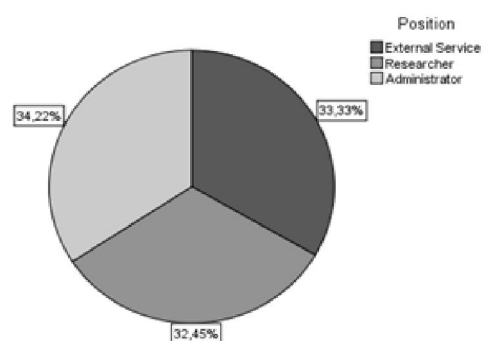


Figure 4.4: Position

System quality

System quality has been shown to have the highest mean value in comparison with the other factors (Table 4.1). It is clear that the system is considered to be relatively easy to use and learn and that there is a relatively good response time of the system.

Table 4.1: System quality

| | N | Minimum | Maximum | Mean | Std.Deviation |
|-----------------------|-----|---------|---------|-------------|---------------|
| Ease of use | 103 | 2 | 5 | 3.44 | 0.915 |
| Ease of learn | 103 | 2 | 5 | 3.42 | 0.913 |
| Response time | 102 | 1 | 5 | 3.31 | 0.944 |
| System quality | | 1 | 5 | 3.39 | 0.922 |

Information quality

The format group items have a higher score than the other items within this factor, which shows that the users are satisfied with the presentation of the information in the system (Table 4.2). The information quality is considered to be relatively good.

Table 4.2: Information quality

| | N | Minimum | Maximum | Mean | Std.Deviation |
|----------------------------|-----|---------|---------|-------------|---------------|
| Content | | | | | |
| Type of info needed | 102 | 1 | 5 | 2.88 | 0.836 |
| Enough info | 103 | 1 | 5 | 2.95 | 0.879 |
| Accuracy | | | | | |
| Accuracy | 101 | 1 | 5 | 2.91 | 1.105 |
| Format | | | | | |
| Presentation | 100 | 1 | 5 | 3.30 | 0.905 |
| Clear info | 99 | 2 | 5 | 3.28 | 0.881 |
| Timeliness | | | | | |
| Update info | 102 | 1 | 5 | 3.22 | 0.929 |
| Information Quality | | 1 | 5 | 3.09 | 0.939 |

System use

The results show that 28.6% of the respondents have logged in the system at least one, while 71.4% of them have never accessed it (Figure 4.5). The majority of the users are nearly equally distributed between the “very rarely”, “at least once a month” and “at least once a week” usage (Figure 4.6).

The majority of the users do not spend a considerable time using it. Most of them spend less than 15 minutes which is followed by an interval of 15 min to 1 hour (Figure 4.7).

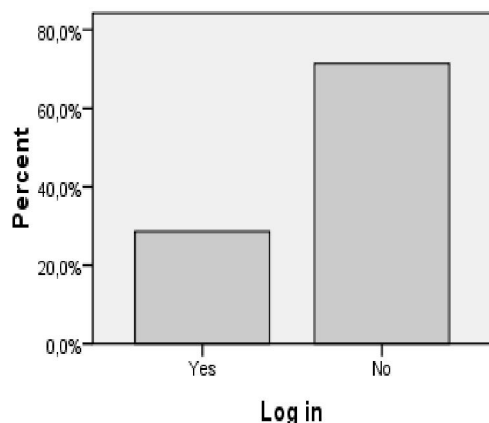


Figure 4.5: Log in

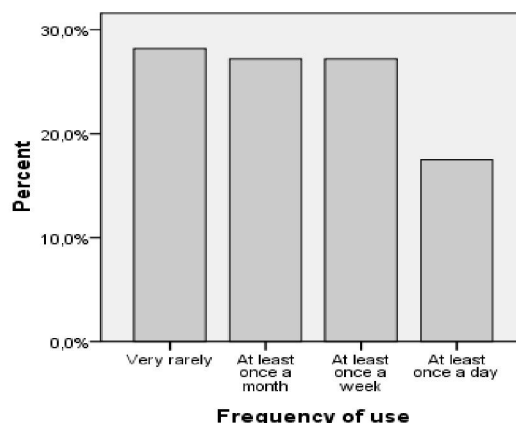


Figure 4.6: Frequency of use

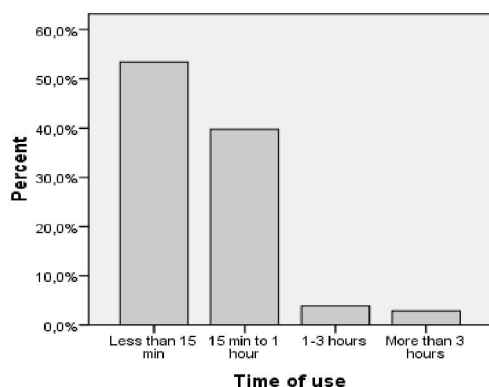


Figure 4.7: Time of use

As there are two main groups of users, based on their access level, we continued with further analyses. The result shows that the administrators have been more interested in the system by logging in at least once, followed by the other group, the investigators. Most of the external service employees have never accessed the system. It is obvious that both the frequency of use and time of use depend upon the access level. Statistically, it is tested by Chi-square test and there dependency is significant (Appendix E). Most of the viewers use the system very rarely, while most of the analysts use it at least once a day. (Figure 4.8) Even for the time of use, most of the viewers use it less than 15 minutes, while most of the analysts use it from 15 minutes to 1 hour, followed by another group who use it from 1-3 hours. While the viewers

are spread only between less than 15 minutes and 15 minutes to 1 hour, the analysts are spread in the four categories, including even more than 3 hours of system use. (Figure 4.9)

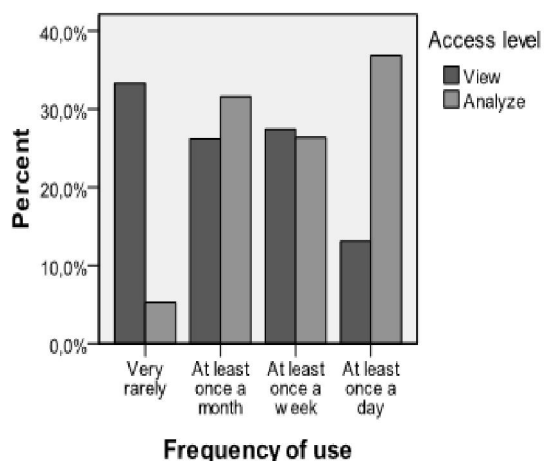


Figure 4.8: Frequency of use vs. Access

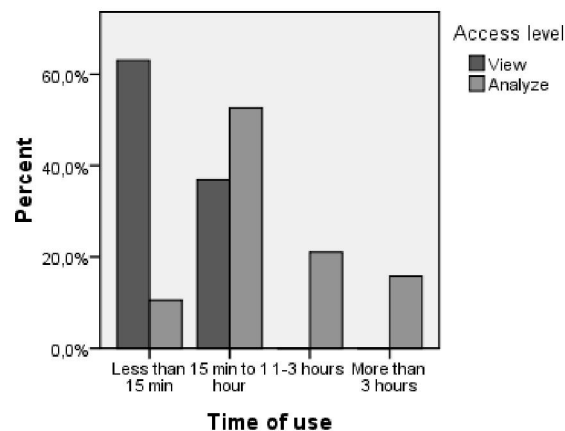


Figure 4.9: Time of use vs. Access

User satisfaction

The average rate given to the satisfaction is 3.07 which is considered to be somewhat above average. So, the users are considered to be relatively satisfied with the system.

Table 4.3: User satisfaction

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---------------------|-----|---------|---------|-------------|----------------|
| Satisfaction | 103 | 1 | 5 | 3.07 | 0.983 |

Individual impact

From the average rates, it seems that in the individual impact, the system has a greater influence mostly in the ability of performing a deeper analyzes and the materials which are in disposal during the decision making process. There is a significant influence in the problem/opportunities identification and in the time of generating reports from the system. In general, with a score of 3.1 out of 5 it is concluded that there is an individual impact of using this system and an average improvement in the users work quality and decision making process.

Table 4.4: Individual impact.

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|-----|---------|---------|-------------|----------------|
| View & Analyzes | | | | | |
| Better understanding | 95 | 1 | 5 | 2.99 | 1.087 |
| Work quality | 103 | 1 | 5 | 2.85 | 1.158 |
| Importance | 103 | 1 | 5 | 3.08 | 1.226 |
| Analyzes | | | | | |
| Prob/opport identific. | 19 | 1 | 5 | 3.16 | 1.167 |
| Deeper analyze | 19 | 1 | 5 | 3.32 | 1.250 |
| Foundation for decision making | 19 | 1 | 5 | 3.32 | 1.157 |
| Report time | 19 | 1 | 5 | 3.16 | 1.214 |
| System is supporting in decision making | 19 | 1 | 5 | 2.89 | 1.286 |
| Individual Impact | | 1 | 5 | 3.10 | 1.171 |

By means of Pearson correlation Table 4.5 shows the correlation matrix among the latent variables studied in this research. The table shows the linear relationships between the factors of the DeLone and McLean (1992) model.

Table 4.5: Correlation of the Latent Variables

| Variables | System quality | Information quality | Use | User satisfaction | Individual impact |
|----------------------------|----------------|---------------------|--------|-------------------|-------------------|
| System quality | 1.000 | | | | |
| Information quality | 0.685** | 1.000 | | | |
| Use | 0.326** | 0.202 | 1.000 | | |
| User satisfaction | 0.727** | 0.854** | 0.229* | 1.000 | |
| Individual impact | 0.614** | 0.746** | 0.528* | 0.596** | 1.000 |

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Survey comments

Most of the comments given by the users were directed to different aspects of the system. Some commented that this system is giving them the opportunity to see connections in a broader perspective than it was done before. SMF was described to have a great potential and was considered to be an important tool according to some of the respondents. Positive response was particular given to the RAR analysis application, but at the same time a user expressed a lack of support by this application and he believed that it is having reliability problems and is not enough adjusted to the needs of the users. Concerning the RAR view application comments described that many errors had occurred and major changes were needed. We also obtained comments about the users' insecurity regarding the correctness of the data. Some were afraid that the data were unreliable and there was an insecurity regarding

the fact if the crime codes were used in a correct way which can result in incorrect data in the applications. Some users were not satisfied by the update of the system as they believed that for the analyze applications they take place once in a month and it is lacking in some other applications. Other comments described the analysis applications as illogical and difficult and that education is needed to truly understand the system, while some admitted that this was not a system focused on their work. There were requests for further development of the system in the future and different issues were pointed out to be adjusted to users' needs such as information from the system Palasso and further development of the diagrams and tables in a more attractive appearance.

We also received comments from the users who have never accessed the system. Around 60 commented that they had never heard about the system and around 30 that they were not using it. Some remarked that now when they received the survey they had found out about the system. They did not know if they had accessed it before because they were uncertain about its name. Comments were also given on how fed up they were with system abbreviation commonly used within the police, in this case SMF. One person commented that the system seemed mostly useful on strategic level and not relevant for all the areas. Another wish was that these systems should be more prognostic and focused on the core business in order to be more useful, while another user, not aware of the purpose of the system, commented that it was probably a system for the bosses to compare numbers and a way to measure the organization in absurdum.

5. Analysis

In this section all empirical data gathered will be analyzed based on DeLone & McLean (1992) model presented in chapter 2. Each success factor of this model will be discussed individually and at the same time in relation to the other factors.

5.1. System quality

System quality is described by DeLone & McLean (1992) as an important factor in information systems. Seddon (1997) discusses some of the measures such as ease of use and learnability related to system quality. To their list of measurable items, DeLone & McLean (1992) added system response time. In this study all these items have been measured simultaneously to get indirect results of system quality.

The system has been found to be relatively easy to use as a mean rate of 3.44 was scored (Table 4.1: System quality) and with a minimum rate of 2. It is obvious that none of the users have found it very difficult. This rate supports the statement of Turban et al. (2007) about the easy to use interface that DSS generally have. It has been shown to be relatively easy to use, by means of Qlikview abilities. Users can select a date or place and receive the information they need. As our interview respondents described, it is only a matter of pushing buttons and selecting and then immediately getting access to the data and information they were looking for. They also believed that the 50 users who had participated in one training session about the system have found no difficulties in using it. On the other hand, some users expressed difficulties when trying to interpret the data produced by the system. This might be a result of their lack of knowledge about the systems in which SMF is built. The system may be found difficult to users who cannot interpret the meaning of the data presented to them. On the other hand, as Doll and Torkzadeh (1998) discuss, a higher ease of use positively affects the decision makers in generating more alternatives. As it will be discussed later in this chapter, the system supports the analysts in making deeper and more detailed analyzes increasing the possibility to study more alternatives and helping the analysts during the decision making process. There is no significant dependency between the access level and the ease of use (Appendix E). Both groups find the system relatively easy to use.

The survey reported a mean rate of 3.42 out of 5 for the ease of learn (Table 4.1), which according to Sharp et al. (2007) show how easy is for the users to learn the system. Similar to the ease of use the minimum rate given was 2, showing that no one found it very difficult to learn. We can conclude that the users find the system relatively easy to learn so the risk that they would not use it because they think that learning it is time consuming, as Sharp et al. (2007) propose, is reduced. This rate is supported by our interviewees who had observed that during the training the users had learned even the most difficult parts. On the other hand, they admitted that the only difficulty which can come up in learning the complexity of the system is the interpretation of the data. As discussed above, this as well was negatively influencing the ease of use. It is very important to have a knowledge on which systems the DSS are built. To correctly interpret data the users need to understand what kind of numbers and figures they are looking on and their meaning if right decisions are to be made. This is considered important, according to Beynon-Davies (2002), because the data which the users rely on are closely related to the success of the decision.

Although there were a difference in learning between the analyst and the view users there were no significant dependency found between the ease of learning and the access level (Appendix E). Both the analysts, the major part of who have learnt the system during the training and the viewers who have mostly learnt it on their own, found it relatively easy to learn.

The response time, which Nielsen (1993) describes as the time the system takes to answer resulted in an average rate of 3.31 (Table 4.1). This result shows that in general the users are in average satisfied with the response time of the system. In order to further enhance it, the capacities of the system should be increased. Perhaps new hardware components could be introduced and as Nielsen (1993) recommends feedback should always be displayed to the users in order not to be frustrated by a slow response time. As expected, there are no significant dependencies between the access level and the response time (Appendix E). Both the analysts and the viewers use the same system and in most cases get the same response time when a command is given.

The system quality showed an overall rate of 3.39 out of 5, with a higher rate in ease of use and learning (Table 4.1). The system quality was therefore shown to be relatively good and most of the users are in average satisfied by it although they have learnt and used it differently. On the other hand, there is a potential for improvement. The users, especially the viewers, should gain a deeper knowledge on which systems DSS bases its data, so that they can understand where the data come from and how to interpret it. Perhaps this can be improved by increasing the number of trainings, for both analyst and especially the viewers. This may also influence the system usage as, according to Pick (2008), the more obvious the benefits of a system become for the company and users, the more the usage rate will increase.

5.2. Information quality

Beynon-Davies (2002) described how the quality of data positively affects the success of decisions. He also lists factors such as relevance, completeness, accuracy, accessibility and update as part of the data quality.

The items, which indirectly measured the information content, were focused on the type and quantity of information available in the system and they received respectively an average rate of 2.88 and 2.95 (Table 4.2). These mean values are considered to be weak, as they are below the average and they also represent the lowest values in the information quality factor. It seems that the users are not as satisfied as it was expected by the type of the information which the system produces and they also think that more information is needed to provide them with a full support. In addition, they stated in the comments that the system was not totally oriented towards their work and they believed that further adjustments were needed in order for this system to be fully functional. According to Allwood (1998), it is important that the users have access to appropriate information in order to solve their tasks. If the information presented is irrelevant, it can lead to difficulties in understanding and also to frustration (Lucey, 2005). One of the users wanted the system to be connected with additional systems so that obtained information would be more complete and detailed. Our interview respondents claimed that more systems are going to be connected to this DSS in the future. We believe that this will help in improving the content of the information as a larger amount of data will become available to the users.

Accuracy showed a rate value of 2.91, very close to the rate of content (Table 4.2). The satisfaction that the users expressed about it was lower than the average. We consider it to be a weak result in comparison with other items within the same factor. It is, according to Lucey (2005), very important that the system is accurate enough to be able to rely on it. It is also worth mentioning that according to Lucey (2005), the accuracy is somehow connected to the decision level. There were some comments which showed uncertainty about the correctness and reliability of the data in the system. They explained their insecurity in terms of crime code usage. They were afraid that some users, used them incorrectly, which could possibly result in wrong data interpretation and consequently wrong decisions. Although the data can be accurate, the fact that the users do not believe in it, influences the decision of using or not using the system. In this way, we can see two aspects of accuracy: the data should be accurate and the user should trust it. Both of them have to be fulfilled if the system is to be considered highly accurate. Even the second step of crime analyses, data collation and analysis, described by (Boba, 2005) can be supported by this system if the data show high levels of accuracy. Accuracy is found to be very important and further improvements needs to be made in order to improve it and in that way gain the trust of the users.

Format of the information received a higher mean value in comparison with the rate of content and accuracy. The way the information is presented and how clear and understandable it is, scored 3.30 and 3.28 respectively (Table 4.2). Both show that the users are relatively satisfied. Due to two separate layout versions of each application, “view” and “analyze”, the users might experience the format differently related to their access level. In the view applications which are available to all users, the changes that are made are temporary. After the end of the session the applications returns to the original settings. The analysts have however, the possibility to customize their own pages by choosing colors, numbers, formats, graphs etc. According to Sharp et al. (2007), it is important that the presentation of information is done in an appropriate format so the users can understand the full meaning of the information which they are looking at. With the help of a dependency tests, it was found that there exists a dependency between the users’ level of access and their ratings about the clarity of information (Appendix E). Most of the analysts rated this item 2 while most of the viewers rated it 4. One of the users commented that the analyze applications were in need of further development. The presentation of information was found by some users somewhat illogical and it was difficult to use the system. Further training and instructions are needed in order to use the system in better way. Taking in consideration the access rights of the analysts they may with more training and guidance be able to present information in a way they think suitable. However, in general, we can conclude that the users are relatively satisfied with the format and the way the information is presented.

The item concerning information update was rated 3.22 (Table 4.2). In this case, it is considered relatively good but we believe that it is important to consider even some unsatisfied comments from some users who have rated it lower. The updates on the analyze applications seems to be the most problematic. By doing a dependency test we found out that there exists a dependency between the access level of the users and their rates on the timeliness. Most of the analysts rated it 2 or 3 while most of the view users rated it 3 closely followed by 4 (Appendix E). This can be explained by a lower update frequency of the analyze applications by having a greater need for updates in these applications as they are using them more often than the view applications. According to Lucey (2005), if information is not updated when needed, it will become worthless. In this way it affects the accuracy of the data and the quality of the decisions taken based on this information. Although there is a

higher score, it is necessary that some of the analyses applications, especially those that are used frequently, should be updated more often to meet the needs of the user.

The information quality received a mean value of 3.09 (Table 4.2) and we consider it to be relatively satisfactory. Most of the users seemed satisfied with the format and the timeliness of the system. Some of the analysts required the applications to be updated more often and that the format could be improved in order to be more understandable. The weakest parts of the information quality were content and accuracy. The system quality could probably be improved with further adjustments of these items. Another important factor that can influence the information quality is the lack of trust that some users had about the data. We believe this can influence the use of the system.

5.3. System use

As shown by the survey results, the majority of the potential users have never accessed the system. Based on their comments, they argue that they had never heard about it and did not know what the system was about. Some others believed that they, at some time had accessed it, but as there were so many systems they did not remember the name and the abbreviation.

David & Jackson (2005) have discussed the concept of slow diffusion of information concerning different systems within the police organization. We believe that this is a phenomena occurring in this case. The information and the advantages of using this system have not reached the potential users as they do not have the knowledge about it. It seems as if the information flows very slowly in the organization. On the other hand considering the discussion of David & Jackson (2005) of how the unfamiliarity with computer systems creates obstacles in their acceptance, it might be a possible justification why the users have not taken the initiative to see what the new system is about. Additionally, our interviewees replied that the use of the system will take time to spread, as it often does in big organizations.

DeLone & McLean (1992) have discussed how information quality and system quality affects the use of the system. In this case, it seems that although those two factors revealed to be relatively good, the non-use is still high. The reason for this is not that the users are not satisfied by the information and system quality, but instead it depends on other factors, where one of them seems to be the lack of information about this system.

During the analyses it was noticed that most of the system users were between the age of 50-59. It was surprising to see that very few people with the age below 39 were using the system. For this reason further analyses were performed and it was observed that the majority of the youngest people worked in external service, in the outside environment. The majority of the people between 50-59 and those older than 60 works as administrators or investigators which means that most of the time they spend in their offices. Based on the significant relationship found between the positions that the employees have and if they had ever logged in to the system we concluded that the use/non-use depended more in the position they had than the age of the users. (Appendix E)

The administrators are found to be most interested in this system, followed by the investigators. Most of the external service employees have never accessed the system. The administrators are usually civilians and they do not have any police background. Their work is mostly focused on administrative tasks e.g. the number of the employees and the performance

of the staff. (Simonsson, 2009 d) As this system might contain applications that can help them in their work this might explain why they are also more interested in the system. The work of the investigators consists of investigating crimes. (Simonsson, 2009 d) Dunworth (2005) discusses that before the crime analyses take place, the investigators start by collecting data from many different sources. This may be one of the reasons why they are more interested and use the system in a higher frequency than the external employees do. As the DSS offers aggregated information from different sources, they might find it easier to look for patterns and relationships in this system. Based on the interview respondents the users now have the possibility to input data in the system. The latter enhance the possibility of the dissemination phase described by Dunworth (2005) to be further on supported. As both the administrators and investigators make analyses by using the data offered by the DSS, they have the possibility to present their findings and analyses to both the view users and other analysts. This definitely increases the usage of the system.

External service includes all the police who work in the outside environment. (Simonsson, 2009 c) That they are working on the field might explain why they show a lower interest in the system and have accessed the system to a lower extent.

To measure the use of the system, another selected item was the system frequency usage. During the analyses of the data it was noticed that there existed a significant dependency between the frequency of use and the users' access level. (Appendix E) It is observed that the majority of people who have view access level use the system very rarely, followed by others who use it at least once a week. While most of those who have analysts access level use it at least once a day.

Based on the interviewees, it was understood that the users who have view access level usually just have a look at the system to get an understanding of what is going on in the organization. The survey results supported the statement of the interview respondents. The low viewer's frequency of the system use shows that they are only getting an idea of how the organization is performing and we believe that they still continue to work in the same way as they have done before. They see the system as a resource of information about general issues which they can access from time to time. On the other hand, we expected a high usage frequency of the analysts because of their work, which Dunworth (2005) defines as assisting investigations, preventing crimes, taking part in resource allocation and trying to meet the administrative needs and goals. To handle their daily tasks they need to look at the system often in order to make analyses and further decisions. We believe that the high usage demonstrates that they find the system as an important and essential tool for their work compared to the viewers.

Seddon (1997) proposed that the time the users spend using a system can be a good measure of the system use. The survey answers showed that most of the users use the system less than 15min. Furthermore, as expected, was another dependency between the access level and the time of use noticed. (Appendix E) On one hand there are the view users who spend less than 15 minutes. On the other hand most of the analysts spend from 15 minutes to 1 hour followed by another group spending 1 to 3 hours in the system. The interview respondents stated that the analysts perform different analyses and take decisions relying on the data they see in the system and have the possibility to go into details by drilling down in the system. Therefore they spend more time than the viewers because, as described by Boba (2005), the analysts help the police department to have a more effective use of their resources and usually this take some time. This shows once again that they find the system an important tool. While for the

viewers, as shown above, it is believed that they just get an overview and do not usually go into deep details as they are not performing any analyses.

Although most of the users have never accessed the system, a difference is noticed among them. The analysts who make deeper analyses and take different decisions have a higher frequency of use and a higher time length than the viewers. We believe that the analysts are using the system for their everyday work and that the view users mostly look at it in order to get a view of what is going on in the organization. This case supports the statement of Arnott & Dodson (2008) regarding DSS which is considered as not mandatory, and in this way affecting the use. The users are free to choose in using or not using this system and this seems to be the case for the viewers.

The correlation matrix showed that the use is not significantly correlated to the information system and at the same time a small correlation is observed with the system quality, nearly 0.326. (Table 4.5) This means that there is a weak linear relationship between the two mentioned factors and the use. Therefore a greater information and system quality does not necessarily mean a greater use. In addition to the correlation it was observed that both the viewers and the analysts have different usage rates, but still they did not have significant differences in rating the information and system quality. They evaluated these two factors nearly equal, which means that in the police organizations other factors seem to have a stronger influence over the use. It is instead mostly affected by other factors such as the positions inside the organization, the access levels, the work they do and the information that the users have about the advantages and benefits of the system. Therefore in this case, the relation between the use, system quality and information quality that is presented in DeLone & McLean (1992) model, is not totally supported

5.4. Satisfaction

Nielsen (1993) describes the overall satisfaction as an overview of how much the users are satisfied by the system and if they like it or not. To get a more objective measure of the satisfaction, as described by Nielsen (1993), the individual rates have been summed and their average was calculated. A mean rate of 3.07 was received, which shows an average satisfaction among the system users (Table 4.3).

There is no significant dependency between the access level of the users and the satisfaction of the system. The majority of them have rated it 3 being relatively satisfied followed by another large group who are more satisfied by rating it 4. (Appendix E) However some users have commented, given different reasons, why they have not rated this item higher. Some are not satisfied with the updates, they find difficulties in understanding the data which are produced by the system. Others apprehend that their needs are not fully supported, they feel somewhat insecure about the reliability and correctness of the data and that they lack the knowledge about the main purpose and functions of the system. On the other hand, they seemed relatively satisfied by the ease of use, ease of learning, the presentation of the information and the update of the system.

DeLone and McLean (1992) argue that user satisfaction is partly measured indirectly through other variables of the model. They propose that information quality, system quality and use affect the user satisfaction of the system. Some of the reasons why the users felt satisfied or unsatisfied, have been analyzed in the information and system quality sections as part of these factors. The overall satisfaction is reflecting how satisfied the users are by the system and

information quality. This is also well supported by the correlation among the latent variables. The user satisfaction variable received significant correlation coefficients of 0.727 and 0.854 with system quality and information quality (Table 4.5). This shows that they are positively related to each other. As these coefficients are near to 1, their relationship is relatively strong. It implies the higher the system and information quality is, the more will the users be satisfied. We can therefore conclude that the system quality together with the information quality affects the user satisfaction and in this case DeLone and McLean (1992) model proposing this relation is supported.

DeLone and McLean (1992) suggest that the use positively affects the user satisfaction and vice versa. We concluded that the overall use of the system was low in contrary to the user satisfaction which is considered relatively satisfactory. Although significant, the correlation between these two variables is very low, 0.229 which means that there exist a weak positive relation between them (Table 4.5). Therefore a higher use may change the user satisfaction very slightly and vice versa. This is also supported by the fact that although the analysts have a higher use of the system, no significant difference was found in the satisfaction among the analysts and the viewers who had a lower use (Appendix E). Therefore both the groups with differences in use are relatively the same satisfied by the system. Hence, there is no strong relationship found between these two factors and they seem mostly to be affected by other factors. The use is mostly being affected by external factors as we described in the previous section, while user satisfaction seems to be affected mostly by system and information quality.

Thus, we can conclude that in the overall perspective this is a relatively good result showing an average satisfaction. Further improvements should be done, especially through other factors such as system quality and information quality which seems to have an effect on it.

5.5. Individual impact

The first three questions of individual impact were posed to both the analysts and the viewers in order to get an overall idea of how the system is influencing their way of working. The remaining questions were addressed only to the analysts, whose main work is analyzing and making decisions.

The item concerning the understanding of important trends received a mean value of 2.99 which means that the users are somewhat satisfied by it (Table 4.4). Pick (2008) discusses that although the quality of the decisions cannot be improved, the users might get a better understanding of different problems by looking at the information presented to them. By having an average rate, this system seems in some way to satisfy one of the benefits of DSS, mentioned by Pick (2008), which is a better understanding of the problems and data. Positive comments were also given and some users explained how the system gives them the opportunity to see connections in a wider perspective that was previously not possible. This as well leads to a better handling of cases as described by Rikspolisstyrelsen (2009).

Work quality received the lowest mean value of the individual impact of 2.85 (Table 4.4). This was expected as the potential users of the system have different kinds of work and level in the organization. The system, as described by the interview respondents, has been created to be a highly useful tool for the analysts and a more optional tool for the view users, who want to have more knowledge about the organization and improve their way of doing things

to be in the same direction with the goals and needs of the organization. Although the work quality has not been satisfactory enhanced, according to Pick (2008) others benefits are obtained from the system usage such as time, less expenses, better understanding. In addition, even though the quality is not very high we can conclude that the organization is obtaining the information in a different way in comparison with the way it was done before. Davis and Jackson (2005) argue that using some kinds of system can change the way the police accesses information. Therefore the system is being more efficient in doing the same work as before but with less effort.

The users' rate of system importance was 3.08 in average, which is considered to be relatively good (Table 4.4). There exists a dependency between the users' access level and their corresponding ratings of the importance of the system. Most of the analysts rated it 5 while most of the viewers rated it 4. (Appendix E). This dependency was expected, because the analysts have a high system use and this means that they rely a lot on this system during their work, while as it has been mentioned above for the viewers it is considered mostly to be an optional tool and the fact that they have a lower use demonstrates it. The system is supporting and helping mostly the analysts in accomplishing their tasks of analyzing and decision making.

Turban et al. (2007) describe problem/opportunity identification as part of the first phase of the decision making process. Receiving an average rate of 3.16 in this survey implies that the system is relatively supportive in this phase (Table 4.4). The problem /opportunity identification has been slightly enhanced and this could be a consequence of the users' possibility to see data in a wider view as well as seeing relations and patterns that were difficult to previously observe. Therefore the users at present, as Turban et al. (2007) describe, can see what is going on in one glance. The ability to drill down in the system, gives them the opportunity, as described by Moran & McCarty (2008), to identify trends and predict where crimes are going to happen. This is also related to the understanding of the data that the analysts see and analyze in the system. The better they understand patterns and relations, the easier it will be to identify different problems. In this case both the understanding of trends and the problem/opportunity identification showed average results.

Design is the second phase of the decision process where different problems are set up, different alternatives are generated and outcomes are calculated (Turban et al., 2007). The three following questions, the enhancement of doing in depth analysis, the value of the system in creating the necessary materials and foundations to support the decision process and the time needed for it, were aimed to measure the support of this second phase.

The improvement in doing deeper analyzes obtained a mean value of 3.32 which is the highest in the category of individual impact (Table 4.4). This is considered a relatively good result, and also based on our interview respondents the "drilling down" ability makes the system easier to be used in performing more in depth analyzes. The analysts consider the analyses process to have been improved and in the future new efficient ways of preventing and analyzing crimes may come up as Rikspolisstyrelsen (2009) argues. A deeper analysis, at the same time, according to Turban et al. (2007), may lead to a higher generation of alternatives during the decision process.

The value of the system in creating a foundation to support the decision process obtained a mean value of 3.32, which is considered relatively good as well (Table 4.4). By receiving the same mean values, as in the former question, it is obvious that the users regard the system

supportive during the design phase. The information produced is found to be successful in creating the basis to generate the different alternatives and choose the best one as Turban et al. (2007) propose. In addition, Pick (2008) argues that DSS enhances the documentation process, which is supported in this case. Our interview respondents described the role of even some controllers, who create the foundations and organize the information needed by their superiors to make decisions.

The time for the decision making has been relatively reduced as indicated by the 3.16 mean rate of the corresponding item (Table 4.4). The users believe that the time it takes to gather all the information and basic material needed for decision making has been reduced, which influence indirectly the overall time of the decision making process. Therefore although we cannot measure the quality of decisions, as Pick (2008) discuss, we can conclude that the decision process is reached in less time, and is a consequence also enhanced.

All the above three questions obtained mean values higher than 3 which show that the system is supporting the second phase of the decision making. Alavi & Henderson (1981) described that the main role of DSS is not to replace the decision-maker but to improve and enhance the decision process, which is what we are concluding in this case.

The aim of the last item was to get an idea about the support the system is giving to the final decision making and how useful the decision maker is finding the system during the phase when he or she is taking the final decision. Choosing the best alternative corresponds to the third step of the decision making process (Turban et al., 2007). In this question a mean value of 2.89 and the highest standard deviation in the factor of individual impact was obtained (Table 4.4). This is a low value but on the other hand we argue that the differences in answers might depend on the fact that the some of the analysts just make analyses and prepare the materials needed during the decision process and others are more responsible in making the final decisions.

The individual impact received a mean value of 3.10 and we rate this as relatively good, approximately similar to the average rate of information quality (Table 4.4). The factors that the users found most problematic were the enhancement of work quality and the support of the system in making their final decisions. On the other hand the different steps of the decision process have been improved such as: problem/opportunity identification, analyzes, availability of the information needed during the decision support, and the time of the decision process. The users were positive about the enhanced possibilities to do deeper analyses and in the values of the system in creating decision support.

In accordance with the model of DeLone & McLean (1992), the higher use of the system by the analysts resulted in an average individual impact. Most of the users have found the system to be important and they find it to have enhanced different parts of their decision making process and analyzing. Therefore, we can see a relation between the use and the impact that the system is having on the users. This is supported even by the significant correlation coefficient of 0.528 between two of them, which shows that the use of the system is affecting positively the individual impact and they have an average strong relation (Table 4.5). At the same time, it seems that even the average user satisfaction which has been measured had influenced the average rated individual impact. A coefficient of 0.596 relates these factors positively together, meaning that the higher the user satisfaction will be, the higher the individual impact will result (Table 4.5). This was also supported by the survey results which showed that both the user satisfaction and individual impact had an average rate above 3.

Thus, in this way we believe that the case supports the DeLone & McLean (1992) relation of the use and user satisfaction with the individual impact.

5.6. Organizational impact

According to DeLone and McLean (1992) the organizational impact refers to the overall performance of the organization and can be measured by variables such as economic performance, return on assets, profitability, cost effectiveness. Davis & Jackson (2005) also describe how IT can have an impact on the workforce, management, financial and organizational activities of an organization. Our respondents argue that this system is having a considerable impact on the organization.

The respondents describe that the impact on the workforce in the HR department is immense. They calculated that the savings per year are around 8-10 fulltime employees. Davis & Jackson (2005) describe how savings related to workforce positively can affect the organizations when deploying IT. The respondents argue that it is very hard to measure the profits in the field of crime analysis, because the system has been gradually introduced and used during the years and therefore it is difficult to make comparisons with how it has been before.

Davis & Jackson (2005) describe how systems often require a large investment from the organization in the initial face of the process. The respondents state that:

“in one year we have already gain the investments” (Appendix B, line 87).

They describe how the savings of around 8-10 employees brings around 5 million Swedish kronor back every year to the organization. These savings are approximately equal to the cost of the system. This is a positive effect of workforce that is also described by Davis & Jackson (2005).

By using the system the respondents describe how they also have the possibility of improved control over the personnel and of measuring the work of the individual. Davis & Jackson (2005) describe that new IT system can affect the processes and structures of an organization which is something our interview respondents believe probably will happen in the future. They want be able to correlate salaries to the work of the individual and in this manner raise the production of the organization.

One major potential effect, described by Davis & Jackson (2005), is the way the employees access the information within the organization.

“ all the persons in the organization have a better way of making up qualified guess of how many crimes will be in the different places”. (Appendix B, line 75).

According to the respondents the employees have now a new system which is an easy and customizable tool for information access. The system should be easy accessible and standardized.

Davis & Jackson (2005) describe how IT system as well can have major effect on decision making, management and in the internal governance. In this case the system is created particularly to be a tool for enhancing the decision making in the organization. The respondents describe

“by looking on all the information we have, we can make a better guess” (Appendix B, line105).

The organization has now has a better way of doing long term plans and crime prediction e.g. of how many crimes will take place in an area.

Now they can also rely more on the data over which the analysis and the decision making process take place. In addition they also have a wider view of the crime development and can make more accurate prediction where to deploy the resources of the organization.

In the organizational impact we could not refer to any mean value due to the format of data collection by means of the interview. The system has resulted in cost savings, and the possibility of doing reliable long term plans in order to use their resources more effectively has been enhanced. We believe that this is the effect of the individual impact taken together, as DeLone& McLean (1992) suggest. We discussed above that the analysts found the system beneficial, important and have a higher use of it. The time of taking decisions and the way of analyzing which have been enhanced might be good arguments to explain the cost benefits of the system. All the factors of the DSS in the police organization, based on the DeLone& McLean success model, have been evaluated and analyzed. Most of the multiple-scale items have been summed and the average was taken to draw overall conclusion about the latent variables of the model. DeLone& Mclean (1992) discuss how system quality and information quality affect the use and user satisfaction, while on the other hand use and user satisfaction affect each-other.

5.7. Summary

The analysis followed the same flow as the model of DeLone and McLean (1992). It started with the characteristics of the system including system and information quality, followed by the system use and user satisfaction and ended up with the impacts that the system use is having on the individuals and organization. All factors have been described individually and at the same time the possible effects and relations that they could have with each other based on DeLone and McLean (1992) have been discussed.

In general system quality, information quality, user satisfaction and individual impact showed to be on acceptable levels. The most problematic factor found was the system use and there was a distinct difference between the analysts who had a high use and the viewers who had a low use. It was unexpected to find that use had a weak relationship with the characteristics of the system and the user satisfaction. We found it to be more dependent on other external factors in the police organization. Factors that are affecting the use were found to be the low information diffusion of the system in the departments and the position and work that the users have in the organization. The consequence is that it is difficult for the DSS to be equally spread in the whole organization.

As it was expected the use of the system lead to an individual impact. The system has according to the analysts improved some the decision making process and is considered an important tool in their everyday work. The organizational impact is that the cost benefit effect of the system has resulted in saving in terms of estimating fewer employees now and in the future. By using the system the organization also has improved the way of doing long term plans resulting in better resource allocation.

During the analyses, when we came across low results we have suggested improvements. An improvement in system quality will lead to a higher user satisfaction and at the same time the individual and organizational impact will be enhanced indirectly. As most of the success factors are related to each other, improvements in one factor will affect the other factors increasing in this way the success of DSS. On the other hand, we cannot conclude that an enhancement in the system characteristics will necessarily increase the use of the system. As we mentioned above the use seems to depend more on other factors in the police organization.

6. Conclusions

The objective of our research was to provide knowledge about the actual use and impact of DSS in police organizations. For this reason an evaluation study, based on DeLone & McLean (1992) was conducted to answer to the following question:

How successful is the Decision Support System in the police organization in Skåne?

Some of the factors which showed to be in an acceptable success level were:

- The system quality was positively experienced by the users who find the interface easy to use and learn.
- The information quality was relatively satisfactory. The most successful aspect were the updates of the system and the way the information is presented.
- There is an average satisfaction about the system which showed to be positively affected by both the system and the information quality.
- The system has an impact on the users and especially on the analysts. It showed to be efficient and is being supportive during the decision making process.
- An important relation was found between the individual impact, the use and the user satisfaction.
- The system use has resulted in a considerable organizational impact. It has been estimated in terms of savings in both staff and money. The organization has gained an enhanced possibility to do more accurate long term plans and a better allocation of resources.

Even though the system showed success qualities it was observed that there were aspects that could be enhanced in order to make the system fully functional.

- The system is far from being equally spread and used within the organization, as the viewers have a very low usage frequency. The use does not have a significant relation with the information quality and it has a very weak relation with the system quality and user satisfaction. The use is found to be more dependent on external factors.
- The majority of the users experience that the system is not having a significant impact on their work quality.
- Some users feel insecure and do not trust the reliability of the system.
- There were observed difficulties in interpreting the information produced by the system.

We arrived at the overall conclusions that the system in general can be considered quite successful but there are still issues that can be improved.

A low level of systematic teaching to all users, a slow diffusion of the information within the police organization and different position levels are obvious obstacles to a successful spread of this DSS. The study can also provide ideas on further improvements in order for the DSS to be fully functional. This can be of interest for the police in Skåne as they have the objective to spread the system to the whole police force in Sweden.

On the other hand, this study can also be of interest to researchers since there are few studies investigating and evaluating the actual use and impact of DSS in police organizations. The findings show that the obstacles are not related to the system per se, but rather to the context of the police organization in which the system is functioning. This is a study of one particular system and other evaluations need to take place if the results should be generalized further.

Appendix A: Interview guide

Name:
Date:

Interview topics

What is your field of work?
What is your level of responsibility?
For how long have you been employed in the Police Organization of Skåne?

How important is IT support in the police work in general?
What strategies does the Police Force have regarding investment and development of new systems?

Have you personally participated in the development of SMF?

Use of the system

How many are registered as users of the system?
How many are actually using the system?
How many have been trained to use the system?
Have you any hypotheses about the level of usage/non usage?
How is the mode of usage, correlated to access level and type of work?

Organizational impact

What impact does this system have on the organization?
Does the system have a cost benefit effect in the overall organization?
Does the system influences the quality of the police work and if so, in what manner?
What impact does the system have on crime rates?

Appendix B: Transcription

The interview was conducted the 6th April 2009, 10-12. Linda-Marie Skog and Olgerta Tona interviewed Berth Simonsson and Ola Hornemark.

Transcription of the interview:

| | | |
|----|------------|---|
| 1 | Gerta | - We want to know a little bit what responsibilities do you have in the system and the main tasks? |
| 2 | Ola | - Well, my responsibilities in the "Polismyndigheten in Skåne" is to work with something called tactical leading or something like that, I guess the translation will be. I am the strategic developer of the system used basically for business intelligence and all kind of statistics and analysts. Berth works at "Planstöd" which is a unit to support the analysts over the entire organization. |
| 3 | Berth | - What I am doing just now? I am the project leader of this. We started about 2 years ago, so it is technical responsibilities. |
| 4 | Linda | - Ok. |
| 5 | Gerta | - What role does IT play in the police work? |
| 6 | Ola | - Well, it's really really a big question but of course IT support, plays a big role in the police work. We have .. Our entire organization has one separate organization only for IT and I think there are about 200 people in this organization. We have basically about 1500 systems operating within the police and of course some of the systems are very old and some of the systems are very new and therefore IT is... Well it's very hard to explain in few words but it's a very difficult and very disorganized IT platform, we can say. Many different programming languages and therefore information are stored in very many different kind of ways and very many different kinds of formats as such. |
| 7 | Berth | - We have about 25000 users in the whole Sweden but here in Skåne there are about three and a half thousands. |
| 8 | Ola | - Some of the police obviously work at their office set. They have their computer. And some of the police are out in the field operating from small computers and radio operating towards databases and such. We have many kinds of information sources for our IT systems, you can say. And of course it has been very difficult times to times to catch all the information and to be able to read something out of it. It's basically there the system we have been developing gets in. |
| 9 | Berth | - We can't be without this IT today. Everything is IT today in this business. We have all these crimes, what will happen and so on. |
| 10 | Linda | - It sounds really essential? |
| 11 | Ola, Berth | - Yes, of course. |
| 12 | Linda | - How have you decided or when have you decided that you have to invest and develop a new system and what is the reason? |
| 13 | Ola | - Well, the basic reason for investing in a new system is something... We have an organization at the top level in the organization of Stockholm. It's called.. |
| 14 | Berth | - "Rikspolisstyrelsen" |

| | | |
|----|-----------|---|
| 15 | Ola | - The nation board of the police, I guess the correct translation is. And there we have one organization mainly who make a modeling of a new system; one organization that is actually producing the new system and one organization who is checking 'is this system up to the model part'. So three different parts decide if a new system is going to be used and of course hopefully most of the systems come from a demand from the entire organization. They present a problem to the national board and then they start developing. This system although has not been made in this way. It's basically.. It was...The use was invented here in Skåne and it has not travelled all the way to Stockholm. |
| 16 | Berth | - We did it by ourselves. We had an idea for 2 years ago. We saw this program and we have been using it since '98...'95...?? |
| 17 | Ola | - '95 I think... |
| 18 | Berth | - And we saw the possibility to see all the data together in an easy way. So that was the idea that everyone in Skåne was going to see this in an easy way. That was the idea... |
| 19 | Ola | - We basically had the system within our network but we didn't use it fully. Probably because the basic hardware of the computers wasn't developed when the system first occurred at our scene and then hardware started developing and made it easier for every different person in the organization to actually use the system for something good. We in Skåne started using it and all our users...and well it started to spread through the organization and it's usually as anything within a big organization it takes a lot of time of course. |
| 20 | Berth | - But today it's only Skåne that have it. No one else. |
| 21 | Linda | - Is it possible for? |
| 22 | Berth | - We have made it in that way that everyone in the whole Sweden can take it and transport it into their system. There are no difficulties. We have built it in that way. |
| 23 | Linda | - Ok, so, when or if they want to? |
| 24 | Ola | - Yes, they can have it. The only basic problem is that many systems used in the police have a kind of a stamp or a mark not made here. If it's not made in Stockholm is very hard to spread to the entire organization, you can say. But at least some other parts of Sweden, a lot of different parts of Sweden really want and need this system. Of course we are far ahead of them and they can easily see the gain of us using it. |
| 25 | Linda | - How many are actually using it today? |
| 26 | Berth | - We don't know but we are nearly 3500 in Skåne able to use it. |
| 27 | Ola | - And I will guess, simply guess, that we are 50 persons using it, if not daily at least couple of times a week. Then the other mass of people sometimes have seen the system, I think. Some of them use it more and some of them use it less, of course. |
| 28 | Berth | - But there are 2 kinds of system. Because we have one for everyone and one part for analyses. |
| 29 | Ola | - And the part for everyone is the hardest part to see the use, of course. The use is basically...well if everyone knows what we are doing they are probably changing their way of doing things to make it better but we cannot possible see if they are using the system or that they are mainly getting a bright idea. So, it's therefore very hard to measure the entire organization's use of the system, as with any system. |
| 30 | Linda | - And how many of them have been trained with this system? |
| 31 | Berth/Ola | - About 50 persons. |

| | | |
|----|-------|---|
| 32 | Linda | - And it was the one for analyzing? |
| 33 | Berth | - Yes for 1 day. It's very easy to learn. It's a hard way to be expert on it. It's hard to master. It's very easy to learn. |
| 34 | Ola | - The basic problem with this system is to know what kind of data you'll see. If I don't recognize the data I can't use the system. To be able to use the system one day of training for the hard part it's more than enough. |
| 35 | Berth | - They have to know about the system which is under and how we got the data. They need to know what we mean with an hour: is this a crime hour when the crime is beginning or is it the date for example today. And this hour is this a calendar hour and so on. We call it different chains in this system. You have to know about what it means. |
| 36 | Linda | - Do most of police know this? |
| 37 | Berth | - Well, some terminology of course exists within the police. Some kind of source for words and some different kinds of police terms of course. It's easy for everyone to know, but to come deep down into the analyses you must know every part of it and understand the complexity of the system. And if you don't.. well, you can push some buttons and get an answer but if you don't know what you have pushed you don't know what kind of answer you'll get of course. |
| 38 | Berth | - This is a crime system of the police and everyone knows what the most things mean because they are writing it every day probably. But when you come to time frames, works hours and such we put some codes on it and they don't know about it at all. |
| 39 | Ola | - They can write reports and can measure how many reports.. They can know that we use different kinds of statistics prognosis in the system. If they don't know the prognosis, of course, they have very little use of it. |
| 40 | Gerta | - Which can be the reasons that some users from 3500 users don't use it? |
| 41 | Berth | - Well, they don't use it at that way. They look at it sometimes. |
| 42 | Ola | - As Berth said we have 2 different kinds of application for every source system. One application just to visualize, look at it. Even if you don't know everything you get the basic idea. The graph going down is probably bad, the graph going up is probably good. We try coloring codes and such. If it's green of course is good and if it's red is bad. You don't have to understand exactly what you see to the main resource of it of course. |
| 43 | Berth | - And we make some analyses in the system too for them so that they not only see the graphs. |
| 44 | Linda | - And the people that do analyses in the system, how do they work with it? |
| 45 | Ola | - Well, it's kind of a broad thing. We have basically helped an organization within the police which are crime investigators and who have some kinds of analysts. Then we have HR people and our economic people and we are basically trying to put it all together because we are thinking that our economic control has to know something at least where the money are coming and people using it for crime investigation have to know at least something how much has this cost. We are trying to do at least like this but basically we can divide the users in at least 2 groups: one group using it mainly for HR and economic and one group using it mainly for crime investigation. It's kind of about fifty-fifty. |
| 46 | Linda | - And this is about what you said around 50 people that... |
| 47 | Berth | - 25-25. They do it every day, every hour. They can drill down to the smallest details which are taken away from the system.... |

| | | |
|----|-------|---|
| 48 | Ola | - Crime per minutes let's say or written reports per person a day and such. |
| 49 | Berth | - And normal investigation we have made as well per person. How many people we have spoken too and so on...So there is very many details... |
| 50 | Ola | - Some people, say about 10 of those 50, use only Qlikview. It's the only thing they do here basically. They only make analyses. |
| 51 | Berth | - We have heard that when the system goes down they call us: "What have you done?" |
| 52 | Ola | - The best, I believe with Qlikview in this case, is that every person can make his own page. The basic main source of the data is the same so therefore the numbers will be the same but they can change very easily the layout in the way they want it to look. Some people think it's easy to see it green and yellow and some other people want to have graphs and some pie charts. It's basically how the people work. Some people can remember a lot of different steps by looking at it and some people need forms of some sort. Therefore as long as the main data source is the same it's a good way to use it, I think... |
| 53 | Berth | - So, we are taking these data from the main system giving them what we think is the best. But they can also change it as they want. |
| 54 | Ola | - And even add some data to them... |
| 55 | Berth | - As we said we are going to put them all together. We don't know how it but we are going to do it. We are not allowed to do it yet. |
| 56 | Ola | - Well, it's hard to connect directly economic to crime investigation. We are not that easy kind of organization. When you say if you use this car it costs this much and you can sell it for this much. It's easy to say that, but when you're coming to investigation crime it's not that easy of course. We have to investigate every crime anyway. How much it cost it's really not a big fact in this case but still we have to know to be able to built up the organization according to it. And therefore it's hard to combine the data. |
| 57 | Berth | - I want to tell too, that our difficulties are not the technical, the difficult is the decisions. We are not allowed to do it or they don't want us to do it. That is the big problem today, we have no technical problems. |
| 58 | Linda | - The technology has come so far so... |
| 59 | Bert | - Yes, it is not a problem. It is very difficult, what you call it, the security numbers, |
| 60 | Ola | - Yes, the social security numbers, of course we have a lot of security within the police. The system is very secure at this level. Sometimes more secure than it have to be. Well basically if you have been a victim of a crime, then you don't want the security numbers to be flushed over the internet of course and therefore we have a high security level. In some way, to produce a Qlikview document, it is so fast so it is unbelievable for a person not normally used to Qlikview. Therefore, some believe that when you developed it so fast it must be unsecure. That is kind of a problem. It is too fast and too easy. |
| 61 | Bert | - Yes. That is because we know how to do it. |
| 62 | Ola | - Probably. |
| 63 | Linda | - We have some organizational questions. What impact does this system have on the organization? |
| 64 | Ola | - Well, in generally, it is very hard to say the organizational in general, since we have our different kinds of analyst fields. We have the crime analyst, we have the HR and we have the economics. And I would say economics is probably the hardest part actually to see the effect |

| | | |
|----|-------|--|
| | | on, we are basically on a level where Qlikview is at the same level as the other economic systems. They can see the same data, it is the same, it is a bit easier but still it is the same. And some persons still like to calculate on papers. In some way they still not believe in the computers, but.. The economic part is well.. It is not under big development. But on HR on the other hand we have had a huge development, let's say about every analyst in HR area is used to Qlikview and it have had a big impact so to say on we have... Well a lot of work we had to put down earlier on this area, but now it is like this (finger snap). In the long run of course we will save personal. |
| 65 | Berth | - Just the time it takes to count employees. Before it took around two or three days and today we have |
| 66 | Ola | - Yes..... |
| 67 | Berth | - Mm |
| 68 | Ola | - It sounds easy but it is really hard to.. |
| 69 | Berth | - But now we can see it in five minutes. |
| 70 | Ola | - Yes of course. All the things like when you are on holiday, when you are sick, how many people will we be in three months, when there will be a football match and that kinds of question it has been really hard within the police. And I think somewhere around.. We have of course made an analyze of how much money we will make by using Qlikview and I think about HR we said around 8 |
| 71 | Berth | - 8-10 people per year. |
| 72 | Linda | - Just in the .? |
| 73 | Ola | - Yes in the HR. So it is really easy because we have to do all this different analyses. The law tells us we have to do this and therefore it is very easy to say how many people we will gain so 8-10 people is a very secure number. It is now like a guess or anything. It is statistically speaking about 95 % sure therefore true. |
| 74 | Berth | - And in crime investigation we don't know, because we haven't had anything else. We don't know if we have saved money or not - |
| 75 | Ola | - A lot of crime investigations we are.. Well we make a lot of effort to make the personal, to make every different working within the police. So we measure what he or she produce and therefore of course through the system Qlikview we can measure if it is good or if it is bad. Only recently we have been able to connect this knowledge to their salary development and therefore it will probably take 5 or 10 or probably 20 years before it has a big impact on the production but still I think we have had an increase for let's say 5-10 maybe 15% in some areas. The increase of production and in some way, this is of course good, but in the long run we are not very sure yet. As I said earlier it is not because producing 40 cars instead of 40. We have to be sure that you don't cut down on the quality of the investigation too and therefore it will take a couple of years to be exactly if this is a good way of doing it. But we can say that, actually now people in the organization have a big picture in the crime development. And all the persons in the organization has a better way of making up qualified guess of how many crimes there will be in different places. And therefore it should be a better effect. Sadly or good, I don't really know, but the police work is not only the police who affect the number of criminals on the streets. When the economics go down for example you think oh no now burglary will go up but no. When the economic goes down less people fight on the streets. |
| 76 | Berth | - They take care of their things better and so on. |
| 77 | Ola | - So it is a lot of different things that is actually affecting crime development. By measuring |

| | | |
|----|-------|--|
| | | them we can make up our small part of changing the curves. We can at least measure that some part. |
| 78 | Berth | - And we can do it quickly. |
| 79 | Ola | - And some kind of numbers we have now used Qlikview for getting. We didn't really have any chance to get earlier so it is not only better information it is totally new information. So hopefully it will make a better gain in that area also. |
| 80 | Berth | - And we have seen now, we just got a call this morning that they know about us out in the organization so they want us to do more and more. |
| 81 | Ola | - And it is very easy for the organization to become used to Qlikview and therefore they expect the.. |
| 82 | Berth | - Why can't you see this and why can you not see this and so on. But for one year ago we could not see anything at al |
| 83 | Ola | - So it is a small problem for man, but a big problem for development. |
| 85 | Ola | - Well do you have anything else you want to ask about? For the organizational impacts. |
| 86 | Linda | - Do you think that the system has a cost benefit... in the organization? |
| 87 | Ola | - Yes we have of course made a calculation over this. Quite a big work I will say. Just a year, I think we will gain money on it easily. Looking at the HR areas. 10 people is around 5 million kroner for us. That is about the money we have spent on it to use it forever so to say. Easily in one year we have already gain the investments the investment of the system. And since we can use it in our HR, probably any organization can use it in their HR too. |
| 88 | Linda | - So it is not specialized for the police? |
| 89 | Ola | - No, no |
| 90 | Berth | - No, absolutely. It is not for police at all. |
| 91 | Ola | - It can suite HR questions in any organization that deal with I will say. I will say that even without the crime investigation it would have been good for the police. |
| 92 | Berth | - We said that if we were going to do this for the whole Sweden, that we can , in three days we could make a system for the whole Sweden. And it is around 10 million for the whole Sweden every year. |
| 93 | Ola | - Three days work. |
| 94 | Berth | - For three days of work. |
| 95 | Ola | - It is actually to short time to make it believable. But that is because we know it, the system Qlikview and we know the other, the main systems too. That is why it is so easy for us to do it. We see that in some system we don't know so much about, it might take a week to 14 days. It is around 1500 system so of course, it is a bit complex, so in 3 days probably. |
| 96 | Linda | - And you are thinking to add more systems? |
| 97 | Berth | - The next time we are going to add the economic system |
| 98 | Linda | - Agresso? |

| | | |
|-----|-------|---|
| 99 | Berth | - Yes. |
| 100 | Ola | - And Qlikview has already for them self developed a couple of application and therefore it is much easier for us to market this kind of application. |
| 101 | Berth | - And QlikTech, they learn us how to develop it and then they let us do it and.. |
| 102 | Ola | - If they have developed it then we got the application for free and they don't make money by them self creating the application they just sell the license and the help to get started and we have the money. It is actually working? Yes. |
| 103 | Linda | - Do you believe that the system influence the quality of the police work? |
| 104 | Berth | - Quality? Yes really. |
| 105 | Ola | - Of course, it is really qualified. Some of the analyses that we developed earlier was like guesses and now we have fact for some of the things we say. And a very small question within the police can have a extremely big impact if we persuade and think that alcohol crimes has anything to do with people getting beaten on the streets, we could actually invest e.g. 500 million earlier and it could just be like it is probably right. And it could have been well supported. We didn't actually have a clue before we made the investment and within the police it is like we gain the money for one year and then we are doing what we are doing that year and then new year and new money and if you have an organization working for a thing like that of course many things you are doing will be like, it will be very expensive and not everything will have the correct impact and what we really would like to do. But by looking on all the information we have we will, can make a better guess and that and only that will be important very much within the police. |
| 106 | Berth | - And the next thing, key numbers will be the next things. |
| 107 | Ola | - When it will be easier for everyone to see if this is good or if this is bad, then key numbers is good but on the other hand if you don't understand the key numbers then what will the information give. |
| 108 | Berth | - But in Qlikview we have the possibility to go down and drill down so you see the things in more details and even if you see this key numbers from the beginning then this is one of the advantages. It is fast so you can view it and know that something was not good and take another one |
| 109 | Ola | - And then we have about 140 different applications |
| 110 | Linda | - Are they on one area or they are divided into many.. |
| 111 | Ola | - They are divided into many areas and Qlikview, basically we are developing the main applications of the organization, basically we have around 12 of those and then we have around 120 for our work and then we have for the unit working with well for the leaders of the organization also. They have for example one question, maybe they remember that I would like to look at this and then we make and application in two hour and then drop it but by saving that application we can use it 2-3 years later and remember that ahh I want to look at this again. You can basically reuse a lot of things developing in Qlikview, just cut and paste basically and therefore if you have made an application calculating reports then you can basically reuse any formula you produced there so it is quite affective. |
| 112 | Linda | - Mm and I think our questions finished now. |
| 113 | Berth | - Ok, good |

Appendix C: Creation of the survey

| CONSTRUCT | ITEMS TO BE MEASURED |
|----------------------------|--|
| SYSTEM QUALITY | Is SMF easy to use? Is SMF easy to learn? Are you satisfied with the response times of the system? (E.g. the time it takes to get an answer to the question) |
| INFORMATION QUALITY | CONTENT Does the system have the type of information you need? Does the system provide sufficient information? ACCURACY Are you satisfied with the overall accuracy of the system? FORMAT Is the output you get presented in a useful format? (eg. charts, tables, graphs)? Is the information presented in clear and understandable way? TIMELINESS Does the system provide up-to-date information? |
| USE | Have you ever logged into SMF? How often do you use SMF? How much time do you spend when using the system? |
| USER SATISFACTION | How do you rate your satisfaction with SMF? |
| INDIVIDUAL IMPACT | By using the system, you get a better understanding of important trends. By using the system you improve the quality of your work. You rate SMF an important tool in your work. The identification of problems/opportunities been improved by using the system. The possibility to do more in depth analysis been improved by using the system. SMF is a valuable tool to produce decision support. The use of the system has reduced the time it takes to create the foundation for decision making. SMF is an important support in decision-making. |

Appendix D: Questionnaire

We are two students, Linda-Marie Skog and Olgerta Tona, studying a Master Program in Information Systems at the University of Lund. We are examining how Decision Support Systems is used in the Police Force. We are conducting this investigation within the Police Force in Skåne, with focus on the System for Measurement and Follow up (SMF)

SMF is an umbrella term for a number of applications, that are developed with the software Qlikview, and available under 'Links and Systems" on Intrapolis.

We kindly ask you to spend 5-10 minutes to participate in this survey. If you have any questions about the survey do not hesitate to get in touch by sending email. Our address is lindamarie.skog@gmail.com. The survey is anonymous and the research results will be generalized. Your integrity will be protected. If you are interested in the results, enter your email address at the end of the questionnaire.

1. Are you?

- a) Police
- b) Civilian

2. Your age?

- a) 29
- b) 30-39
- c) 40-49
- d) 50-59
- e) 60

3. Gender?

- a) Female
- b) Male

4. Your work position?

- a) External service
- b) Researcher
- c) Administrator

5. Have you ever logged into SMF?

- a) Yes
- b) No

If you answered "No" to question number 5, end the questionnaire or continue to question number 27 (Other comments).

6. What access level do you have?

- a) View
- b) Analyze

7. How often do you use SMF?

- a. Very rarely
- b. At least once a month
- c. At least once a week
- d. At least once a day

FRÅGEFORMULÄR

Vi är två studenter, Linda-Marie Skog och Olgerta Tona, som studerar ett Masterprogram i Informationssystem på Lunds Universitet. Vi vill undersöka hur beslutsstödssystem kan används inom polisen. Vi genomför denna undersökning inom polisväsendet i Skåne Län där vi inriktat oss på ert Verksamhets Statistik System (VSS). VSS är ett samlingsnamn på ett antal applikationer som är framtagna med programvaran QlikView och finns under "Länkar o System" på Intrapolis.

Vi ber dig att spendera 5-10 minuter med att fylla i denna enkät. Har du några frågor går det bra att maila oss på lindamarie.skog@gmail.com. Undersökning är helt anonym och forskningsresultaten kommer att presenteras generaliserade. Din integritet kommer att skyddas. Om du är intresserad av att ta del av resultaten, skriv din mailadress i slutet av formuläret.

1. Är du?

- a) Polis
- b) Civil

2. Hur gammal är du?

- a) 29
- b) 30-39
- c) 40-49
- d) 50-59
- e) 60

3. Kön?

- a) Kvinna
- b) Man

4. Din position?

- a) Yttre tjänst
- b) Utredare
- c) Administratör

5. Har du någonsin loggat in i VSS?

- a) Ja
- b) Nej

Om du svarade nej på fråga 5 så ska du avsluta frågeformuläret eller fortsätta till nummer 27 (Övriga kommentarer)

6. Vilken åtkomstnivå har du?

- a) View
- b) Analyse

7. Hur ofta använder du VSS?

- a. Mycket sällan
- b. Minst en gång i månaden
- c. Minst en gång i veckan
- d. Minst en gång om dagen

8. Hur länge använder du systemet åt gången?

- a. Mindre än 15 min
- b. 15 min till 1 timme
- c. 1-3 timmar
- d. Mer än 3 timmar

20. Kvaliteten på ditt arbete har förbättrats med hjälp av systemet.

Håller inte alls med
1 2 3 4 5 Instämmer helt

21. VSS är viktigt i ditt arbete?

Håller inte alls med
1 2 3 4 5 Instämmer helt

Följande frågor (22-26) riktar sig enbart till dem som svarade att de har åtkomstnivå analyse på fråga sex. Du som svarat view skall inte besvara följande frågor utan hoppa direkt till nr. 27 (Övriga kommentarer)

22. Identifiering av problem/möjligheter har förbättrats genom användningen av systemet.

Håller inte alls med
1 2 3 4 5 Instämmer helt

23. Genom att använda VSS har du möjlighet att göra mer djuplodande analys än vad som var möjligt tidigare.

Håller inte alls med
1 2 3 4 5 Instämmer helt

24. VSS är ett värdefullt verktyg för att ta fram beslutunderlag

Håller inte alls med
1 2 3 4 5 Instämmer helt

25. Användningen av systemet har förkortat den tid det tar för dig att få fram ett beslutsunderlag?

Håller inte alls med
1 2 3 4 5 Instämmer helt

26. VSS är ett viktigt stöd i beslutsfattande?

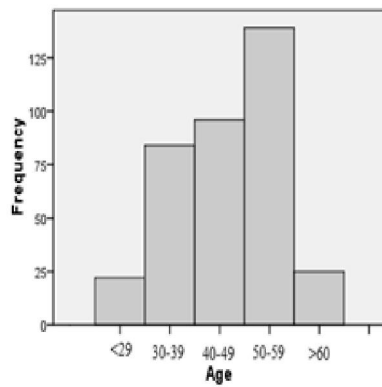
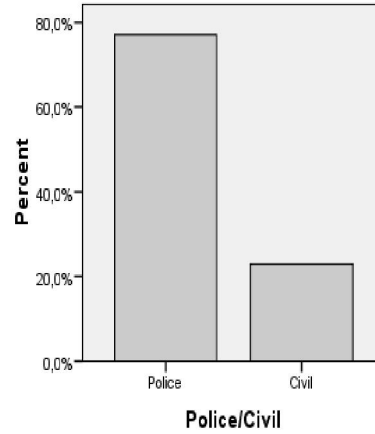
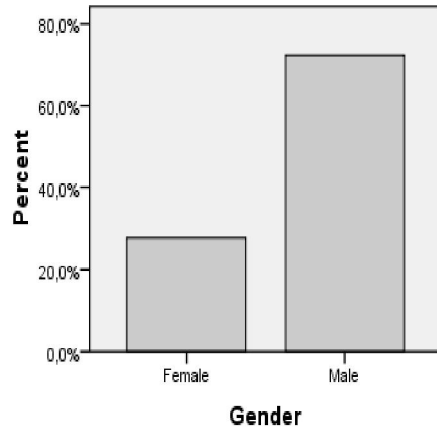
Håller inte alls med
1 2 3 4 5 Instämmer helt

27. Övriga kommentarer

Vi tackar så mycket för att du har tagit dig tid att fylla i detta frågeformulär!

Appendix E: Survey analyses

Background information



Dependency tests and cross tabulations

1- Access level vs. ease of use

Case Processing Summary

| | Cases | | | | | |
|-------------------------------|-------|---------|---------|---------|-------|---------|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Access level * Ease of use | 103 | 28.1% | 264 | 71.9% | 367 | 100.0% |

Access level * Ease of use Crosstabulation

| | | | Ease of use | | | | Total |
|--------------|-----------------------|-----------------------|-------------|-----------------|--------|-----------|--------|
| | | | Difficult | Relatively easy | Easy | Very easy | |
| Access level | View | Count | 15 | 32 | 28 | 9 | 84 |
| | | % within Access level | 17.9% | 38.1% | 33.3% | 10.7% | 100.0% |
| | | % within Ease of use | 93.8% | 80.0% | 84.8% | 64.3% | 81.6% |
| | Analyze | Count | 1 | 8 | 5 | 5 | 19 |
| | | % within Access level | 5.3% | 42.1% | 26.3% | 26.3% | 100.0% |
| | | % within Ease of use | 6.3% | 20.0% | 15.2% | 35.7% | 18.4% |
| Total | Count | 16 | 40 | 33 | 14 | 103 | |
| | % within Access level | 15.5% | 38.8% | 32.0% | 13.6% | 100.0% | |
| | % within Ease of use | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | |

Chi-Square Tests

| | Value | df | Asymp. Sig. (2-sided) |
|------------------------------|--------------------|----|-----------------------|
| Pearson Chi-Square | 4,659 ^a | 3 | .199 |
| Likelihood Ratio | 4.654 | 3 | .199 |
| Linear-by-Linear Association | 2.505 | 1 | .113 |
| N of Valid Cases | 103 | | |

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is 2,58.

2- Access level vs. ease of learn

Case Processing Summary

| | Cases | | | | | |
|---------------------------------|-------|---------|---------|---------|-------|---------|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Access level * Ease of learn | 103 | 28.1% | 264 | 71.9% | 367 | 100.0% |

Access level * Ease of learn Crosstabulation

| | | | Ease of learn | | | | Total |
|--------------|------------------------|------------------------|---------------|--------------------|--------|--------------|--------|
| | | | Difficult | Relative y easy | Easy | Very easy | |
| Access level | View | Count | 13 | 38 | 22 | 11 | 84 |
| | | % within Access level | 15.5% | 45.2% | 26.2% | 13.1% | 100.0% |
| | | % within Ease of learn | 86.7% | 84.4% | 78.6% | 73.3% | 81.6% |
| | Analyze | Count | 2 | 7 | 6 | 4 | 19 |
| | | % within Access level | 10.5% | 36.8% | 31.6% | 21.1% | 100.0% |
| | | % within Ease of learn | 13.3% | 15.6% | 21.4% | 26.7% | 18.4% |
| Total | Count | 15 | 45 | 28 | 15 | 103 | |
| | % within Access level | 14.6% | 43.7% | 27.2% | 14.6% | 100.0% | |
| | % within Ease of learn | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | |

Chi-Square Tests

| | Value | df | Asymp. Sig. (2- sided) |
|---------------------------------|--------------------|----|------------------------------|
| Pearson Chi-Square | 1,350 ^a | 3 | .717 |
| Likelihood Ratio | 1.314 | 3 | .726 |
| Linear-by-Linear Association | 1.281 | 1 | .258 |
| N of Valid Cases | 103 | | |

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is 2,77.

3- Access level vs. response time

Case Processing Summary

| | Cases | | | | | |
|------------------------------|-------|---------|---------|---------|-------|---------|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Access level * Response time | 102 | 27.8% | 265 | 72.2% | 367 | 100.0% |

Access level * Response time Crosstabulation

| | | | Response time | | | | | Total |
|--------------|------------------------|------------------------|---------------|------------------|------------------------|------------------|--------|--------|
| | | | Never | Some of the time | About half of the time | Most of the time | Always | |
| Access level | View | Count | 1 | 14 | 34 | 27 | 7 | 83 |
| | | % within Access level | 1.2% | 16.9% | 41.0% | 32.5% | 8.4% | 100.0% |
| | | % within Response time | 50.0% | 77.8% | 89.5% | 79.4% | 70.0% | 81.4% |
| | Analyze | Count | 1 | 4 | 4 | 7 | 3 | 19 |
| | | % within Access level | 5.3% | 21.1% | 21.1% | 36.8% | 15.8% | 100.0% |
| | | % within Response time | 50.0% | 22.2% | 10.5% | 20.6% | 30.0% | 18.6% |
| Total | Count | 2 | 18 | 38 | 34 | 10 | 102 | |
| | % within Access level | 2.0% | 17.6% | 37.3% | 33.3% | 9.8% | 100.0% | |
| | % within Response time | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | |

Chi-Square Tests

| | Value | df | Asymp. Sig. (2-sided) |
|------------------------------|--------------------|----|-----------------------|
| Pearson Chi-Square | 4,037 ^a | 4 | .401 |
| Likelihood Ratio | 3.871 | 4 | .424 |
| Linear-by-Linear Association | .078 | 1 | .779 |
| N of Valid Cases | 102 | | |

a. 4 cells (40,0%) have expected count less than 5. The minimum expected count is ,37.

4- Access level vs. format

Case Processing Summary

| | Cases | | | | | |
|--------------------------|-------|---------|---------|---------|-------|---------|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Access level * Format | 99 | 27.0% | 268 | 73.0% | 367 | 100.0% |

Access level * Clear info Crosstabulation

| | | | Format | | | | Total |
|--------------|-------|----------------------------|------------------|------------------------|------------------|--------|--------|
| | | | Some of the time | About half of the time | Most of the time | Always | |
| Access level | View | Count | 14 | 26 | 36 | 4 | 80 |
| | | % within Access level | 17.5% | 32.5% | 45.0% | 5.0% | 100.0% |
| | | % within Clear info | 60.9% | 86.7% | 87.8% | 80.0% | 80.8% |
| Analyze | Count | Count | 9 | 4 | 5 | 1 | 19 |
| | | % within Access level | 47.4% | 21.1% | 26.3% | 5.3% | 100.0% |
| | | % within Clear info | 39.1% | 13.3% | 12.2% | 20.0% | 19.2% |
| Total | Count | Count | 23 | 30 | 41 | 5 | 99 |
| | | % within Access level | 23.2% | 30.3% | 41.4% | 5.1% | 100.0% |
| | | % within Clear info | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

Chi-Square Tests

| | Value | df | Asymp. Sig. (2-sided) |
|------------------------------|--------------------|----|-----------------------|
| Pearson Chi-Square | 7,856 ^a | 3 | .049 |
| Likelihood Ratio | 7.062 | 3 | .070 |
| Linear-by-Linear Association | 4.562 | 1 | .033 |
| N of Valid Cases | 99 | | |

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,96.

5- Access level vs. update info

Case Processing Summary

| | Cases | | | | | |
|-------------------------------|-------|---------|---------|---------|-------|---------|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Access level * Update info | 102 | 27.8% | 265 | 72.2% | 367 | 100.0% |

Access level * Update info Crosstabulation

| | | | Update info | | | | | Total |
|--------------|-----------------------|-----------------------|-------------|------------------|------------------------|------------------|--------|--------|
| | | | Never | Some of the time | About half of the time | Most of the time | Always | |
| Access level | View | Count | 0 | 14 | 33 | 29 | 7 | 83 |
| | | % within Access level | .0% | 16.9% | 39.8% | 34.9% | 8.4% | 100.0% |
| | | % within Update info | .0% | 66.7% | 82.5% | 93.5% | 87.5% | 81.4% |
| | Analyze | Count | 2 | 7 | 7 | 2 | 1 | 19 |
| | | % within Access level | 10.5% | 36.8% | 36.8% | 10.5% | 5.3% | 100.0% |
| | | % within Update info | 100.0% | 33.3% | 17.5% | 6.5% | 12.5% | 18.6% |
| Total | Count | 2 | 21 | 40 | 31 | 8 | 102 | |
| | % within Access level | 2.0% | 20.6% | 39.2% | 30.4% | 7.8% | 100.0% | |
| | % within Update info | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | |

Chi-Square Tests

| | Value | df | Asymp. Sig. (2-sided) |
|------------------------------|---------------------|----|-----------------------|
| Pearson Chi-Square | 14,997 ^a | 4 | .005 |
| Likelihood Ratio | 13.387 | 4 | .010 |
| Linear-by-Linear Association | 9.221 | 1 | .002 |
| N of Valid Cases | 102 | | |

a. 4 cells (40,0%) have expected count less than 5. The minimum expected count is ,37.

6- Position vs. Log in

Case Processing Summary

| | Cases | | | | | |
|-------------------|-------|---------|---------|---------|-------|---------|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Position * Log in | 339 | 92,4% | 28 | 7,6% | 367 | 100,0% |

Position * Log in Crosstabulation

| | | | Log in | | Total |
|---------------|------------------|-------------------|--------|--------|--------|
| | | | Yes | No | |
| Position | External Service | Count | 18 | 95 | 113 |
| | | % within Position | 15,9% | 84,1% | 100,0% |
| | | % within Log in | 18,6% | 39,3% | 33,3% |
| Researcher | Count | Count | 23 | 87 | 110 |
| | | % within Position | 20,9% | 79,1% | 100,0% |
| | | % within Log in | 23,7% | 36,0% | 32,4% |
| Administrator | Count | Count | 56 | 60 | 116 |
| | | % within Position | 48,3% | 51,7% | 100,0% |
| | | % within Log in | 57,7% | 24,8% | 34,2% |
| Total | Count | Count | 97 | 242 | 339 |
| | | % within Position | 28,6% | 71,4% | 100,0% |
| | | % within Log in | 100,0% | 100,0% | 100,0% |

Chi-Square Tests

| | Value | df | Asymp. Sig. (2-sided) |
|------------------------------|---------------------|----|-----------------------|
| Pearson Chi-Square | 34,053 ^a | 2 | ,000 |
| Likelihood Ratio | 33,312 | 2 | ,000 |
| Linear-by-Linear Association | 29,408 | 1 | ,000 |
| N of Valid Cases | 339 | | |

7- Access level vs. frequency of use

Case Processing Summary

| | Cases | | | | | |
|------------------------------------|-------|---------|---------|---------|-------|---------|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Access level * Frequency of use | 103 | 28.1% | 264 | 71.9% | 367 | 100.0% |

Access level * Frequency of use Crosstabulation

| | | | Frequency of use | | | | Total |
|--------------|---------------------------|---------------------------|------------------|-----------------------|----------------------|---------------------|--------|
| | | | Very rarely | At least once a month | At least once a week | At least once a day | |
| Access level | View | Count | 28 | 22 | 23 | 11 | 84 |
| | | % within Access level | 33.3% | 26.2% | 27.4% | 13.1% | 100.0% |
| | | % within Frequency of use | 96.6% | 78.6% | 82.1% | 61.1% | 81.6% |
| | Analyze | Count | 1 | 6 | 5 | 7 | 19 |
| | | % within Access level | 5.3% | 31.6% | 26.3% | 36.8% | 100.0% |
| | | % within Frequency of use | 3.4% | 21.4% | 17.9% | 38.9% | 18.4% |
| Total | Count | 29 | 28 | 28 | 18 | 103 | |
| | % within Access level | 28.2% | 27.2% | 27.2% | 17.5% | 100.0% | |
| | % within Frequency of use | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | |

Chi-Square Tests

| | Value | df | Asymp. Sig. (2-sided) |
|------------------------------|--------------------|----|-----------------------|
| Pearson Chi-Square | 9,508 ^a | 3 | .023 |
| Likelihood Ratio | 10.359 | 3 | .016 |
| Linear-by-Linear Association | 7.491 | 1 | .006 |
| N of Valid Cases | 103 | | |

a. 1 cells (12,5%) have expected count less than 5. The minimum expected count is 3,32.

8- Access level vs. time of use

Case Processing Summary

| | Cases | | | | | |
|-------------------------------|-------|---------|---------|---------|-------|---------|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Access level * Time of use | 103 | 28.1% | 264 | 71.9% | 367 | 100.0% |

Access level * Time of use Crosstabulation

| | | | Time of use | | | | Total |
|--------------|-----------------------|-----------------------|------------------|------------------|-----------|-------------------|--------|
| | | | Less than 15 min | 15 min to 1 hour | 1-3 hours | More than 3 hours | |
| Access level | View | Count | 53 | 31 | 0 | 0 | 84 |
| | | % within Access level | 63.1% | 36.9% | .0% | .0% | 100.0% |
| | | % within Time of use | 96.4% | 75.6% | .0% | .0% | 81.6% |
| | Analyze | Count | 2 | 10 | 4 | 3 | 19 |
| | | % within Access level | 10.5% | 52.6% | 21.1% | 15.8% | 100.0% |
| | | % within Time of use | 3.6% | 24.4% | 100.0% | 100.0% | 18.4% |
| Total | Count | 55 | 41 | 4 | 3 | 103 | |
| | % within Access level | 53.4% | 39.8% | 3.9% | 2.9% | 100.0% | |
| | % within Time of use | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | |

Chi-Square Tests

| | Value | df | Asymp. Sig. (2-sided) |
|------------------------------|---------------------|----|-----------------------|
| Pearson Chi-Square | 39,929 ^a | 3 | .000 |
| Likelihood Ratio | 35.751 | 3 | .000 |
| Linear-by-Linear Association | 34.070 | 1 | .000 |
| N of Valid Cases | 103 | | |

a. 4 cells (50,0%) have expected count less than 5. The minimum expected count is ,55.

9- Satisfaction vs. Access level.

Case Processing Summary

| | Cases | | | | | |
|-----------------------------|-------|---------|---------|---------|-------|---------|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Satisfaction * Access level | 103 | 28.1% | 264 | 71.9% | 367 | 100.0% |

Satisfaction * Access level Crosstabulation

| | | | Access level | | Total |
|------------------------|----------------------|-----------------------|--------------|---------|--------|
| | | | View | Analyze | |
| Satisfaction | Not at all satisfied | Count | 2 | 3 | 5 |
| | | % within Satisfaction | 40.0% | 60.0% | 100.0% |
| | | % within Access level | 2.4% | 15.8% | 4.9% |
| Relativley unsatisfied | Count | Count | 20 | 5 | 25 |
| | | % within Satisfaction | 80.0% | 20.0% | 100.0% |
| | | % within Access level | 23.8% | 26.3% | 24.3% |
| Neutral | Count | Count | 32 | 5 | 37 |
| | | % within Satisfaction | 86.5% | 13.5% | 100.0% |
| | | % within Access level | 38.1% | 26.3% | 35.9% |
| Relatively satisfied | Count | Count | 25 | 5 | 30 |
| | | % within Satisfaction | 83.3% | 16.7% | 100.0% |
| | | % within Access level | 29.8% | 26.3% | 29.1% |
| Fully satisfied | Count | Count | 5 | 1 | 6 |
| | | % within Satisfaction | 83.3% | 16.7% | 100.0% |
| | | % within Access level | 6.0% | 5.3% | 5.8% |
| Total | Count | Count | 84 | 19 | 103 |
| | | % within Satisfaction | 81.6% | 18.4% | 100.0% |
| | | % within Access level | 100.0% | 100.0% | 100.0% |

Chi-Square Tests

| | Value | df | Asymp. Sig. (2-sided) |
|------------------------------|--------------------|----|-----------------------|
| Pearson Chi-Square | 6,453 ^a | 4 | .168 |
| Likelihood Ratio | 4.991 | 4 | .288 |
| Linear-by-Linear Association | 1.871 | 1 | .171 |
| N of Valid Cases | 103 | | |

a. 5 cells (50,0%) have expected count less than 5. The minimum expected count is ,92.

10- Importance vs. Access level.

Case Processing Summary

| | Cases | | | | | |
|------------------------------|-------|---------|---------|---------|-------|---------|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Importance * Access level | 103 | 28.1% | 264 | 71.9% | 367 | 100.0% |

Importance * Access level Crosstabulation

| | | | Access level | | Total |
|----------------|-----------------------|-----------------------|--------------|---------|--------|
| | | | View | Analyze | |
| Importance | Strongly disagree | Count | 9 | 3 | 12 |
| | | % within Importance | 75.0% | 25.0% | 100.0% |
| | | % within Access level | 10.7% | 15.8% | 11.7% |
| | Disagree | Count | 21 | 2 | 23 |
| | | % within Importance | 91.3% | 8.7% | 100.0% |
| | | % within Access level | 25.0% | 10.5% | 22.3% |
| | Neutral | Count | 22 | 5 | 27 |
| | | % within Importance | 81.5% | 18.5% | 100.0% |
| | | % within Access level | 26.2% | 26.3% | 26.2% |
| | Agree | Count | 25 | 2 | 27 |
| | | % within Importance | 92.6% | 7.4% | 100.0% |
| | | % within Access level | 29.8% | 10.5% | 26.2% |
| Strongly agree | Count | 7 | 7 | 14 | |
| | % within Importance | 50.0% | 50.0% | 100.0% | |
| | % within Access level | 8.3% | 36.8% | 13.6% | |
| Total | Count | 84 | 19 | 103 | |
| | % within Importance | 81.6% | 18.4% | 100.0% | |
| | % within Access level | 100.0% | 100.0% | 100.0% | |

Chi-Square Tests

| | Value | df | Asymp. Sig. (2- sided) |
|------------------------------|---------------------|----|------------------------------|
| Pearson Chi-Square | 13,249 ^a | 4 | .010 |
| Likelihood Ratio | 11.860 | 4 | .018 |
| Linear-by-Linear Association | 1.827 | 1 | .176 |
| N of Valid Cases | 103 | | |

a. 5 cells (50,0%) have expected count less than 5. The minimum expected count is 2,21.

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