

Master's Thesis in Informatics

How to evaluate IT/IS investments

- The criteria used depending on the underlying needs

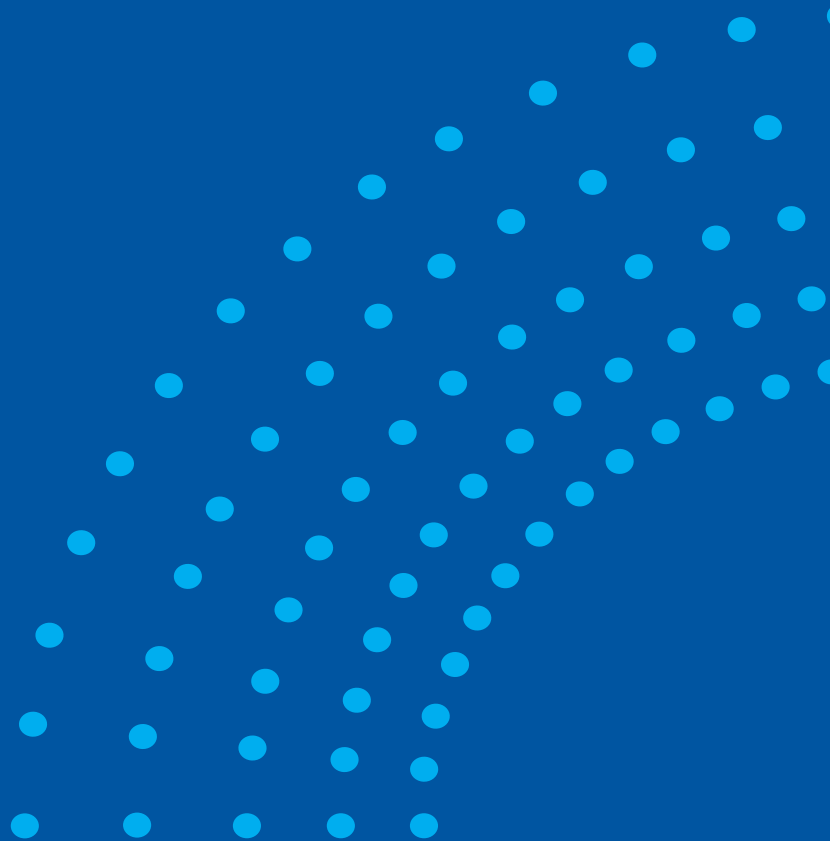
Katrin Andersson & Peter Vinqvist



IT University
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- The criteria used depending on the underlying needs

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Abstract

Efforts to find appropriate criteria, which are used to evaluate IT/IS-investments, are intensified by researchers and practitioners due to the increasing impact of IT. The difficulties when measuring IT/IS investments using financial terms triggers the development of a plethora of models, criteria and measurements.

This thesis study the reasons why investments in IT/IS are performed and what criteria are used when evaluating IT/IS investments depending on its reason.

This thesis suggests that different criteria are used depending on the underlying need for the IT/IS investment. This suggestion is based on an empirical study where members of IT/IS investment decision processes in Sweden participates. The results shows that the most common underlying needs for IT/IS investments are *rationalization, increased production, reliable system, support/service/equipment and process development*. The most common criteria to evaluate these investments are *savings, operational cost, needs and wants from the organization, Future support/debugging/repair time, initial cost of investment, strategic alignment, easy to handle and time*.

Many researchers claim that there has been a change of the purpose of IT/IS-investments from only being a tool for production improvement to also become a strategic tool. Our results show that there is still a focus on the production, rationalizing and simplification of the operational day to day work. One explanation could be the fact that the study is carried out in cooperation with respondents primarily located at the operational level in their organizations. Although, there are signs of awareness among the respondents of other purposes with IT/IS investments than production improvement.

Keywords: Business Value, IT/IS evaluation, decision making process, Delphi-study

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Thank you all!

12th of January 2005

Katrin Andersson

Peter Vinqvist

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1 Introduction

Annually, \$2 trillion are spent on IT-investments globally (Carr, 2003) and 120 billion SEK nationally in Sweden (Werner et al., 2004). IT is clearly becoming a bigger part of company budgets. IT is a tool to support and improve functions within the company just as one invests in a new machine and as with every investment a company decides to execute, one must be clear of what one gain, both financially and non-financially, from such investments as well as which needs does this investment fulfill in our organization. Assessing benefits from IT/IS investment is filled with uncertainties, especially those investments with benefits that are realized over a long period of time or are not directly observable. (In this thesis, IT/IS is referred to **Information Technology/Information Systems** and investments could be both hardware technology and software.)

The needs for IT/IS investments vary within the organization. Depending on what needs corporations have, one faces different challenges when IT/IS investments to fulfill these needs should be made. One has to deal with, except the purpose, obstacles with IT/IS investments and how to create the basic data which is the foundation of the decision. However, basic data is not the only thing that managers base their decision on. Managers are affected by their own perception of value and earlier experiences and the literature refers to this irrational behavior as “gut feeling” (Powell, 1992) or “act on instinct” (Farbey et al, 1993, 1999). Furthermore, when making investment decisions, there are criteria that need to be fulfilled before the decision become a reality. These criteria also vary depending on the underlying needs, i.e. different criteria are important depending on which need the investment intends to fulfill.

This thesis has been supervised by Urban Nulden who is an Associate Professor at the Victoria Institute and Department of informatics at the Göteborg University and Mats-Eric Olovsson at Semcon AB.

1.1 Background and Problem Area

Organizations estimate that about 20% of their IT spending is wasted and that 30% to 40% do not increase business performance (Willcocks and Lester, 1993). Further studies show that 70% of all IT/IS investments seem to give no adequate return on investment (Hochstrasser and Griffiths, 1990).

Nobel Prize winning economist Robert Solow states that we see computers everywhere except in the productivity statistics. Productivity growth has slowed every decade since the 1960's while investments in information technology have grown dramatically. Some take this as a proof that information technology doesn't affect productivity (Atkinson and Court, 1998).

Brynjolfsson (1993) contradicts this statement and claims that there is an unawareness of IT's real effect and refers to it as the productivity paradox of Information Technology. Brynjolfsson argues that a shortfall of evidence is not necessarily evidence of a shortfall and continues the shortfall of IT productivity is as much due to deficiencies in our measurement and methodological tool kit as to mismanagement by developers and users of IT. Willcocks and Lester (1996) support this statement and

claim that the failure to identify IT/IS benefits and productivity says as much about the deficiencies in assessment methods and measurement, and the rigor which they are applied.

There has been a change in the use of information systems from no longer being introduced for the purpose of improving operational efficiency, but for creating competitive advantage or strategic opportunities in the future (Jurison, 1996). Nowadays IT/IS investments are made due to a variety of reasons, including improved quality, increased variety of products or services, and better responsiveness to customer needs (Jurison, 1996).

In the search for new criteria and measurements the focus is set on the qualitative criteria and measurements and the difficulties to measure these. In addition to several studies (Peffer and Saarinen, 2002, Seddon et al, 2002 and Bacon, 1992) a change of attention is taking place regarding IT-investment evaluation. The exclusiveness of the financial criteria has shifted to also consider the strategic criteria.

The aim of this thesis is to give a contribution to the researchers of the IT/IS evaluation area by investigating which criteria are used depending on the underlying need for an IT/IS investment. Earlier empirical studies (Bacon, 1992 and Seddon et al, 2002) show which criteria are experienced as the most important. Furthermore, there are also studies that are suggesting what criteria should be used when evaluating IT/IS investment in relation to the underlying need (Hochstrasser, 1990 and Willcocks, 1996). Although, there is a lack of studies that tries to relate the criteria experienced as most important to the underlying need of IT/IS investments on the basis of empirical studies. This thesis contributes to the knowledge of the relation between the criteria experienced important and the underlying need of the IT/IS investment. This study focuses on the Swedish industrial production branch and contributes to the knowledge of the IT/IS evaluation in this specific branch. In order to reach the aim of the thesis a study on the experienced important criteria and IT/IS investment underlying needs by members of the decision making process working at companies in the Swedish industrial production branch has been performed.

1.2 Purpose and research question

The purpose of this thesis is to examine which criteria are found important when making a decision whether to invest or not depending to the underlying need of the IT/IS investment. The study also examines which of the criteria used are experienced as most important when making different decisions. In order to do this we have focused on people with knowledge in IT/IS investment evaluation in Sweden. An empirical study has been performed in participation with members of IT/IS decision making processes in Swedish companies in order to answer our research question:

Which criteria are found important when evaluating whether to invest or not in IT/IS depending on the investments underlying needs?

The underlying needs and criteria experienced by the respondents have been studied and then used when investigating their relation in order to answer the research question.

1.3 Delimitation

This study is delimited from providing the answer to which criteria are the ultimate ones since there is no reasonable chance for us to do that due to resource constraints. The respondents have been selected together with our supervisor at Semcon because they have experience within the area of decision making and creating basic data for IT/IS investments. Most of the respondents are located at the operational level of the organizations.

1.4 Disposition

Below the different sections of this thesis are shortly presented:

Introduction - describes the background, problem area and purpose of this thesis.

Background and theoretical framework – presents an overview of the problem area of IT/IS investment evaluation and the decision making process. It also presents theoretical frameworks considering different methods and criteria to use when evaluating an IT/IS investment.

Method - presents the scientific standpoint of the study and the process of work.

Results- presents the results obtained from the empirical study according to what needs are experienced to perform an IT/IS investment, which criteria are used to evaluate an IT/IS investment and the relation between these criteria and underlying needs.

Discussion – discusses the findings presented, compares the theoretical findings with the empirical, discusses what could be affecting the result and how credible it is.

Conclusions – shortly answers the research question.

2 Background and theoretical framework

The purpose with this chapter is to present the theoretical framework and background of this thesis. The chapter starts with presenting the purpose of and obstacles with IT/IS investments. The next section contains issues regarding decision making within an organization and the decision process from the initial need to the final investment decision. How to create basic data for IT/IS investment decisions is also presented in this chapter. Finally, theoretical support for the choice of appropriate data to analyze depending on the investment-needs is presented.

2.1 IT/IS investment

In this section the objectives; and obstacles with; IT/IS investments is presented.

2.1.1 Objectives with IT/IS Investments

Several decades ago the definition of an investment in information technology was slightly different than today. Nowadays, the development of IT has reached a technical level which makes it possible to evolve from being a tool for rationalizing routine business processes in the “back office”, such as payroll automation or inventory control, to become a tool for improving effectiveness, gain and sustain business advantage and to change entire business processes (Renkma, 1998). However, productivity efficiency is still a valid reason for investing in IT but managers are becoming aware of the other dimensions of IT. It is a question of priority; different corporations have different objective with IT/IS investments. Tallon et al. (2000) present the different objectives with IT in figure 1.

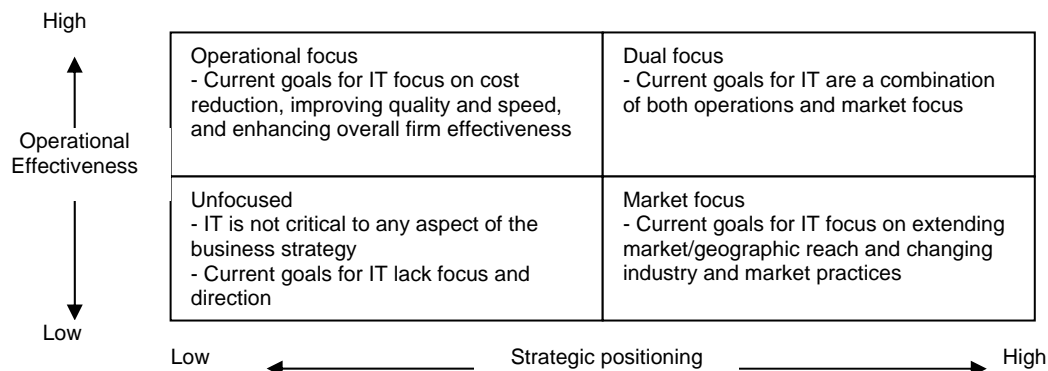


Figure 1 Corporate goals for IT, Tallon et al. (2000)

A high rate of operational effectiveness indicates that a company has an overall high rate of operational effectiveness and a low rate indicates the opposite. A high rate of strategic positioning means that the company has a clearly defined objective to reach a strategic position in relation to markets and geographic extension.

Operational focus - have clearly defined goals for IT and investments will be focused on increasing production speed, improving quality and lowering costs.

Unfocused – company views IT as a “money consumer” and the budget should be as little as possible instead of an investment to be managed.

Dual focus – is simply a combination of operational and market focus.

Market focus – focuses more on the external functions of IT such as strategic positioning and creating improved customer relations, i.e., the use of IT to enhance value proposition.

The objectives with IT affect which type of investment the corporations will choose to carry out and the reasons for investing in IT vary. Investment decisions that create maximum market value to shareholders are, according to financial theorists, the major reason to invest (Dos Santos et al., 1993). Further, managers consider investing in IT because of the ability to gain competitive advantage from it. Several models and frameworks in the literature (Rockheart et al., 1984, McFarlan, 1984, Porter, 1980 and Wyman, 1985 in Ward, 1986) suggest that Information Technology can be the key to achievement in:

- redefining the boundaries of the industry, removing constraints to growth;
- developing new products or services;
- realigning the balance of power in the supplier-customer relationship;
- changing the basis of competition between existing rivals;
- establishing barriers to deter new entrants.

2.1.2 Obstacles with IT/IS Investments

Different foci of IT/IS face different challenges. The operational focus of the corporation creates problems when evaluating investments due to the strong alignment to production efficiency which excludes strategic consideration. The unfocused corporation misses the opportunities with IT. The market focused corporation uses IT for mainly strategic purposes, however, operational productivity should not be excluded, which the dual focused company notices and adopts a combination of operational and market foci.

As well as the corporation's foci, managers' perceptions affect the investment decision. As mentioned earlier, when complex decisions are necessary, managers fall outside the traditional boundaries of decision-making and "act on instinct" or following "gut feeling". (Farbey et al., 1994 and Powell, 1992). Further description of the decision making process is given in section 2.2.2.

IT/IS investments are constantly a subject of disappointment and the investment evaluation raises many questions. As mentioned above, organizations estimate that around 20% of their IT spending is wasted and that 30%-40% do not contribute to business performance. Further, around 70% of all IT/IS investments seem to give no adequate return on investments (Renkma, 1998).

To reach the planned objectives with an IT/IS investment, there is a need to be clear of how the investment contributes to the business performance of the organization. However, attempts to show the linkage between IT-investments and business performance have shown mixed results. While some studies have shown positive impact, comprehensive literature indicates that a large number of studies have found little or even negative correlation between IT/IS investments and business performance (Jurison, 1996).

Jurison (1996) defines the reasons for the confusions about the IT-value and the difficulty to prove IT's impact on business performance as;

- Inappropriate measures
- Inappropriate unit of analysis
- Failure to account for time lag

The measurement problem is a difficult question for decision-makers. Hochstrasser (1992) in Ballentine and Stray(1998) claim that it is the lack of solid but easy to use management tools for evaluating, prioritizing, monitoring and controlling IT/IS investments that causes IT project to show a high failure rate. This lack of adequate measurements causes consequences for the corporation since the alignment between IT and corporate strategy is one of the most important issues regarding IT/IS investment in Europe and North America (Computer Sciences Corporation in Tallon et al., 2000).

However, a strategic alignment is difficult to obtain since the nature of IT/IS investments include three different categories of benefits “tangible”, “intangible” and “hidden”. The tangible benefits are easily measured and have attached quantifiable value. The intangible benefits are known but often neglected by the management due to difficulties with quantifying values using existing methods. Hidden benefits do not appear to the decision maker and Kaye in Milis and Mercken (2004) resemble the hidden benefits to an iceberg were the hidden benefits symbolizes the benefits below the surface (Milis and Mercken, 2004). Hallikainen (2003) compares IT-investments with other types of investments and come to the conclusion that IT-investments have some special characteristics which make it difficult to evaluate. First, the benefits are mainly intangible in nature which causes monetary measures to be difficult to use and subjective arguments have to be applied. Second, the benefits of IT/IS investments are often realized over a long period of time which makes the traditional financial investment evaluation techniques inappropriate due to their short-term focus.

The IT evaluation challenge model (Willcocks and Greaser, 2001) presented in figure 2 illustrates the considerations one has to do when evaluating an investment in IT/IS.

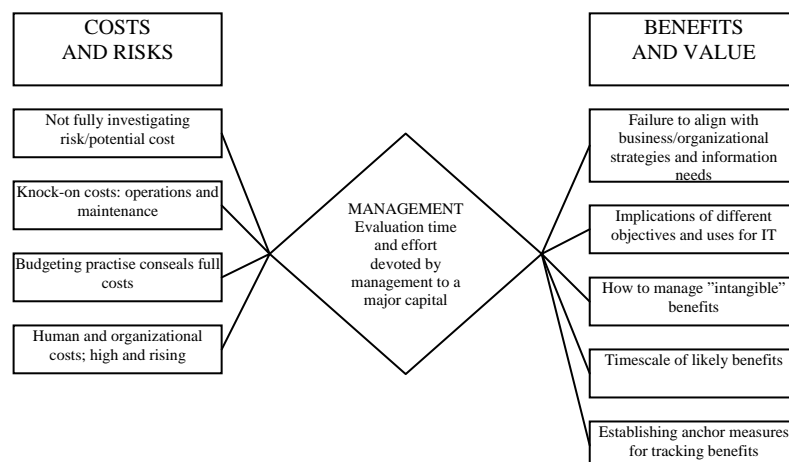


Figure 2 IT evaluation challenges model, Willcocks and Greaser (2001)

The figure shows the two sides of the evaluation equation. If costs and risks represent

the downside of IT investment, then benefits and value represent the upside. All must be considered when delineate the net benefit from any specific IT investment.

Cost and risks issues

Not fully investigating risk/potential cost. Risk is a component of IT/IS investments and project undertakings that is often ignored but can lead to disaster if left unmanaged.

Knock-on costs: operations and maintenance. In the course of investment analysis, reviewed costs are confined frequently to the hard, identifiable costs of the project, while additional knock-on costs are understated and/or not explicitly associated with the project. These types of costs are often ignored but the consequences could be that costs grow beyond control since an adequate categorization is missing.

Budgeting practices conceal full costs. If the IT-department manages the budget, that budget will be isolated from the rest of the organization, which will contribute to the failure to identify IT-related costs in the rest of the organization. A separated budgeting process will not reflect the strategic goals/needs of the organization due to lack of strategic planning within the budget process.

Human and organizational costs: high and rising. A growing technical influence within the organizations causes a need for additional knowledge workers. One needs to be aware of these costs, otherwise the human/organizational costs could exceed the technical costs.

Benefits and value: Concerns

Failure to align with business/organizational strategies and information needs. A study made by Willcocks and Graeser (2001) showed that the strategic match was seen as the most important investment evaluation criteria but there were severe difficulties attaining such alignment.

Implications of different uses and objectives for IT. As technology penetrates the organization, unpredictable effects will occur and the consequence will be difficulties to isolate specific effects from IT. To be able to understand these effects, some sort of measurement or evaluation must take place.

How to manage intangible benefits. The intangible nature of many benefits should lead to the concept that “measurement is not just a number”. In other words, evaluation or measurement does not have to boil down to a concrete number. Instead, if the appropriate stakeholder in an organization understands the terms of an IT/IS investment and agrees on the types of benefits to be derived in deceptive terms, then the investment can be pursued in the knowledge that benefits elicitation and the commitment to achieve those benefits will depend on the interaction among, and actions of, salient stakeholders.

Timescale of likely benefits. Any number of benefits, both tangible and intangible, are affected by the timescale upon which the benefit in question is recognizable. In other words, a lag could exist between the IT/IS investment/spend and the ultimate delivery and recognition of the benefit. The problem is to convince the management that the time lag will not defeat the purpose of the investment itself.

Establishing anchor measures for tracking benefits. The benefits to be derived from technology spend are evolving as quickly as the technology itself which lead to

that the measurement must also evolve. Further, organizations must recognize that evaluation is not merely a one-off exercise but an enduring undertaking that can contribute significantly to the management process.

The evaluation challenges model summarizes the problems and necessary considerations need to be done with IT/IS investments. Difficulties with measurements, i.e. the lack of appropriate methodology for evaluation despite the identified 160 models (Katz, 1993), the far too extensive use of financial measures and different perceptions among decision-makers, cause investment not to fulfill the stated objectives.

It is not only linking IT to business along with corporate foci that affects if an investment is successful or not. It is managers who make the final decision and the process is far more complicated than just look at the data and then making a decision. Within this section, we present what the literature has to offer regarding the process of decision-making.

2.2 Investment decisions in organizations

The difficulties regarding making IT/IS investment decisions derive from more than collecting basic data. How the decision making process occurs and who makes the final decision also affect the outcome. This section describes the decision levels within a company as well as the decision making process.

2.2.1 Decision levels

Salter et al (2004) claim that an organization can consists of individuals and groups working towards a common goal. These are referred to as agents. For example, the board of directors, which consist of a number of individual board members, are an agent but the members can also act as individual agents independently from the board. The different groups of agents make decisions with different effects related to the strategic, tactical and operational levels. The decisions made at each of these organizational levels have different characteristics shown in table 1.

Table 1. Characteristics of decisions, from Jennings and Wattam (1998) through Salter et al. (2004)

	Timescale	Nature of risk	Structure	Control
Strategic	Long term	High	Ill defined	Heuristic
Tactical	Medium term	Moderate	Variable	Qualitative
Operational	Short term	Low	Well defined	Quantitative

Strategic decisions, usually made at the ‘board level’, do have a long term perspective but the structure is ill defined. Tactical decisions, made by ‘middle management’, tend to be medium term and use mainly qualitative data to support decisions. The operational decisions, made at “low level management”, have short term effects and are mainly based on quantitative data. Each of these levels has different needs which can be fulfilled in several different ways (Salter et al, 2004).

Strategic needs can be fulfilled by tactical action requiring tactical decisions. Tactical decisions address strategic needs by optimizing the organizations performance within the predetermined strategic direction (Salter et al, 2004). Tactical decisions also address action on the part of agents to fulfill the resulting tactical needs; these are

operational actions requiring operational decisions. Operational decisions address tactical needs through substantive actions, specific actions with a substantive result. Agents responsible for carrying out operational actions may have no need to make further decisions as the actions to fulfill their needs are immediately available (Salter et al, 2004).

2.2.2 The process of making decisions

(Huber and McDaniel, 1986, p. 5) defines decision making as “the processes commonly portrayed as occurring early in the “problem solving process” – the sensing, exploration, and definition of problems or opportunities – as well as the generation, evaluation, and selection of solutions“.

A decision making process is the entire chain of occurrences that will ultimately lead to that a decision is made and executed. Further, decisions are about collecting information and then systematize, analyze, interpret and communicate with other, before a choice between alternatives is made (Jacobsen and Thorsvik, 1998). Several different models exist that describe the decision making process. However, there exist some consistent parts in the different processes. Table 2 shows how different decision making models are connected. Salter et al. (2004) have identified six different components which work as the link between the different models:

1. Information
2. Need
3. Potential Action
4. Choice
5. Selected action
6. Report

Table 2. Different decision making models

Component	Adair (1985) in Salter et al. (2004)	Jennings and Wattman (1998) in Salter et al. (2004)	Fulop et al. (1999) in Salter et al. (2004)	Drucker (1967)
Information	Sense effects			The Classification
Need	Define objectives	Goals and objectives	Recognition of problem	The Definition
Potential Action	Develop options	Alternatives	Gathering and analysis of data	The specifications
Choice	Evaluate and decide	Choice	Evaluation of alternatives	The Choice
Selected action	Implement	Implementation	Implement	The Action
Report	Monitor consequences			The Feedback

Regarding investments in IT/IS, researchers claim that those decisions are very difficult to make due to the complex nature; a complexity that originates from difficulties to assess value and benefits obtained from the investment (Bannister and Remenyi, 2000). As a result, the managers use “gut instinct” (Powell, 1992) or base decisions on “acts of faith” (Farbey et al., 1993). Further, when facing complex IT/IS investments decisions, managers tend to return to rather simple evaluation techniques

such as cost-benefit analysis (Bannister and Remenyi, 2000). There are advocates of rational decision making that do not like those decisions are made out of the managers own experience and perception of the investment. They argue that decisions should be based on data obtained from investment evaluation techniques (Bannister and Remenyi, 2000).

A decision is made by a human and not by an organization and therefore it is not obvious that the organizational value and the value for the decision maker are the same thing. As Bannister and Remenyi (2000, p.7) put it: “Although one can normally differentiate between the value of an IT/IS investment to an organization and to the decision makers, in practice, in the mind of the decision makers, both are confounded. It is simply not part of human nature to make totally detached decisions about anything, never mind the choices which will affect them personally.” Perception will always affect how decisions are made, i.e. decisions are not only affected by numbers and costs, but by cultural, political, personal and a host of other factors (Bannister and Remenyi, 2000).

To summarize, Bannister and Remenyi (2000) argue that in order to improve IT-investment decisions, a deeper understanding of what is going on in the managerial mind is desirable. Further, Lacity and Hirscheim (1995 in Bannister and Remenyi 2000, p.8) state that “The problem is that meaningful measures of departmental efficiency do not exist for IS” and that “much of the knowledge required to make efficient economic decisions (related to information systems) cannot be expressed as statistical aggregates, but is highly idiosyncratic in nature”. Bannister and Remenyi (2000, p.8) finish their article with their view of the value of IT-investments: “After all, value, like beauty and the contact lens, remains in the eye of the beholder and the eye of the beholder in business and management situations needs to be cultivated. Were it any other way, there would be far fewer poor or bad business decisions – whether IT-related or not”.

2.3 The need for IT/IS investments

Why do organizations perform IT/IS investments? This section aims to describe the purposes of IT/IS investments in the perspective of what need they are to satisfy. In order to do this, we will develop an understanding of the variety of ways these investments can be viewed and classified. Some classifications performed by different researchers are described below in Table 3. The investments types have been categorized in order for the reader to get a better overview of the similarities and differences between the researchers’ categorizations.

Table 3 Overview of types of investments (Peffer and Saarinen, 2002, Hochstrasser, 1990 and Willcock and Lester, 1996)

Type of investment	Hochstrasser (1990)	Willcock and Lester (1996)	Peffer and Saarinen (2002)
cost	Cost replacement projects (IT systems introduced to automate manual activities related to information processing.)	Investments to improve performance (Investments to reduce costs and/or increase revenues.)	Routine cost saving (Focus on automation of operations tasks to produce cost saving.)
mandatory		Mandatory investments (Investments to satisfy minimum legal requirements, facilitate business operations and/or keep up with the competition.)	Strategic necessity (Focus on meeting strategic needs that are essential and inevitable.)
strategy	Economy of scale (IT-systems introduced to allow a company to handle an increased volume of data.) Economy of scope (IT-systems introduced to allow a company to perform an extended range of tasks.) Customer support IT-systems introduced to offer better services to costumers.	Investments to achieve competitive advantage (Investments to achieve a competitive leap.)	Strategic IT (Focus on the strategic role of IT.)
product	Quality support projects (IT-systems introduced to increase the quality of the finished product.) New technology projects (IT-systems introduced to exploit strategically the business potential of the new technology, to do things that were not possible before.)	Investments in research (Investments to be prepared in the future.)	Strategic product value related IT (Focus on developing new products.)
infrastructure	Infrastructure projects (Hardware or software systems installed to enable the subsequent development of front-end systems.) Information sharing and manipulation projects (IT-systems introduced to offer better information sharing and information manipulation.)	Infrastructure investments (Investments to enable the benefits of other applications to be realized.)	

This approach of classification; to arrange the investments or projects according to what needs they are to satisfy, has been adopted by several researchers such as Hochstrasser (1990), who identifies eight different types of projects presented in the second column in table 3. He suggests that individual IT-initiatives can be classified into larger project groups that share similar business objectives. Willcock and Lester (1996) have performed another classification of IT/IS investment which matches business objectives with types of IS/IT-projects presented in the third column in table 3. The IT/IS investments are categorized into the five different types. Peffer and Saarinen (2002) have adopted another view when they categorize IT/IS investments. They have studied which view managers have on the role of IT/IS investments and found four views of the role; routine cost saving, strategic necessity, strategic IT and strategic product value-related IT presented in the fourth column in table 3. Peffer and Saarinens (2002) categorization of the investment are further presented below;

When the IT-investment is seen as a **routine cost saver**, the role is focused on automation of operational tasks to produce cost savings. The main use of IT-investments is to keep costs in line with industry norms.

When IT-investments are seen as a **strategic necessity**, the role of IT/IS investments

is to meet strategic needs. When an innovative competitor makes an IT/IS investment and either poses a market share threat from product value advantages or confers cost advantages, new technology becomes essential and these investments are inevitable.

When the IT-investment is seen as **strategic** the role of IT is intentionally and generally strategic and investments will be made to pursue a technologically assertive strategy.

When the IT-investment is seen as **strategic product value-related**, investment focus of IT is on the development of new products. The investors believe that they can make IT-investments to improve product value through information or convenience improvement within their niches.

Willcock and Lester (1996) and Hochstrasser (1990) build their classifications on a correlation between investment value and the organization's business objectives. Peffer and Saarinen (2002) build their classification on a correlation of the investment value and the role of IT/IS investments in the organizations.

To assess the value of different needs, different evaluation criteria and measurements can be used. A review of the IT/IS investment evaluation and different criteria used to evaluate these investments are presented in the next section.

2.4 Creating basic data for the IT/IS investment decision

Basic data for the investment decision should present the value and benefits of the investment. To be able to produce such data, one must have access to accurate and well-founded evaluations of the investment proposals. However, IT/IS investment evaluation is a complex task filled with obstacles and uncertainties. In this section, we will present the objectives and realization of IT/IS investment evaluation.

2.4.1 Evaluation Process

Before making an investment, decision-makers evaluate the alternatives to find the most attractive one. They assess the basic data which contains measures such as benefits, future cash flows of the investment and costs related to the investment. A study by Sheppard (1990) showed that managers find it important to distinguish between the investments that maintain company status quo and investments that potentially contribute to competitive advantage. Farbey et al (1992) consider the reason to why a company appraises IT/IS investments. They suggest that the objectives are;

- To justify investments.
- To enable organizations to decide between competing projects, especially if capital rationing is an issue.
- To act as a control mechanism over expenditure, benefits and the development and implementation of the projects.
- To act as a learning device enabling improved appraisal and systems development to take place in the future.

Other reasons that have been found as objectives to the appraisal of IT/IS

investments are (Ballantine and Stray, 1998);

- To gain information for project planning.
- To ensure that systems continue to perform well.
- To enable decisions concerning expansion, improvement or the postponement of projects to be taken.

From the reasons to evaluate, we move on to how an evaluation is conducted. Willcocks and Graeser (2001) have put together the IT evaluation and management cycle model shown in figure 3 which brings together a large amount of ideas, methods and practices that are to be found in the evaluation literature today. The model illustrates the need to carry out an evaluation through the entire process from identifying benefits with the investment to system development. In order to make this work, there is a need for motivated, salient stakeholders who use the evaluation criteria, techniques and take part in several different interrelated activities:

1. Identifying net benefits through strategic alignment and prioritizing.
2. Identifying types of generic benefit, and matching these to assessment techniques.
3. Developing a family of measures based on financial service, delivery, learning and technical criteria.
4. Linking these measures to particular measures needed for development, implementation and post-implementation phases.
5. Ensuring each set of measures run from the strategic to the operational level.
6. Establishing responsibility for tracking these measures, and regularly reviewing results.
7. Regularly reviewing the existing portfolio, and relating this to business direction and performance objectives.

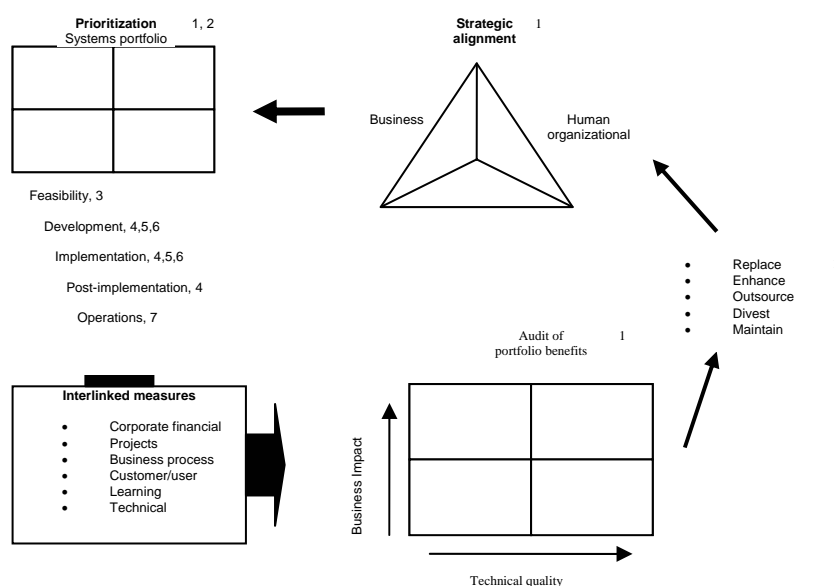


Figure 3 IT/IS Evaluation and management Cycle, Willcocks and Greaser (2001)

Each number in the IT/IS evaluation and management cycle (figure 3.) is connected to the activities above. This first activity is divided into several steps in the figure and therefore, number one is reoccurring in the figure.

Each phase is described more in detail below.

Strategic alignment – Alignment between business, information systems and human resource/organizational strategies affects the value of the evaluation effort. If there is no support for the evaluation in the organization, the result may even be counter-productive.

Prioritizing – The prioritizing of resources between projects is a problem. Several classificatory schemes do exist in the literature. However, Willcocks and Graeser choose to present a schema of how projects could be divided into several categories.

1. Efficiency;
2. Effectiveness;
3. Must-do;
4. Infrastructure;
5. Competitive edge;
6. Research and development

Each type of project could then be matched to an appropriate evaluation method.

Feasibility – Every IT/IS investment in the portfolio needs to be examined regarding the feasibility. During this phase, a set of anchor measures is established that is used in development, implementation and operational phases.

Development and implementation – The development phase includes the development of performance measures (criteria) which are applied across a system's lifetime. These measurements are tied to processes and people responsible for monitoring performance, improving the evaluation system and also helping to “flush out” and manage the benefits from the investment. Tracking these measurements along with the alignment to business performance is important to be able to deliver benefits from the investment.

Post-implementation – This phase is too often neglected despite the fact that it is one of the most important areas as far as IT evaluation is concerned.

On-going operations – Here, companies are a target for criticism since they are not good at dropping decisions. It is a necessity to regularly assess the on-going systems portfolio to avoid spending valuable resources on investments which will not deliver what it supposed to do. Decisions regarding systems, service divestment, outsourcing, replacement, enhancement and/or maintenance are necessary to do continually.

The evaluation of an IT/IS investment is necessary to ascertain what the investment will provide along with administrative purposes such as project planning and justification. The next section will present different approaches one can have on IT/IS investment evaluation.

2.4.2 Evaluation methods

There are, as mentioned above, a plethora of different evaluation methods. In this thesis, we use the most common classification of evaluation models; economic, strategic and mixed models.

Methods with a **financial approach** to investments only consider impacts that can be translated into monetary terms (Berghout and Renkema, 2001). Traditionally, they are prescribed for the justification and selection for all corporate investment proposals, and focus on the incoming and outgoing cash flows as a result of the investment. When appraising a project in financial terms, the purpose is to evaluate the financial return ex-ante (i.e. before the investment is actually implemented), as well as the consequences from the earnings and expenditures which result from the investment.

Some authors suggest that managers look beyond the traditional financial indicators and measures what management thinks is important, i.e. a **strategic approach** (Simmons, 1998). These factors could for example be strategic match, competitive advantage, management information, competitive response and strategic IT infrastructure. These dimensions of value could, as in the method of Information Economics be aggregated using a process of scoring and weighting that allows competing projects to be compared (Simmons, 1998).

If one considers disadvantages and advantages with strategic models and financial models, one will find that the major advantages with financial models are that they are easy to use and clearly define values in monetary terms. The major disadvantages are the lack of consideration of intangible effects and that it is difficult to estimate accurate cash flows. It is the other way around with strategic models. These models lack financial measurements and are extensive in nature. However, the purpose with strategic models is to be able to adopt an extensive view of activities within the company and to see how an investment affects the entire organization, not to put figures on intangible values (Milis and Mercken, 2003). The **mixed models** consider both aspects and combines both strategic and financial concepts. Examples of models are further described in Appendix A.

2.4.3 Criteria used to measure the value of IT/IS investments

Criteria are according to Bacon (1992) concerned with the financial and non-financial justification used in the proposing, evaluating and deciding upon a project or investment. Criteria answer the question: Why was the investment decision made?

Existing methods for justifying the investment in IT projects are usually based on financial criteria which are considered inadequate because of lack of strategic integration and ignorance of the intangibles and non-financial performance measures (Gunasekaran et al, 2001). Bacon (1992) means that in the effort to measure value, especially when it comes to investments in IT/IS, the financial measurements are not enough;

“While it might be said that every business decision eventually comes down to financial criteria, there are other criteria that should be, and in practice are, considered by the managerial decision maker.”

Bacon, 1992

The criteria used to evaluate IT-investments can be divided into tangible and intangible criteria;

- Tangible – The tangible benefits address the part of the investment that management can easily identify and attach a quantifiable value to (Milis and Mercker, 2003). These criteria used to assess these benefits are referred to as measurable and often financial.
- Intangible – The intangible benefits are known to the management but are difficult to measure or quantify (Milis and Mercker, 2003). These benefits are often about user behavioral and psychological constructs, like participation and attitudes (Shao and Lin, 2001). Farbey et al (1999) means that these benefits are more difficult to assess and evaluate and instead of measures, judgment has to be used to ascribe a value to the consequence of change.

According to Seddon et al (2002) hundreds of different measures have been developed and used for assessing the benefits of IT.

Research has been performed with the aim to find out what criteria are used by organizations today when evaluating investments in IT/IS. In order to give an understanding of what kind of criteria exist and are used in the business world, a review of some of these studies is presented below.

Bacon (1992) performed a research on 20 CIOs to identify criteria that are used in the selection of IT project. These criteria have been grouped into three groups; **financial criteria**, **management criteria** and **development criteria**. The financial criteria's purpose is to show the return of the project in cold hard cash or the time it takes to recover the project costs. Typical financial criteria are Return On Investment (ROI) and Payback Period. The purpose of using management criteria is to see how well the project supports the strategic and managerial needs. Managerial criteria could include support of business objectives and Legal/Government requirements. Development criteria are connected to the actual project process, i.e. specifications and requirements.

Bacon (1992) has also performed study on 80 companies, which made significant investments in IT/IS, to find out the usage of the criterion found in the earlier research. Further, Bacon (1992) determines the average ranking of each criterion based on the total value of projects to which the criterion is applied. The majority of the respondents consisted of chief information officers (CIOs), chief financial officers (CFOs) and chief executive officers (CEOs) but also other managers that were considered appropriate. The result shows, for example, that the companies using Net Present Value (NPV) as a criterion ranked it as number four regarding importance in terms of the total value of projects to which it is applied.

Column three in table 4 shows the percentage of companies that use a given IT/IS project selection (investment) criterion, and column four shows the average percent of projects to which a given criterion is applied for those companies using the criterion. Column five shows the average of the respondents ranking of each criterion based on the total value of projects to which the criterion is applied. Further description of the criteria exists in appendix B.

Table 4. Criteria used in the selection of IT projects (Bacon, 1992)

Evaluation categories	Criteria	% of companies using the criterion	% of projects to which applied by companies using	Ranking
Financial Criteria (discount cash flow)	Net present value	49	58	4
	Internal rate of return	54	54	2
	Profitability Index Method	8	47	14
Financial Criteria (other financial)	Average/Accounting Rate of return	16	47	10
	Payback method	61	51	5
	Budgetary Constraint	68	64	8
Management Criteria	Support Explicit Business Objectives	88	57	1
	Support Implicit Business Objectives	69	44	3
	Response to Competitive Systems	61	28	6
	Support Management Decision Making	88	29	7
	Probability of Achieving Benefits	46	63	9
	Legal/Government Requirements	71	13	13
Development Criteria	Technical/System Requirements	79	25	12
	Introduce/Learn New Technology	60	13	15
	Probability of Project Completion	31	62	11

Peffer and Saarinnen (2002) performed a study and developed a set of IT/IS investment evaluation concepts after scanning banking industry journals and discussions with four bank executives. The concepts were divided into five categories according to whether the evaluation objectives involved; profitability, use/operations, strategic value, development/procurement and risk.

A survey on 105 CIOs and other senior bank executives, where they were asked to rate the importance of each of the categories of evaluation concepts, were performed. The focus of the study was the evaluation at the CEO level. As a result, all five evaluation categories were rated as important and table 5 shows the evaluation categories in the order of importance for ex ante evaluation. The evaluation methods for each evaluation category is shown in column two, table 5. The proportion of bank executives who stated that they used each evaluation concept to justify proposed systems and are shown in column three, table 5.

Table 5 Evaluation categories and the most used methods to evaluate each category

Evaluation categories	Methods	Usage in Ex ante evaluation
Profitability (cost and benefit)	Cost/Benefit Analysis	0.85
	Payback period	0.73
	Return on investment	0.58
	Discounted cash flow	0.38
	Model of the banks operations	0.16
Use/operations (effective, reliable, and flexible use of system)	User satisfaction	-
	Maintenance feasibility	0.7
	Reliability testing	0.68
	Level of system use	-
Strategic value (importance for the success of the bank)	Analysis of customer needs	0.79
	Analysis of user requirements	0.79
	Analysis of competitive threats/opportunities	0.63
	Analysis of industry structure and competition	0.62
	Critical success factors	0.15
	Value chain	0.06
Development/procurement (control of implementation of the system)	Project schedules	0.83
	Project budgets	0.82
	References from other bankers	0.72
	Post implementation audit	-
	Programming productivity	-
Risk (effects on technical, economic, implementation, operational and financial assumptions)	Financial feasibility	0.86
	Economic feasibility	0.86
	Technical feasibility	0.81
	Operation feasibility	0.77
	Implementation feasibility	0.68

According to a study performed by Seddon et al (2002) on 80 European IS/IT managers the six most important criteria used in the feasibility studies of an IT-investment ranked from most to least important are;

1. Strategic match with the business
2. Satisfaction of customer needs
3. Productivity improvements
4. Traditional cost benefit
5. Return on investment
6. Strategic IS architecture

Section 2.5, “Choice of criteria depending on needs”, will further discuss how different criteria can be used to evaluate different IT-investments.

2.5 Choice of criteria depending on needs

Farbey et al (1992) means that the apparent success of ROI for non-IT projects has led organizations to search for some other single technique which can deal with all IT projects during all circumstances. This quest for the “ultimate method” is proving fruitless because the range of circumstances to which those techniques would have to be applied is so wide that no single technique can cope, even though some authors have claimed that the method they espouse provides the answer for all situations (Farbey et al., 1992).

Many researchers argue that different IT/IS-investments can make different types of

contribution to an organization and therefore evaluations should be based on different criteria (Seddin et al., 2002, Venkantrama, 1997, Farbey et al, 1992, 1994, 2001). Various contextual frameworks for selecting evaluation methods for specific IT/IS investments have been presented in the literature (Hallikainen, 2003).

This section will present a number of theoretical frameworks developed by a variety of researchers on how to choose criteria/evaluation methods for evaluating IT/IS investments. The frameworks presented in this section are in short presented in Table 6 below.

Table 6. Summary of different perspectives on how to choose evaluation criteria presented in this section.

Areas of classification	Description
Type of project (Hochstrasser, 1990)	Evaluation criteria are selected depending on the projects effect on business functions.
Investment type (Willcock and Lester, 1996)	Evaluation criteria are selected depending on how the project matches business objectives.
Role of IT-investments (Peffer and Saarinen, 2002)	Evaluation criteria are selected depending on the view of the role of IT/IS investments.
Role of IT and Evaluation constrains (Farbey et al, 1994)	Evaluation criteria are selected depending on a mix of different factors to define the role of IT and the evaluation constrains.
Organizational level (Gunasekaran et al, 2001)	Evaluation criteria are selected depending on the organizational level and the benefits and cost addressed at each level.

In section 2.3, we described different needs for IT/IS investments. Below we will describe different perspectives on which criteria to use depending on which type of investment is to be performed. Table 7 shows an overview of Hochstrassers (1990), Willcock and Lesters (1996) and Peffer and Saarinen's (2002) classifications of IT/IS investments and how criteria are matched to the different types of investments.

Table 7 Perspectives on which criteria to choose depending on type of investment

Classification	Description	Investment type	Typical criteria	Evaluation method focus/factors
Type of project (Hochstrasser, 1990)	Evaluation criteria are selected depending on the projects effect on business functions.	Infrastructure projects	3-5 years business scenario for analyzing the necessary IT infrastructure to support the aims of scenarios.	
		Cost replacement projects	Simple or extended cost benefits analysis, including also indirect cost savings.	
		Economy of scale projects	Analyzing the increased ability for capacity handling with the same level of resources or increased ability to speed up the business cycle.	
		Economy of scope projects	Analyzing the increased ability to expand the scope of business with the same level of resources and the increased flexibility to change rapidly products and services according to specific market needs.	
		Customer support projects	Methods based on the Customer Resource Life Cycle, analyzing how well the system will fulfill critical needs of costumers through the stages of the lifecycle.	
		Quality support projects	Porter's value chain analysis, value linking and value acceleration.	
		Information sharing and manipulation projects	Information flow analysis of key business goals.	
		New technology projects	Risk evaluation techniques.	
Investment type (Willcock and Lester, 1996)	Evaluation criteria are selected depending on how the project matches business objectives.	Mandatory investments	Analysis of cost	
		Investments to improve performance	Cost/benefit analysis, assessment of hard to quantify benefits, pilots for high risk investments.	
		Investments to achieve competitive advantage	Analysis of cost and risk.	
		Infrastructure investments	Setting of performance standards, analysis of costs.	
		Investment in research	Setting objectives within cost limits.	
Role of IT-investments (Peffer and Saarinen, 2002)	Evaluation criteria are selected depending on the view of the role of IT/IS investments.	Routine cost saving IT	Cost and benefit; cost-benefit analysis, Payback period analysis, Return on investment, project schedules, project budgets, (reference from other bankers)	Accounting/development control
		Strategic Necessities	Project feasibility and operations concepts; reliability testing, industry structure and competition, competitive threats/opportunities technical feasibility, economic feasibility, implementation feasibility, operational feasibility, financial feasibility	Risk/reliability
		Strategic IT	Organizational objectives; (model of bank operations), maintenance feasibility, critical success factor, value chain analysis	Strategic IT/operation success
		Strategic product value-related IT	Customer needs and competitor analysis; discounted cash flow, critical success factors, customer needs, analysis of user requirement	Strategic value

One perspective on which criteria to use when evaluating IT/IS investments are developed by Hochstrasser (1990) and found in the first section of table 7 which use different criteria according to a projects effect on business functions. He means that to facilitate the generation of evaluation criteria and to standardize evaluation processes across the whole organization, examples of good practice suggest that individual IT-initiatives can be classified into larger project groups that share similar business objectives. A set of evaluation criteria can be developed for each class of business objective supported by a particular IT system.

Willcock and Lester (1996) suggest a similar classification scheme that matches projects with business objectives shown in the second section in table 7. According to the different investment types a set of suitable measures has been developed.

Peffer and Saarinen (2002) used the evaluation methods they found as the most used in the *ex ante* evaluation in the bank business (presented in the section above) and classified them according to the role of the IT/IS investment (presented in section 2.4). The third section in table 7 shows this classification where the roles of IT/IS-investments that are to be evaluated are matched with a focus of evaluation and evaluation methods in order to give the right information to the decision maker. The four discovered roles of IT/IS investments; routine cost savings IT, strategy necessity, strategic IT and strategic product value-related IT, all have different focus of evaluation and different used evaluation methods which are presented below;

Routine cost savings IT

The IT/IS investments found in this role of IT are IT-based products and process innovations that others can very quickly imitate. The main use of IT-investments is to keep costs in line with industry norms. The evaluation focus is on accounting cost and benefit measures to improve operating income.

The *accounting/development* control factor would provide methods that are closely linked with financial accounting measures together with information from other bankers. This set of evaluation concepts might be used in addition to evaluate routine cost savings.

Strategic necessity

The main focus on the evaluation will be on project feasibility and operation concepts.

The *risk/reliability* control factor will provide information about development success, but little information about benefits or the impact of the project on firm success.

Strategic IT

The focus of evaluation for this view is on organizational objectives. Because of the difficulties linking the system purpose to the organizational objectives the executives may be unsatisfied with the evaluation process.

The *strategic IT/operation success* factor includes strategy methods from such as critical success factors and the value chain which is consistence with the strategic IT perspective.

Strategic product value-related IT

Executives with this perspective are keen to observe what their customers want and what their competitors may be doing and they expect IT/IS investments to pay off in terms of market share and revenue.

The *strategic value* factor suggests that the IT-investment should be viewed in terms of its impact on the organization. The use of customer needs and strategic management concepts indicates expectations that the investment will generate returns by increasing revenue.

Another perspective is given in Gunasekarans et al. (2001) model over the different considerations on each of the strategic, tactical and operational levels when justifying

IT/IS investments illustrated in table 8. They have considered the benefits and costs at all levels including various decision making at different levels together with appropriate performance measurements.

Table 8. Considerations and typical measures for IT/IS investments at different organizational levels (Gunsekarans et al., 2001)

Organizational level	Considerations	Typical measures
Strategic	Strategic Objectives of investment in IT Support for Corporate Strategy Top Management Support Competitive Performance Objectives Long-term Cost and Benefits	Typically measures concern profit in relation to sales and investment, together with targets for growth in absolute terms or with regard to market share. Business may also wish to include employee polices and environmental issues as part of their overall objectives.
Tactical	Performance Indicators Generating Data Evaluation Methods Security Involvement of Senior Management	It is essential when the tactical Critical Success Factors are identified that appropriate “hybrid” performance measures are identified and described. Such measures might include the impact the project has on turnover, manufacturing lead times, new product development, and so on.
Operational	Existing IT System Data Migration Software User Perception Servers System Integration Existing Operating Systems	<i>None described</i>

The considerations and suitable measures for each strategic level according to Gunasekaran et al (2001) are further described below;

At the **strategic** level the inputs into corporate strategy need to be linked to the objectives of the business. First, it provides the basis for establishing a clear direction for the business, and demonstrates both the strategic awareness and strategic willingness, which are essential to corporate success. Second, it will define the boundaries and mark the parameters against which the various inputs can be measured and consistency established, thus providing the hallmark of a coherent corporate plan.

For each company the objectives will be different and will reflect the nature of the economy, markets, opportunity and preferences of these involved. These objectives need to be well thought through, held logically together and should provide the necessary direction for the business.

Typical measures concern profit in relation to sales and investment, together with growth objectives in absolute terms or market share. The business may also want to include employee polices and environmental issues as a part of their overall objectives.

At the **tactical** level, resources are identified and there is a need for establishing

“tactical” critical success factors (CSF). These should be project specific, and are requirements, which must be fulfilled by isolating detailed tasks, processes and resources, to ensure medium/short-term tactical success. If these CSF are not achieved, they will become an obstacle to corporate progress, and may ultimately result in a loss of business, and failure in the achievement of project deliverables (Gunasekaran et al, 2001).

It is essential when the tactical CSF are identified that appropriate “hybrid” performance measures are identified and described. Such measures might include the impact the project has on turnover, manufacturing lead times, new product development, and so on.

Although the strategic perspective may not have non-financial indicators, the tactical dimension will have a combination of both tangible and intangible measures. Furthermore, it is essential to develop appropriate mechanisms for the quantification of the tangible measures.

At the **operational** level the identification of operational CSF is performed. These are requirements, which must be achieved at an operational day-to-day level, to ensure project success. When the operational CSFs are identified micro performance measures must be detailed. These considerations could be classified as follows; IT and IS are being developed with the IT or IS department working closely with the business functions, the company emphasizing on the importance of the balance between involvement of the user departments and the IT or IS functions considered to resolve the problems (Gunasekarans et al, 2001).

Farbey et al (1994) have developed a framework shown in figure 4 with the purpose to decide which methods to use when evaluating IT/IS investments. Farbey et al (1994) asked themselves what people need to know or take into account if they are to apply more appropriate evaluation methods. They identified five factors that influences the way the investment decision is handled; the role of evaluation, the decision environment, the system, the organization, and the cause and effect relationship.

Role of evaluation – The role of evaluation is linked with the time and the level of the task. In the early stages the main issues are broad-brush and involve general requirements; at later stages the concerns are more detailed and involving exact specifications of what the project is intended to do.

Decision environment – IT decisions do not occur in a vacuum and the choice of evaluation method should match the culture of the organization. The evaluation may have to confirm an existing corporate procedure, or there may be no established practice. The decision-makers expect only hard quantified benefits or they may be happy to deal with soft qualitative benefits.

The system – The criteria by which a system should be judged must reflect the nature and purpose of that system.

The organization – The competitive position of the organization may also affect the evaluation. Factors such as the industry situation; whether it is stable or consists of a lot of re-structuring, turbulence and high levels of IT-development the leadership role of the organization; whether it aims to pioneer or follow.

Cause and effect relationship – The degree to which it is possible to predict the

impact of the new system is an important factor in determining how to perform an evaluation. The impact of the new system may be direct or indirect; it could directly show result e.g. a pay role system will directly reduce costs (direct), or it may depend on something or someone else e.g. the capability of the manager to use information to perform better decision-making in order to deliver the expected benefit (indirect).

These factors are the foundation of the framework supported by a matrix and a three step process to perform the matching.

The process consists of the three stages;

1. Represent the circumstances of the project which is to be evaluated as points on a series of two times two matrixes.
2. Use the information about evaluation techniques to locate each technique at some point on a two times two matrix.
3. Overlay the matrixes to match project with technique.

		Role of IT			
		Conservative	Radical		
		Tactical Quantifiable Simple Support System Follower Certain Impact	Strategic Qualitative Sophisticated Core System Leader Uncertain		
Evaluation Constrains	Well defined	Specification Stage Standard Decision procedure Numbers important Specific Application Stable Environment Direct Impact	<table border="1" style="width: 100%;"> <tr> <td>Return on Investment Payback Cost/Revenue</td> <td>Cost Benefit Analysis</td> </tr> </table>	Return on Investment Payback Cost/Revenue	Cost Benefit Analysis
	Return on Investment Payback Cost/Revenue	Cost Benefit Analysis			
Fuzzy	Requirement Stage Ad Hoc Procedure Numbers not important Infrastructure Turbulent environment Indirect Impact	<table border="1" style="width: 100%;"> <tr> <td>Experimental methods Multi-objective Multi-criteria</td> <td>Boundary Values Critical Success Factors Information Economics Return on Management Value Analysis</td> </tr> </table>	Experimental methods Multi-objective Multi-criteria	Boundary Values Critical Success Factors Information Economics Return on Management Value Analysis	
Experimental methods Multi-objective Multi-criteria	Boundary Values Critical Success Factors Information Economics Return on Management Value Analysis				

Figure 4 Summary matrix over the project characteristics and evaluation methods, Farbey et al, 1992, 1994

2.6 Summary

The literature shows that depending on what purpose corporations have with IT, one faces different challenges when IT/IS investments should be made. One has to deal with, except the purpose, obstacles with IT/IS investments and how to create the basic data that is the foundation of the decision. However, the literature shows that the basic data is not the only thing that managers base their decision on. Managers are affected by their own perception of value and earlier experiences and the literature refer the more irrational behavior as “gut feeling” or “act on instinct”.

The needs for IT/IS investments varies within the organization. From the need, basic data is created based on the underlying need. The evaluation of IT/IS investments are problematic since there are large amount of uncertainty of what benefits are obtained.

Researchers claim that this is due to deficiencies of the evaluation methods and incongruence among the measurements. The financial evaluations methods are criticized because they do not reflect the true value of an investment. Intangible values are often neglected and put aside. Strategic and mixed-models do not solve the complexity but creates some sort of understanding for other values than the monetary ones. Furthermore, when making investment decisions, there are criteria that need to be fulfilled before the decision become a reality. The literature categorizes criteria into financial, development, operational, strategic and risk criteria. Different criteria are important to different people. This section was concluded with how to the literature has combined different criterion with different needs, i.e. what criteria should be used when evaluating a particular investment.

3 Method

This thesis is performed through a literature study and an empirical study.

The purpose of the literature study is to present characteristics, process and difficulties regarding IT/IS investments. The focus lies on the needs with IT/IS investments, the decision process and the criteria and methods used when evaluating IT-investments.

The purpose of the empirical study is to find out what criteria are found important depending on the underlying need in the ex ante stage by respondents with knowledge of the decision making process in Sweden.

3.1 Choice of method

All scientific work takes place within the field of some existing rules. However, it is far from obvious which these rules are or should be. The choice of theory of science possesses a high impact on which the rules are and why they should be used (Lundahl and Skärvad, 1999).

Theory of science is the knowledge of what science is, how it evolves and how it interplays with praxis and the evolution of the society generally (Andersen, 1998). Two scientific main directions exist, the positivistic and the hermeneutic theories. Positivism is the scientific basis for the natural science point of view and is the ground for the quantitative method while hermeneutic is an alternative research ideal with its roots in the humanistic tradition of science that is the foundation of the qualitative method (Lundahl and Skärvad, 1999).

Thurén (1996) means that with a hermeneutic point of view, research involves investigating people's experiences and perceptions. This research is performed with a hermeneutic point of view by looking at our respondents experience and understanding of the need and criteria to consider when assessing the value of IT/IS investment.

When carrying out a study, one is confronted with the question whether to make a qualitative or quantitative investigation. According to Trost (1997) and Patel (1987) the choice between the qualitative or quantitative method depends on the purpose of the project. In a simplified way Patel (1987) mean that a researcher that chooses the quantitative method is searching for knowledge that is to be measured, described and explained in our reality. With focus on the qualitative method, one can through different types of data collection, create a deeper understanding of the problem's complexity that is studied. It is also important to understand the problem's complexity in relation to the comprehensive picture. This method gives little room for statistic, mathematic and arithmetic formulas; data is not of the sort that makes this possible. The knowledge purpose is primary "understanding" and not "explanation". The primary knowledge purpose of the qualitative method is to explain causes to the phenomena that are objects for the research (Andersen, 1998).

In our study we have used the qualitative method to obtain an understanding of the experienced needs for IT/IS-investments and what criteria are used by our respondents when evaluating IT/IS investments.

We have chosen to use the Delphi method to obtain our result. The Delphi method is

further explained in section 3.2.1 below. This method is chosen because of the following arguments:

- The aim of the Delphi study is to elect and refine group judgment (Dalkey, 1969) which suits well with this study's aim are to show the opinions and experiences of a group.
- The Delphi study is performed in an iterative process (Dalkey, 1969). To form the group judgment in our study there were some concepts that had to be found and classified before the final judgment could be performed. Therefore the iterative process that this method contains of suited this study.
- According to Okoli and Pawlowski (2004) there are two types of situation where the Delphi method is especially useful; forecasting and issue identification/prioritizing and concept/framework development including identification/elaboration of a set of concepts followed by classification/taxonomy development. These usefulness situations suits our studies aim to identify and classify a set of concepts well.

The Delphi study has been performed through questionnaires. Since the method consists of an iteration of the answers in the former step, the answers had to be presented to the respondents. The use of questionnaires gave the possibility to present the iterated data in a structured way which facilitated the overview for the respondents. The expected answers were also short fact answers that did not need any further explanation and therefore did not need any direct following questions. Since the study contained several steps that consumed time from our respondents, the choice of questionnaires gave the respondents more flexibility to answer on their conditions, i.e. when they have the time to do it. Our choice of theory of science and methods are illustrated in figure 5.

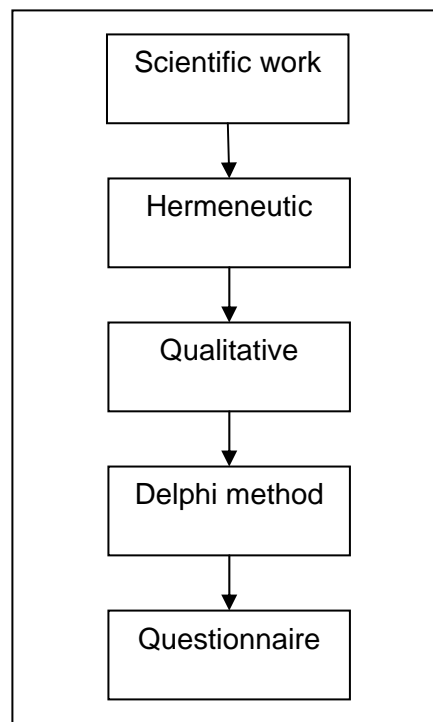


Figure 5 Choice of theory of science and method used in our study

3.2 Research material

This section is divided in two parts; a description of the empirical method used and the respondents of this study.

3.2.1 Delphi method

The research method used for data collection in this thesis is the Delphi method. The Delphi Method was designed at RAND Corporation in a study to find methods to improve decision making. Delphi is a method for eliciting and refining group judgment (Dalkey, 1969) and to obtain the most reliable consensus of a group of experts (Dalkey and Helmer, 1963 in Okoli and Pawlowski, 2004). The rationale for the procedure is primarily the age-old saying “Two heads are better than one” when the issue is one where exact knowledge is not available (Dalkey, 1969). When conducting a Delphi study, one typically uses a series of questionnaires interspersed with controlled opinion feedback (Rowe et al., 1991 in Okoli and Pawlowski, 2004).

“Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem” (Linstone and Turoff in Okoli and Pawlowski, 2004, pp. 16).

The procedures have according to Dalkey (1969) three features:

- **Anonymous response** – opinion of members of the group are obtained by formal questionnaires.
- **Iteration and controlled feedback** - interaction is effected by a systematic exercise conducted in several iterations, with carefully controlled feedback between rounds.
- **Statistical group response** – the group opinion is defined as an appropriate aggregate of individual opinions on the final round.

These features are designed to minimize the biasing effects of dominant respondents, of irrelevant communications and of group pressure toward conformity (Dalkey, 1969).

Okoli and Pawlowski (2004) recommend that the respondents in a Delphi study should be limited to 10 to 18 persons. They mean that the Delphi group size does not depend on statistical power, but rather on group dynamics for obtaining a consensus among experts. They also mean that the questionnaire of the study should be limited to maximum 30 minutes due to the multiple steps during the entire study. The participants should be able to calculate their time commitment. These recommendations have been adopted by us when designing our study.

3.2.2 Respondents

The respondents of this study were chosen because they are a part of the decision making process of IT/IS investments and possess knowledge in the area of evaluation of investments in IT/IS. The respondents were selected together with the department of Industrial IT at Semcon AB and are all situated at their customers.

At first, fifteen possible respondents were contacted by phone and introduced to the study and asked if they were interested in participating. After some discussion with

possible respondents, twelve persons part of the decision making process, announced their will to participate in the study. During the process of collecting answers of our first step in the Delphi study we lost four persons due to their time constraints and received answers from eight respondents. In the second step of the Delphi study eight respondents replied but in the third step there were only seven respondents that replied.

The respondents are spread over the organizational hierarchy levels where five of our respondents are situated at the operational level, two at the tactical and just one is situated at the strategic level. One of the respondents at the tactical level did not reply our third step in the Delphi study. The companies where the respondents are situated are part off the industrial production branch.

3.3 Process of work

This section describes the procedure of work within this study. It is described more in detail in the subsections; Emergence of our research area, Literature study, Empirical Study and Analysis.

3.3.1 Emergence of our research area

We were introduced to the research area “value of IT” during the course *Business Informatics*. After meeting Mats-Eric Olovsson, manager of the department of Industrial IT at Semcon AB, and discussed our joint interest for the research area, the agreement became to write this thesis with Mats-Eric Olovsson as our supervisor. Semcon needed a way to present and motivate the value of their services. A model for evaluating the value of IT was discussed, where the focus should be the ex ante stadium. This problem was further discussed with our academic supervisors Anna Plantén, Elisabeth Frisk and Urban Nulden in order to find the academic contribution of this study. We were recommended to limit our focus and that became examining which criteria are important to the customers when they consider investments in IT/IS depending on underlying needs.

3.3.2 Literature study

To present an overview of the research area and earlier studies, a literature study was conducted. The purpose of this study was also to enable a comparison of the results in the empirical study with the literature in section five. The literature study was performed through investigating books and articles within the context of IT/IS investment evaluation, decision-making regarding IT/IS investments, benefits with IT/IS investment and, criteria for IT/IS investment. During the entire research, the development of the theoretical framework has been an iterative process and the search for literature has proceeded during the entire study. Most of the references are found at the Economic library, part of the Göteborg University library, and its on-line databases such as Science Direct, Business Source Premier and Emerald.

3.3.3 Empirical study

The first contact with the respondents of the empirical study was by phone and we introduced the study and explained the conditions. Information about the Delphi study

was e-mailed to the respondents that had agreed to participate. The e-mail consisted of the procedure and the expected result explained in detail.

Before the study was started, a time schedule was developed for the Delphi study and a brief plan about what the questionnaires should include and the expected result. We planned for the study to proceed over five weeks. With this in mind we planned for five questionnaires to be performed. This should give the respondents one week to answer each questionnaire. This was also explained to them in the introduction of the study. The study ended up including three questionnaires partly depending on time constraints and difficulties of receiving the answers in time from the respondents.

All of the questionnaires were sent out through e-mail and contained an explanation of the questionnaire. All of the questionnaires were developed to take no more than 15 minutes to answer. The purpose of designing a short questionnaire is to keep the respondents motivated to participate throughout the entire study. A pilot study was performed on each of the questionnaires with focus on functionality and content before sent out. After receiving the answers from each questionnaire the results were compiled and analyzed before developing the next questionnaire.

To obtain the desired result in each questionnaire from the respondents, the survey as a whole was semi-structured with different characteristics for each questionnaire.

The process of the study is described in figure 6.

Phase 1

The purpose of the first phase was to find out what kind of basic data were used by the respondents when evaluating IT/IS investments. A questionnaire was developed and sent out shortly after the first contact with the respondents was established which can be found in appendix D. The question was unstructured as to prevent the respondents to be directed by us and to give them the possibility to answer in their own words which information they needed to make a decision whether to go through with an IT/IS investment or not. The time limit to answer the questionnaire was one week.

When the answers from eight of the respondents finally were collected after two weeks, we had to put a deadline and exclude the ones that did not answer. We started to put the information together and while doing this we found two recurrent concepts; "need in the organization" and "business value". The next questionnaire was based on their experience of the two concepts.

Phase 2

The purpose of the second phase was to find out what our respondents meant with business value and what the underlying needs for investments in IT/IS are. A questionnaire was developed and to find out this information that are to be found in Appendix D. All answers were collected after three weeks.

While putting together the information that was received in the second questionnaire, the design of the third one started. Because of time constraints, we decided that the third questionnaire would be the last one.

Phase 3

The objectives of the third questionnaire (see Appendix D) were to find out what each

respondent found as the underlying needs for IT/IS investments where they were part of the decision making process. A further objective was to examine the correlation between the underlying needs of an IT/IS investment and the criteria interpreted as important to evaluate the investment.

A matrix with the criteria found in the first questionnaire on one axis and the underlying needs on the other axis was developed. This to make our respondents tell us which of the basic data they found important when evaluating possible IT/IS investments depending on what needs they were to fulfill. A scale was developed to find out the importance of the criteria for each need.

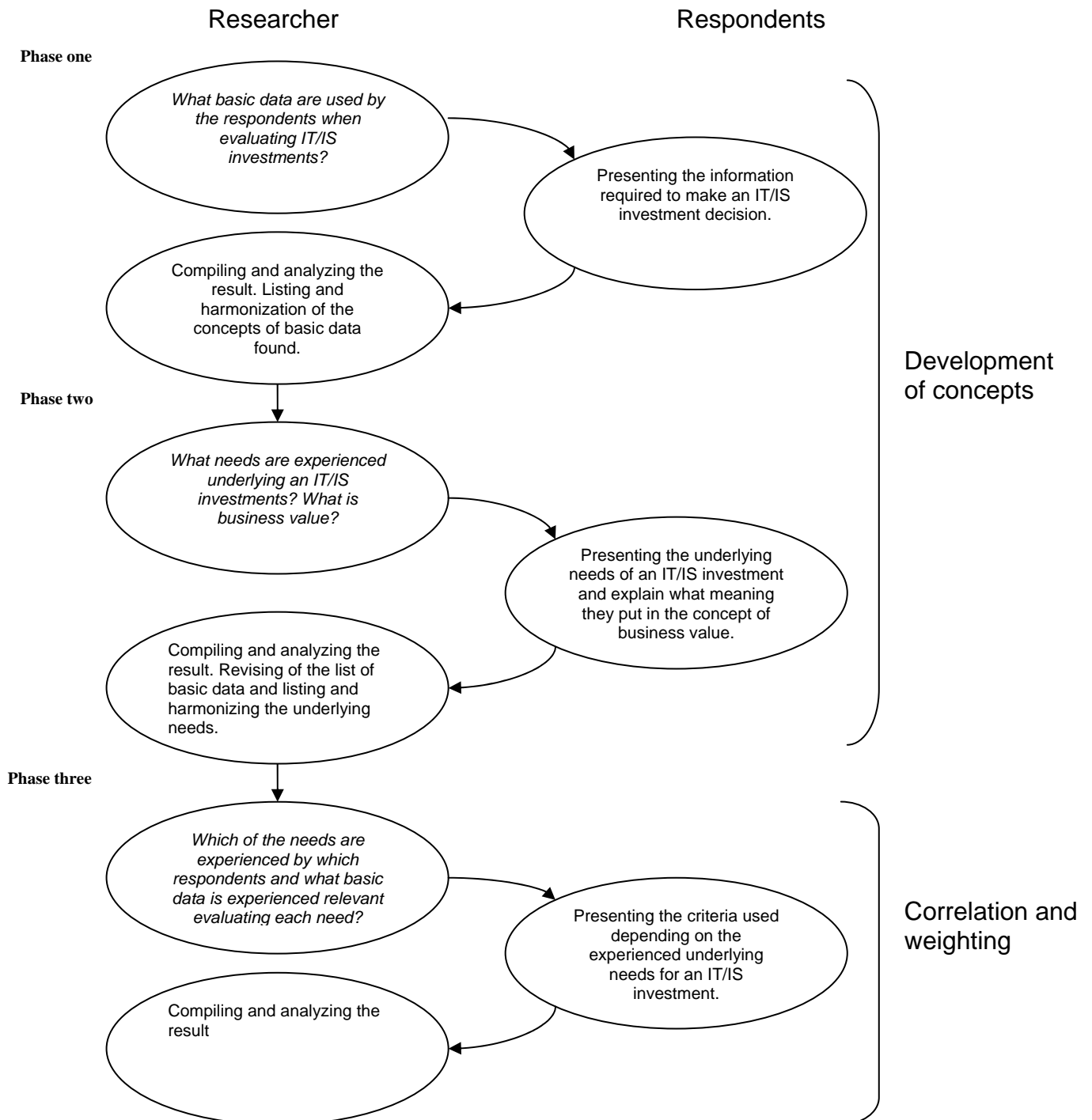


Figure 6 Process of our Delphi study

3.3.4 Analysis

After compiling the result of the empirical and theoretical results, a comparison between the criteria and underlying needs in relation to IT/IS investments found in the literature are compared with the results from the empirical study. The appropriateness of the method used is evaluated in relation to the research question of this study. The credibility of the result of the study is also analyzed. The result of the analysis is presented in the discussion chapter.

4 Results

This section presents the findings from the empirical study. The results are divided into three parts corresponding to the phases of the Delphi study.

Since the method used in this study contains three phases, there is a need for an analysis of the results for each step before moving on to the next. Therefore, the result contains both analysis and method of analysis.

The small group of respondents in the Delphi study has the consequence that the result can not be generalized to all decision making process in Sweden.

4.1 Phase 1 – Examining the criteria used to evaluate IT/IS investments

This phase examined the criteria experienced by our respondents as the information needed when evaluating an IT/IS investment. This was found out through the first Delphi questionnaire found in Appendix D.

The respondents in our study used various criteria when evaluating an IT/IS investment. Examples of different criteria used are shown below:

- One criteria mentioned by many respondents was business value.
- One respondent expressed that the only criteria used when investing in IT/IS is the payoff period. “A usual IT-investment, the only thing to go on is the time period for payoff and it have to be less than one year...”
- Another respondent answered: “We do not normally make any payoff calculations”. Instead the respondent means that from a general point of view “these decisions are made out of a combination of need and feeling”. This could be that equipment is getting old and need a change or that a new need has arisen within the organization. If the investment is found viable, it is realized.
- Many of the respondents expressed a much wider set of criteria used when making a decision about investments. As an example, one of the respondents mentioned needs, possible problems, payback period, possible effect of a rationalization or other advantages, risks and basic data for quotations.

Because of the indistinctness of the concept of business value we decided to interpret the concept further in phase two described in the next subchapter to make it more concrete. Because of this the other criteria found in phase one are also presented in phase two.

4.2 Phase 2- Examining the concept business value and the needs for IT/IS investments experienced.

This phase of the Delphi-study aimed to find out what our respondents experienced as underlying needs of an IT/IS-investment and investigated the meaning of the concept business value. Some analysis was also performed to be able to compile the result.

4.2.1 Business value criteria

The business value of an IT/IS investment was considered when making the investment decision by many of the respondents in the first phase of the study but because of the indistinctness of the concepts, an attempt to concretize was performed in the second phase as a part of the second questionnaire (see appendix D).

The respondents' view of the concept varies and to obtain some sort of concretizing, we have categorized the views into three different views;

- The concept business value was seen as giving **strategic benefits**. The strategic business value is explained as: “development of the business through support from IT which gives competitive advantages or savings”. It could also be “developing IT-systems that tie the customer to the company or deepen the value chain”. In another perspective, business value is seen as “something positive out of the investment” that could be in an overall long term perspective which could mean that it gives negative consequences locally or short term but positive.”
- The concept business value is seen as **business benefits** that answer strategic needs such as “equipment is obtained because that there is need and not just because new things are to be bought”. It is also seen as a tool to improve a product; “To be able to contribute to a product with better quality and lower cost.” The value is also expressed as performing “Savings on personnel” or “effects on processes”.
- The concept business value is interpreted more as **operational benefits**. Business Value is seen as “Reduced time of reparations/debugging”, “Easy to handle” system and “Functioning IT-system”. Another view of Business value at the operational level is; “A mumbo jumbo word in a mumbo jumbo language.”

Because of the varying views of business value it is not seen as a single criterion but the different views have been seen as criteria used when compiling the set of criteria used when evaluating IT/IS-investments.

At first, we categorized the collected answers into groups of criteria and secondly, the concepts that the respondents used to express the needed information have been interpreted and harmonized into a set of criteria.

4.2.2 Categorization of criteria

The criteria found in the first and second step of the Delphi study have been related to as financial, strategic, business or operational factors.

The *financial criteria* assess the financial impact an IT/IS investment would have on the company.

The *strategic criteria* refer to criteria that assess how an investment affects the company from a strategic perspective.

The *business criteria* refer to criteria that assess the direct consequences on the business from an investment.

The *operational criteria* assess the direct influence an investment would have on the

daily work in a technical perspective.

The criterion *feeling* refer to the decision makers instincts and feelings about the IT/IS investment based on earlier experience and personal perceptions.

The criteria categorized into these groups have are presented below and further down summarized after a harmonization of the concepts in table 9.

Financial criteria

The financial criteria are used by many of our respondents and are the most commonly occurred. Cost and profitability calculations seem to be used by most of our respondents.

Cost is one criterion that is considered for the initial investment, the operation and the support and maintenance. The cost exists in form of how many man-hours are needed as well as if the investment leads to increased cost of operations. Possible expected savings are also observed as an effect from rationalizing staff, maintenance and operations. While some respondents mentioned the use of payback period, which considers the time until the investment reach break-even, one respondent marked that they did not use the payback method. If there is any other effect on the resources on the business this is also considered. Profit and savings do seem to have a common view among most of the respondents since they mention profit as savings from staff and maintenance.

Strategic criteria

How well the investment is aligned to the existing strategy is considered when making an investment decision. If the investment is a strategic necessity or just supporting current strategy is also considered. As well as strategic alignment the strategic criteria can also fulfill current needs by improving competitive advantage, tie the customer to the company or deepen the value chain. Most investments have some sort of time perspective and one of our respondents view the long-term perspective as an important criterion.

Operational criteria

An issue considered as a criterion by many of the respondents is how the future support will work. Will there be changes in access and quality of the support and will the support meet our demands? Another criterion considered is the life length of the investment. Furthermore, if there is experienced needs and wants in the organization i.e. from a “system owner” as well as safety aspects are also considered.

Business criteria

Business criteria are considered when the purpose of the investment is to plan, maintain and control the business. Consequences of a decision not to carry out the investment are important to one of our respondents as well as if there are any man-hours occupied by other projects. A further business criterion is how the investment would affect the quality of the final product. Risk assessment with IT/IS investments are performed by two respondents. One of the respondents assess risk on a scale from 1-10 with level of frequency and seriousness. The time plan is also considered when making the decision whether to go trough or not with the investment. Finally, needs and wants in the organization e.g. from a “system owner” is also mentioned.

Feeling

One criterion expressed that did not fit in any of the other categorized groups was feeling. This refers to a positive or negative “gut feeling” of the IT/IS investment.

4.2.3 Harmonization of criteria

The information experienced to be needed when making IT/IS investments have been collected and categorized and a harmonization of the information into criteria has been carried through. These criteria are presented in table 9. The different categories that the criteria are divided into are found in column one. The criteria are presented in column two and categorized according to the criteria categories in column one. Every criterion is described in column three.

Table 9 Criteria used when evaluating IT/IS investments by our respondents

categories	criteria	Description
Financial criteria	Initial cost of investment	Cost before the implementation of the investment (hardware, software, man hours)
	Operational costs	Costs for e.g. Support and maintenance
	Revenue	Financial revenue from the investment.
	Payback period	The period of time before the investment reach break-even.
	Time	Hours required for the investment.
	Savings	The financial savings from the investment.
Strategic criteria	Strategic alignment	How well the investment will fit company strategy.
	Competitive advantage	Effect on competitive advantage of the company.
	Customer attachment	Attachment of new and existing customers to the company and thereby result in an increased “power of negotiation”.
	Deepen the value chain	Improvement of the internal process and improved relations to buyers and suppliers.
	Long term perspective	Advantages/savings obtained in a long time perspective. Life-length of the investment.
Business criteria	Time constrains	Time constrains of the investment e.g. time occupied by another projects.
	Product quality	Changes in quality of the end-product manufactured by the company.
	Needs and wants from the organization	Whishes from the organization to carry out a particular investment i.e. from a “system owner” or user.
	Consequences of not investing	Consequences from a decision not to invest. (both financial and non financial)
Operational criteria	Easy to handle system	Easy to handle system when it comes to user-friendliness, possibilities to upgrade and expand, compatibility with other systems etc.
	Security aspects	Security protection against attempts of trespassing, virus, equipment breakdown etc.
	Future support/debugging/repair time	Change in current support/debugging and reparation procedure. Changes in accessibility of the support. Efficient debugging. Easy to repair.
	Feeling	Positive or negative feeling about the investment (so called gut feeling).

4.2.4 Experienced needs of IT/IS investment

This subsection will present and categorize the identified needs that our respondents claim to be underlying IT/IS investments followed by a harmonization of the concepts used to express the needs.

The collection of experienced needs was performed in our second Delphi questionnaire, found in Appendix D. Though a detection of patterns in the needs they were categorized according to similarities into system, business and strategic needs. The system needs consist of system technical needs such as reliable system. The business needs consist of needs to maintain and develop the business. The strategic needs consist of strategic needs such as business development.

4.2.4.1 Categorization of needs

As well as with the criteria, we have first categorized the experienced needs from the respondents. The categorization is presenting empirical data and the concepts of need are not distinguished until a harmonization of the concepts is performed through interpretation and analysis. The purpose of this categorization is to be able to relate with earlier studies and add a further dimension to analysis. The needs are divided into the following categories:

System needs refers to the needs from an operational perspective which purpose are to satisfy the technical requirements of the system.

Business needs refers to the prerequisites to be able to successfully plan, maintain and control the business.

Strategic needs refer to needs, which purpose is to clarify and supporting the company's overall strategy.

System needs

The needs at the system level are many. The most fundamental system need is that the IT-system should work and be reliable. The need could also derive from that the system has served its time or there is a lack of support, service and spare parts. Furthermore, debugging of the system could be difficult and a simpler debugging process is required.

There is a need to have long lived systems because of the short life length of IT/IS in relation to the hardware. But even if the old system is working, a new one might include service and support and a new operating system which justifies an investment. One example mentioned by one of the respondents was that "a server that is three years old and depreciated is replaced with a new one because that the latest version of the operation system is included in the price". When the IT/IS equipment reaches a specific age either the guaranty expires or the price of the service from the supplier rise to a point where there is not longer viable to keep the equipment according to calculations. This creates a need for a new IT/IS investment.

Investments in IT/IS can also be performed because that new system works more efficient. Another reason to invest in IT/IS is that with a change and upgrade of systems equipment higher performance might be needed and an investment is performed.

More equipment can also be required because of an extension with new employees; new production or new functions are to be run on the equipment.

The IT/IS investments can spring from a change of info system including method, operating s system, programming language and database.

These needs expressed by the respondents have been summarized in two needs; reliable system and the need for support/service/equipment which are also presented in table 10.

Business needs

The need for rationalization was expressed by many of the respondents. The rationalization was explained by one of the respondent as successfully lower costs or lead time. Another respondent described rationalization as reducing labor and material need. Further, one other respondent, at the organizational level, described rationalization as cost saving through the exchange of hardware, software, suppliers, support etc. and reducing unnecessary work that is accomplished by the staff. There is also an explicit need to lower costs. This results in changes regarding support, supplier, hardware or software.

Changes of the process of work create a need for equipment that supports the new processes. One respondent says “the equipment is to support the new way of working and not the other way around”. Further needs could also be derived from improvement of product-quality, processes or the environment.

The need for increased production will create a further need for new equipment. New products also create need for new equipment. Visualization of the production process in order to assess performance also creates new needs.

The need could also be derived from a wish to increase the quality on the products, processes or the environment.

External effects are the needs that derive from legal demands, suppliers, products, the environment and technology. These investments are things that in themselves not need changes but where other factors need adaptation. These needs could be external or internal needs or depend on the system itself (i.e. the systems serial number is reaching its end). Another respondent mentions that an investment can be forced e.g. when the support of a system is canceled.

Another respondent mentions that an investment can be forced e.g. when the support of a system is canceled.

Strategic needs

Two underlying needs that can lead to IT/IS investments, according to our respondents, are the request for business development and business support. This could be different types of functionality that creates new businesses e.g. e-commerce. Existing business can also be further developed through support of the business by IT and the result becomes competitive advantages or cost savings. It could also result in the customer becoming tied to the company or a deeper value chain.

4.2.4.2 Harmonization of needs

The needs experienced by the respondents have after the categorization above been harmonized into concepts and are presented in table 10. The first column in table 10 shows the different categories that the needs have been divided into. The second column shows the needs that the respondents’ answers have been harmonized into, which are categorized into the need categories presented in column one. The third column shows a description for each need in column two.

Table 10 Experienced needs for IT/IS investments by our respondents

category	Need	Description
Strategic	Business development	Development of new businesses like business areas, markets, new ways of making business.
	Business support	Support to existing businesses to facilitate and make more effective business process.
	Product development	Need to develop new products or develop existing products further.
Business	Fulfillment of law and environmental needs	Fulfillment of needs of the law to avoid legal proceedings.
	Increased production	Need to increase the production.
	Improved quality	Need to increase the product quality.
	Process development	Need to develop new processes and further develop existing once.
	Project support	Need to support an intern project.
	Rationalization	Savings through increasing the efficiency of personnel and production
System	Reliable system	A system that is stable because of its reliability.
	Support/service/equipment	Need of improving or introduce new support/service/equipment.

4.3 Phase 3 - The relation between the underlying need and criteria used

This chapter aims to show the relation between the experienced underlying need for an IT/IS investment (from questionnaire 2) and the criteria found as important when evaluating the IT/IS investments (from questionnaire 1 and 2). The correlation was examined in the third questionnaire, found in Appendix D, where the earlier captured needs and criteria were used to design a matrix to be filled in by the respondents. The purpose with this design was to obtain which criteria are important to the respondents when they have specific needs. Seven out of the original eight respondents took part in this step of the Delphi study.

The questionnaire was designed to investigate:

- How important did the respondents experience each criterion.
- Which needs were experienced by the respondents.
- Which criteria were found important to use depending on experienced need.
- How important are the criteria found to respective experienced need.
- The needs experienced by four or more of the respondents are further examined together with the most common used criteria when evaluating IT/IS investments to satisfy these needs.

Table 11 below shows how important the respondents experienced the criteria in two ways; by how many respondents experienced the criteria important, and the average experienced importance. The number of respondents that experience the criteria as important are presented in the respondents column. A respondent is included in the sum of respondents if he/she has experienced the criteria as important when

evaluating one or more needs.

The average importance of a criterion is presented in the importance column. These figures are calculated with numbers that corresponds with the experienced importance that have been filled in by the respondents in the third Delphi phase by the respondents. A scale from zero to three was developed where zero is not important and three is very important. For each need that the respondents experienced to be underlying an IT/IS investment they had to mark for every criteria in the criteria column in table 11 its importance on the scale when evaluating the investment. The importance column shows the average experienced importance calculated from the respondents responds in the third Delphi step.

Table 11 Experienced importance of criteria

	criteria	Respondents	Importance
Financial Criteria	Initial cost of investment	7	1,54
	Operational costs	7	2,09
	Revenue	6	2,09
	Payback period	6	2,31
	Time	7	2,16
Strategic Criteria	Savings	7	1,92
	Strategic alignment	6	2,24
	Competitive advantage	6	1,96
	Costumer attachment	5	2,23
	Deepen the value chain	5	2,27
Business Criteria	Long term perspective	6	1,85
	Time constrains	4	1,85
	Product quality	5	2
	Needs and wants from the organization	7	2,56
Operational Criteria	Consequences of not investing	6	2,4
	Easy to handle system	6	2,44
	Security aspects	5	2,38
	Future support/debugging/repair time	7	2,4
	Feeling	4	2,22

Table 12 below presents the criteria that the respondents are finding important for each need that they experience to be underlying IT/IS investments where they are part of the decision making.

The second row in the table shows the different needs developed in the second Delphi phase.

Row number three presents how many of the seven respondents that experienced each of the different needs, listed in row one, to be underlying investments in IT/IS where they are part of the decision making.

The following rows presents how many of the respondents, listed in row number three, experiences the criteria, listed in column one, as important.

For example, the need business development (third column, second row), are experienced by three of the respondents (third column, third row). The following rows in the third column shows how many of these respondents are experiencing each of the criteria in column two as important when evaluating an IT/IS investment to satisfy

the need of business development. For example, the third column, fourth row, shows that two out of three of the respondents experience Initial costs of Investment as an important criterion when evaluating IT/IS investments to satisfy the need of business development. In this way the experienced importance of criteria can found for each need.

Table 12 Relation between experienced needs and used criteria.

		Need											
		Strategic			Business						System		
		Business development	Business Support	Product development	Fulfillment of law and environmental demands	Increased production	Improved quality	Process development	Project support	Rationalization	Reliable system	Support/service/equipment	
Respondents experiencing need		3	3	3	3	4	2	4	2	6	5	5	
Criteria	Financial	Initial cost of investment	2	2	2	2	4	2	3	2	5	4	4
		Operational costs	2	2	2	2	4	2	3	2	6	4	4
		Revenue	2	3	1	1	3	1	3	1	2	3	2
		Payback period	2	2	1	2	4	2	3	2	4	4	3
		Time	2	3	1	2	4	2	3	2	3	5	4
		Savings	2	3	1	2	4	2	3	2	6	4	3
	Strategic	Strategic alignment	3	3	2	2	4	2	3	2	5	4	3
		Competitive advantage	3	3	1	1	3	1	3	1	3	3	2
		Customer attachment	3	3	1	2	4	2	2	2	4	4	3
		Deepen the value chain	3	3	1	2	4	2	2	2	4	4	3
		Long term perspective	2	2	1	2	4	2	3	2	4	4	4
	Business	Time constrains	2	2	1	2	4	2	2	2	3	4	3
		Product quality	2	2	2	2	4	2	3	2	4	4	3
		Needs and wants from the organization	2	3	1	2	4	2	3	2	5	4	4
		Consequences of not investing	2	2	2	2	4	2	2	2	4	4	4
	Operational	Easy to handle system	2	2	2	2	4	2	3	2	4	5	4
Security aspects		2	2	2	2	4	2	2	2	4	4	3	
Future support/debugging/repair time		2	2	2	2	4	2	4	2	5	5	5	
Feeling		2	2	1	2	4	2	2	2	3	4	3	

There were no criteria that were not experienced as important by any respondent in relation to any of the underlying needs.

The underlying needs where the average number of respondents that experienced the importance of the financial criteria exceeded two thirds were product development

and fulfillment of law and environmental demands.

The underlying needs where the average number of respondents that experienced the importance of the strategic criteria exceeded ninety percent of the respondents were business development, business support, increased production and project support.

The underlying needs where the average number of respondents that experienced the importance of the business criteria exceeded ninety percent of the respondents were increased production, improved quality and project support.

The underlying needs where the average numbers of respondents that experienced the importance of the operational criteria exceeded ninety percent of the respondents were rationalization and reliable system.

Out of the needs presented in table 12, the five needs that more than half of the number of respondents (four or more) experienced as underlying IT/IS investments are presented below in table 13. These needs are presented in the first column ranked according to the number of respondents experiencing each need as underlying IT/IS investments. The reason that the other needs have been left out in this compilation is due to the small number of respondents in our study and the difficulty to draw any conclusions from a group with less than half of the respondents. The table also shows the category that the need belongs to (column 2) and the number of respondents that experienced it to be underlying IT/IS investments (column 3). For each need, the criteria experienced as important by at least four respondents, when evaluating an IT/IS investment to satisfy these needs, are presented in column 4. The number of respondents that have marked each need as underlying an IT/IS investment that also experience the criteria as important when evaluating this IT/IS investment are shown in column 5. A weighting of the criteria have been performed to show how important the criteria are experienced. This weighting is based on questionnaire three (see Appendix D) where the respondents were asked how important, in a scale from zero to three, they experienced the criteria when evaluating IT/IS investment in relation to each need. These numbers of importance is calculated for each need by dividing the total sum of the importance for one need and divide it by the number of respondents experiencing that need. The scale stretches from zero to three where zero is not important and three is very important. This figure of importance is presented in column 6. For each criterion the category that it belongs to are shown in column 7.

Table 13 The most common needs and the criteria used in relation to these need.

Need	Category	Respondents	Important criteria	Respondents	Importance	Category
Rationalizing	Business	6	Savings	6	2,5	Financial
			Operational cost		2,17	Financial
			Needs and wants from the organization	5	2,17	Business
			Future support/debugging/repair time		2	Operational
			Initial cost of investment		1,83	Financial
			Strategic alignment		1,67	Strategic
Reliable system	System	5	Future support/debugging/repair time	5	2,4	Operational
			Easy to handle		2,4	Operational
			Time		2	Financial
Support/service/Equipment	System	5	Future support/debugging/repair time	5	2,6	Operational
Process development	Business	4	Future support/debugging/repair time	4	2,5	Operational
Increased production	Business	4	**			

Rationalizing is experienced as an underlying need to perform IT/IS investments by six out of seven of our respondents and thereby the most common need in this case study. The criteria considered important by most respondents performing an IT/IS investment evaluation when rationalization is the underlying need is the financial criteria savings and operational cost. Both of them were considered important by all of the respondents that experienced this need (six out of six respondents). The medium grade of importance for savings were 2,5 Operational costs 2,17. The second group of criteria was marked as important by five out of six respondents and contains of the criteria needs and wants in the organization, future support/debugging/repair time, initial cost of investment and strategic alignment.

Reliable system and *Support/service/equipment* are experienced as a need by five out of seven respondents when investing in IT/IS.

The criteria experienced important by most of the respondents when evaluating IT/IS investments that are to satisfy the need of reliable system are Time, Easy to handle and Future support/debugging/repair time were the criteria which were all marked as important by all of the respondents experiencing the need (five out of five). According to the grade of importance the two criteria future support/debugging/repair time and Easy to handle system were both 2,4 while the importance of time were graded 2.

The *Support/service/equipment* need has one criterion that all of the respondents experiencing this need (five out of five) considered important and that was the *Future support/debugging/repair time*.

Process development and *Increased production* were considered as needs by four out of seven respondents. *Process development* has one criterion that all of the respondents considered as important and that is the *Future support /debugging/repair time*. *Increased production* has no criteria which qualify into the list. The respondents that experienced *Increased production* as an underlying need to perform an IT/IS investment also experienced almost all of the criteria as important.

The experienced needs presented above and experienced by the respondents belong to the categories “system” and “business” i.e. system technical needs and needs to maintain and develop the business. This could be an effect of the fact that most of our respondents are situated at an operational or tactical organizational level and that just one respondent are situated at the strategic level. The strategic needs could have had a higher level of experiencing if the strategic level were represented to a higher grade. The mostly used criteria are operational and financial which also could be explained with the respondents situation at the operational and strategic levels.

The criteria experienced most important when evaluating IT/IS investments to satisfy the strategic needs of business support and business development are the strategic criteria of strategic alignment, competitive advantage, customer attachment and deepen the value chain.

The strategic criteria of product development doesn't at all seem to be evaluated with strategic criteria but more with the operational and business criteria

The criteria experienced most important when evaluating IT/IS investments to satisfy business needs are the financial criteria but all of the other groups of criteria is also considered important by most of the respondents.

The criteria experienced as important by most respondents when evaluating the system needs are the operational criteria. But even in this group of needs even the other criteria are experienced important by many of the respondents.

Future support/debugging/repair time is the most recurrent criteria used and high rated for all the operational and business needs.

Worth notice is that the criterion strategic alignment is the only strategic criteria in the list. Since we only have one person located at the strategic level, the persons located at the lower levels also find this important despite their main responsibility in their organization is not strategic issues.

The criteria that generally are considered important by our respondents are the financial costs, savings and time criteria, the operational criterion future support/debugging/repair time and the business criteria needs and wants from the organization.

5 Discussion and analysis

This chapter starts with an analysis where we compare our empirical study with earlier studies presented in the theoretical framework to explore similarities as well as differences. We compare the needs as well as the criteria. In the discussion section, we reflect upon why the respondents experience certain needs and criteria as important while others have been left unmarked, what the methodological limitations with our study are and how could further research be conducted based on our study.

5.1 Comparison with earlier studies

By comparing the result of the empirical study performed in this thesis with the studies presented in the theoretical framework we can see that the needs underlying an IT-investment by our respondents is much similar to the respondents in the earlier described studies. In table 14 we present a composition of the earlier studies presented in the theoretical framework together with the results from our study to obtain an overview and possibility of comparison of which different needs that could trigger an investment in IT/IS according to the different studies. The needs are divided into different groups of needs which are similar.

Table 14 Needs for IT/IS investments found in the literature and our study

Peffer and Saarinen (2002)	Hochstrasser (1990)	Willcock and Lester (1996)	Our study
<ul style="list-style-type: none"> • Routine cost saving 	<ul style="list-style-type: none"> • Cost replacement projects 	<ul style="list-style-type: none"> • Investments to improve performance 	<ul style="list-style-type: none"> • Rationalization • Process development • Increased production
<ul style="list-style-type: none"> • Strategic necessity 		<ul style="list-style-type: none"> • Mandatory investments 	<ul style="list-style-type: none"> • Law and environmental demands
<ul style="list-style-type: none"> • Strategic IT 	<ul style="list-style-type: none"> • Economy of scale • Economy of scope • Customer support 	<ul style="list-style-type: none"> • Investments to achieve competitive advantage 	<ul style="list-style-type: none"> • Business Development • Business Support
<ul style="list-style-type: none"> • Strategic product value related IT 	<ul style="list-style-type: none"> • Quality support projects • New technology projects 	<ul style="list-style-type: none"> • Investments in research 	<ul style="list-style-type: none"> • Improved Quality • Product development
	<ul style="list-style-type: none"> • Infrastructure projects • Information sharing and manipulation projects 	<ul style="list-style-type: none"> • Infrastructure investments 	<ul style="list-style-type: none"> • Reliable system • Support/service/equipment • Project support

A first look at table 14 indicates that the respondents of our empirical study have need similar to the ones found in earlier research. However, we are restrictive regarding conclusions from the comparison between our study and earlier studies since the interpretation of the different concepts as well as the categorization could differ from earlier surveys. Needs that we interpret as strategic or financial could be interpreted by other researchers in a different way.

The different surveys also differ regarding respondents. The earlier studies have been concentrated to a management view on IT/IS investment evaluation. Though we can see a differences in our study where consideration have been taken to these levels and we have found many more “operational” needs such as reliable system and

support/service/equipment. This result could be affected by the fact that most of the respondents in the study are located at the operational level.

The earlier studies are also performed using other research methods. None of them is carried out through a Delphi study; instead, regular quantitative surveys are used to obtain the results. This could result in that their set of needs is more structured since they are developed by the researchers and not by the respondents as in our case.

Only Peffer and Saarinen (2002) development of criteria are based on an empirical study and none of the earlier researchers have let the respondents themselves relate the use of criteria and needs as in our study but this is performed by the researchers themselves.

Despite different views of IT/IS investment, interpretation issues, different access to resources and the way the different studies were carried out, there are similarities in the result of the studies. Our result are based on a limited survey with a limited number of respondents but still they experience similar needs as the respondents in the other reviewed studies that are based on larger samples. Further, the other studies reviewed do occur in foreign countries that do not have the same culture, hierarchy and values as we do and still, we can find similarities in the experienced needs for IT/IS investment between the studies. Not only do we see similarities between our study and the earlier studies but if one compares the earlier studies with each other, the same similarities appear.

Table 15 shows a compilation of the criteria earlier presented in this study, both from our theoretical and from the empirical findings.

Table 15 Presentation of the different criteria found in the theoretical and empirical study.

Evaluation categories	Peffer and Saarinen 2002	Bacon 1992	Seddon et al. 2002	Our Study
Financial criteria	<ul style="list-style-type: none"> • Cost/Benefit Analysis • Payback period • Return on investment • Discounted cash flow • Model of the banks operations 	<ul style="list-style-type: none"> • Net present value • Internal rate of return • Profitability Index Method • Average/Accounting Rate of return • Payback method • Budgetary Constraint 	<ul style="list-style-type: none"> • Traditional cost benefit • Return on investment 	<ul style="list-style-type: none"> • Initial cost of investment • Operational cost • Revenue • Payback period • Savings • Time
Operational criteria	<ul style="list-style-type: none"> • User satisfaction • Maintenance feasibility • Reliability testing • Level of system use 			<ul style="list-style-type: none"> • Easy to handle system • Future support/debugging/repair time
Strategic criteria	<ul style="list-style-type: none"> • Analysis of customer needs • Analysis of user requirements • Analysis of competitive threats/opportunities • Analysis of industry structure and competition • Critical success factors • Value chain 	<ul style="list-style-type: none"> • Support Explicit Business Objectives • Support Implicit Business Objectives • Response to Competitive Systems • Support Management Decision Making 	<ul style="list-style-type: none"> • Strategic match with the business • Satisfactory of customer needs • Strategic IS architecture 	<ul style="list-style-type: none"> • Deepen the value chain • Customer attachment • Competitive advantage • Strategic alignment • Long term perspective
Development criteria	<ul style="list-style-type: none"> • Project schedules • Project budgets • References from other bankers • Post implementation audit • Programming productivity 	<ul style="list-style-type: none"> • Probability of Project Completion • Technical/System Requirements • Introduce/Learn New Technology 		
Risk criteria	<ul style="list-style-type: none"> • Financial feasibility • Economic feasibility • Technical feasibility • Operation feasibility • Implementation feasibility 	<ul style="list-style-type: none"> • Probability of Achieving Benefits 		<ul style="list-style-type: none"> • Consequences of not investing
Business criteria			<ul style="list-style-type: none"> • Productivity improvement 	<ul style="list-style-type: none"> • Product development • Process development • Product quality • Needs and wants from the organization
Other criteria		<ul style="list-style-type: none"> • Legal/Government Requirements 		<ul style="list-style-type: none"> • Feeling • Time constrains

A comparison between the results of the studies indicates that there are similarities in the use of criteria and that our respondents use approximately the same criteria as the respondents of the earlier studies. The financial and strategic criteria are the most popular. Respondents in all of the studies use these criteria. In the studies where a ranking of the importance of the criteria have been performed these groups are at the top. The rate of similarities between the different groups of criteria varies and some categories are missing in some studies. As with the needs, how you interpret the concepts does affect which category the criterion should belong to. As well as similarities, the comparison also shows that there exists an inconsistent categorization of criteria. A widespread range of categories could cause difficulties when using the criteria to assess value but it must also indicate that there are many factors that have to be identified before trying to create common definitions of the criteria. Culture, location and decision making process are factors whose effect on which criteria are used, should be investigated further.

The problem discussed around the needs with the interpretation and categorization can also be found by the comparison of the criteria. A comparison between Peffer and Saarinen's (2002) results (see table 5) and our study (see table 9) shows that the financial criteria are common in both studies. However, the difference is that our study does not have the same categorization of the criteria as Peffer and Saarinen (2002). The financial criteria in their study are located in the financial (cost/benefit analysis), development (project budgets) and risk categories (financial and economic feasibility). In our study the category financial includes all financial criteria. This difference exist due to different interpretation of which category should contain which criteria. However, in the financial category many of the studies present the same criteria and there seem to be clear where the financial criteria should be placed. In the financial category the criteria and methods used are experienced and clearly defined. This affects the high usage of the financial criteria by corporations.

Criteria located in the operational category are only found in our and Peffer and Saarinen's (2002) study. This can be explained by the fact that our study includes respondents at the operational level and Peffer and Saarinen (2002) have included operational executives. Bacon (1992) and Sedon et al (2002) have concentrated on CIOs and IT/IS managers in their choice of sample. The respondents at the operational level do most likely have a more operational perspectives when evaluating IT/IS investments than the ones at the strategic level.

Strategy is a wide concept and therefore there are few criteria that are common in all of the studies. Instead, the amount of strategic criteria in the studies are compared and the strategic criteria are of importance in all studies, even in our and Peffer and Saarinen's (2002) study, which have a more operational focus.

The amount of development criteria in Peffer and Saarinen's (2002) survey that are not to be found in the result of the other studies, could be explained by the fact that they have not only investigated the ex-ante phase but also ex-post.

5.2 Criteria and needs for IT/IS investment

The different focus of the companies causes different needs and different criteria are used depending on those needs. If one apply the corporate goal for IT matrix (Tallon

et al. 2000) on our study, the respondents' experienced needs such as rationalization, reliable system and process development indicate that the operational focus is dominating among our respondents. However, there are also indications of awareness among the respondents that there are other needs than those which strictly are connected to an operational focus. Business development and business support are mentioned by the same respondents and these belong to a market focus and therefore there are also respondents that have a dual focus.

How the process of making the decisive decision about an investment is performed could have an effect on what the respondents in the empirical study experiences as needs and the criteria they use when evaluating. How standardized the process is at the corporation and how careful the respondents actually go through the different steps of the process affect how the outcome of the investment will be. Our study is based on personal experiences of the respondents and therefore they have different experiences of ways of conducting a decision making process. The definition of what the consequences of an investment may be and the choice among investment alternatives varies from different individuals. Furthermore, experience and the perception of value and needs also vary. Our study shows that even the respondents that are located at the same organizational level and have similar responsibilities prioritize different needs and criteria. Factors such as cultural, political, personal and other factors affect the decision. One should have this in mind when interpreting our results of what the important needs and criteria are.

5.2.1 Underlying needs for IT/IS investment – which are experienced?

Our study indicates that *rationalizing*, *reliable system* and *process development* are the most usual needs underlying the IT/IS investments where our respondents are part of the decision making. If other respondents located in different organizations would have been studied, the result could have been different. Also, our respondents are located at different levels of the organization and this could also have an effect on our results. The strategic needs were suggested by a CEO located at the top management of the company. The main responsibility is to have an overview of the entire company and make strategic decisions that affect the company's strategy and overall objective. The system and business needs were suggested by respondents located at operational and tactical level.

There is one category of respondents that we have excluded in our study and these are the users of the system. Those are the people who actually experience the direct effects of the investment. Not every investment has a direct effect on the users but if the decisions makers considers a typical IT/IS investment such as a new business system, the effects become necessary to consider if the decision makers wants the system to work as planned. Although the respondents mentioned needs and wants from the organization as a criterion, they did not consider the user needs as important. This we find interesting since the users ability to quickly adopt and learn the new system is a cost saver and there are indications that costs is important among our respondents since *rationalizing* is ranked as the most important need along with the financial criteria connected to rationalizing.

Project support is a need that only two of the respondents find as an underlying need to an IT/IS investment. IT/IS projects within organizations show a remarkable high

rate of failure which costs a large amount of resources. With the failure rate among IT/IS projects mentioned by Renkma (1998) we find it noticeable that this need is not more common occurred when the support for those projects could be a tool for lowering the failure rate and lowering the waste of valuable resources.

The lack of respondents that finds *fulfillment of law and environmental* needs as an underlying need to the IT/IS investment where they are part of the decision making is also worth notice since these are prerequisites for the business to be allowed to exist and produce goods or whatever the purpose is with the business. The reason could be that this need is so obviously necessary that they did not consider it at all. The respondents could view this need as a matter of course and therefore not consider it as a need.

Product development and *product quality* are experienced by 50% of the respondents to be underlying needs for IT/IS investments. Our respondents are located at production companies that are dependent on a successful end-product and should be very interested in *product development* as well as *product quality*. The corporation's in our study do not lack competitors which produce similar products. The quality of the product should therefore be seen as a competitive advantage and be experienced as an important need that should be supported, for example, by IT. Underlying needs experienced could be affected by the responsibilities of the respondents. If we had asked quality managers or other managers, the answer could have been different.

The reasons for IT/IS investments have according to Jurison (1996) changed from operational efficiency to a variety of reasons such as competitive advantage and strategic opportunities. The underlying need for IT/IS investment experienced by most of the respondents is *rationalizing*. Increased efficiency is included in the concept of rationalization in our study. This indicates that the respondents in our study have not changed the focus of their IT/IS investments in the way that researcher claims the IT/IS investments have changed in general. Again, we want to relate this result to the group of respondents in our study and the predominant representation from the operational level. At the operational level the strategic decisions are not as salient as in the tactical and strategic level and this could affect that the need of rationalization is still experienced as the most important by the respondents even if the researchers claims that strategic reasons should increase. Rationalization is a wide concept compared to other needs included in this study and this could affect the reason why this is the underlying need experienced by most respondents.

The needs that are experienced by second most respondents to be underlying the IT/IS investments, where they are part of the decision making, in our study are tied to each other by the system category. These needs are; *reliable system* and *support/service/equipment*. To have a reliable system and a working support service and equipment could be related to the day to day operational activity. That these needs are common among the respondents could be related to the fact that most of them are situated at the operational level.

A system that is reliable and where the support and service are working properly and the equipment is sufficient, should be a priority due to that reliability saves money. If the system is not reliable or sufficient enough, the savings and efficiency improvement could be lost and the system may actually increase costs instead of the opposite. *Reliability* and *sufficient support/service/equipment* are prerequisites for the rationalization effects to occur.

5.2.2 Important IT/IS investment criteria

If we look at the criteria most of our respondents experience as important when evaluating the needs experienced by most respondents (see table 11 and table 12), we can see that financial and operational criteria are marked as the most important criteria. The IT investments where the underlying need is rationalizing is primarily evaluated with financial measures since the criteria the respondents look at are savings and operational cost.

The respondent at the strategic level put emphasis on the strategic criteria such as customer attachment and competitive advantage since the underlying needs experienced by this respondent are Business development and support. When a decision to invest in IT/IS is made at this level to satisfy the needs, it will according to Salter et al (2004) require actions at the tactical level.

The tactical decisions will according to Salter et al (2004) in its turn require actions at the organizational level. These actions do sometimes but not always require that decisions are made. Experienced needs at the organizational level are i.e. “Reliable system” and an improved “support/debugging/repair time”. When decisions about IT/IS investments are made at this level the criteria of “Easy to handle system” and “future support/debugging/repair time” are seen as the most important criteria.

Even if the “agents” as Salter et al (2004) name the groups and individuals, work towards a common goal the same underlying need can be expressed differently at different organizational levels. That means that the organizational structure and culture have a big role in what is seen as needs because this affects if the members of decisions at all levels have a big picture of the overall goal of investments and the underlying problems. This in its turn affects which criteria that are considered at each decision level.

These “agents” are also individuals, which are the ones that makes decisions and not the organization. Bannister and Remenyi (2000) point out that our own perception will always affect how we make decisions i.e. our decisions are not only affected by numbers and costs, but by cultural, political, personal and a host of other factors (Bannister and Remenyi, 2000).

5.2.3 The relation between underlying need and criteria used

The usage of the criteria that the respondents in this study in relation to the underlying need they have when evaluating IT/IS investments indicates that there are patterns. For example, when IT/IS investments suppose to satisfy the need for reliable system are evaluated, the operational and financial criteria are found as most important. When the support/service/equipment needs are to be satisfied with an IT/IS investment, the operational criteria are used when evaluating the investment.

This indicates that there are some criteria that have a greater part in a decision than others depending on the underlying need of the IT/IS investment. There is no overall number one criterion but their importance vary with the means of the investment.

The study also argues for the importance of different criteria regardless of the underlying need. In this study there is no underlying need where any of the criteria is experienced as not important by all of the respondents. We interpret this result as a confirmation that there is a need for a set of different criteria as well as that the

evaluation requests different criteria and basic data at different organizations and by different decision makers.

As we have found different experiences of importance for the different criteria depending on the organizational level our respondents are a part of, there are other aspects to consider. Besides the decision is probably not performed by a single decision maker, but several decision makers with different views of the criteria importance are part of the decision making which adds the need of a wide set of basic data to satisfy all of them.

5.3 Using Delphi as research method

The Delphi-study is affected by the limited resources of the study as well as implications when collecting the answers from the respondents. Using a Delphi-study to investigate the research question is suitable since we wanted the respondent to list important criteria depending on underlying needs that they experience by themselves. The advantage with a Delphi-study is that you obtain something that could be compared to a group opinion instead of just individuals.

The aim of the Delphi-study, to reach of consensus, can be questioned in our study. Through the fact that the concepts used in our study can be interpreted differently by different respondents a true consensus is impossible to reach. Over all we are questioning if a consensus could ever be made in a Delphi-study. Though, how could ever all of the respondents' opinions be the same? It is still a question of weighing in the end.

A major disadvantage with a Delphi-study experienced in this study is that it is time consuming and that it is critical that every participating respondent answer your questionnaire since there are few respondents in a respondent group. If we had used a regular quantitative questionnaire, we could ignore the ones that did not answer and just make a note in the thesis that x percentage answered our study. A Delphi-study requires dedication from the respondents throughout the entire study. The dedication was experienced as a problem in our study since there were always delays in the answers from the respondents. If one want to learn from our study and avoid the obstacles we encountered, read the following tips:

- A Delphi-study requires **extensive planning** and one have to be much clearer what one want as result from the study than we were. One must think one step ahead all the time. A more extensive pilot study is recommended were you develop the different steps depending on answers to obtain the big picture of what the study will result in.
- **Commitment from the respondents** is essential. The idea with a Delphi-study is not cover as many respondents as possible but to obtain a smaller group of committed respondents that could answer several questionnaires. We did not get the commitment we wanted and several of our respondents left the study mainly due to time constraints. A tip is to be very clear of what you require from your respondents regarding time and commitment and explain that if they hesitate, it is better that they say no to participate. Respondents that do commit to only two out of four questionnaires are not desirable.

- The **selection of respondents** should also be better thought through than our selection. In a Delphi-study, it is essential that the respondents have similar characteristics since the researcher wants to reach consensus within a specific group of people. If there are large differences among the participating respondents, there is a risk that the validity will be lower since there are many other factors that could affect the respondents' answers.

5.4 Further research

Based on this thesis and our interest in the area, we present the following further research suggestions:

- The framework of needs and criteria found in this study could be used at a larger number of respondents to gain a higher credibility.
- A comparison of the experienced needs and criteria at different corporation by performing the same sort of Delphi-study as ours at the different corporations.
- Within our study, experience from different organizational levels is limited. A further study could investigate this matter by dividing respondents into different groups depending on where they are located within the organization, e.g. a group of respondents located at a strategic level and one group located at the operational level. The different groups then reach consensus about the concepts and then the researchers could ask them which the most important needs and criteria are. The results could then be interpreted and the different groups located at different organizational levels could be compared to give an indication of how the location within the organization affects which criteria are important.
- A study of which evaluation methods are used for each of the criteria, e.g. how the respondents assess the savings received from an IT/IS investment.

Furthermore, future surveys should also investigate the factors that we do not consider in our study such as culture, hierarchy, size of the corporation and location.

6 Conclusions

Within this section we summarize our results, analysis and discussion to answer our research question.

Which criteria are found important when evaluating whether to invest or not in IT/IS depending on the investments underlying needs?

The most important underlying needs experienced by our respondents are *rationalizing, reliable system, support/service/equipment, process development* and *increased production*. The criteria experienced as most important in relation to the needs listed above are presented below.

- The criteria experienced as most important when evaluating investments to satisfy the need of rationalization are savings and operational costs.
- The criteria experienced as most important when evaluating investments to satisfy the need of a reliable system are the future support/debugging/repair time, a easy to handle system and the time to implement the investment.
- The criteria experienced as most important when evaluating investments to satisfy the need of support/service/equipment are future support/debugging/repair time
- The criteria experienced as most important when evaluating investments to satisfy the need of process development are future support/debugging/repair time.

The majority of the criteria that are used to evaluate the most common needs belong to the financial and operational category.

The criteria used to evaluate the IT/IS investment are identified as financial, strategic, operational, business and the criterion of gut feeling. The overall most used criteria are the operational criterion future support/debugging/repair time followed by the financial criteria of costs and savings. The criteria overall experienced as most important is the needs and wants from the organization followed by the easy to handle system and savings. These are criteria that are experienced important independently of the underlying need the investment should satisfy.

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8 Appendix

A – Concepts of the research area

Within this thesis, we discuss and analyses many concepts which are constantly returning in the literature. Below, we have put together the most commonly occurred concepts in the literature within our research area. The concepts are somewhat not generally accepted as definitive definitions and are a subject for discussion.

IT Value - “The outcome of financial and non-financial consequences of the IT investment” (Berghout and Renkema, 1997).

Benefits - “A benefit is the consequence of an action that protects aids, improves, or promotes the well-being of an individual or organization. Benefits take the form of cost savings, cost avoidance, improved operational performance, and “intangibles” (King and Schrems, 1978).

Investment criteria – An investment criterion is a measurement of benefits, which is used to decide weather an investment should take place or not. For example, if cost savings is a benefit then production cost could be an investment criterion that contributes to the basic data for the investment.

Information Technology (IT)- Eaton et al. (1988) in Powell (1992) uses the definition: “The acquisition, processing, storage and dissemination of vocal, pictorial, textual and numeric information by a microelectronics-based combination of computing and telecommunications”.

Information Systems (IS) - “An information system in its simplest form can be defined as a technological system that manipulates, stores, and disseminates symbols (representations) that have, or are expected to have, relevance and an impact on socially organized human behavior. (Hirschheim et al., 1996)”

Information Technology Evaluation (IT/IS evaluation) - “The evaluation of IS, in general, is considered as the determination and measurement of the costs and benefits associated with an investment in IT (Software, hardware and telecommunications)” (Apostolopoulos and Paramataris, 1997).

Information Technology Investment (IT/IS investment)- “An investment in information technology (IT) refers to an acquisition of hardware or software which is expected to increase or expand the possibilities of an organization’s information system (IS) and render long-term benefits” (Apostolopoulos and Paramataris, 1997).

Decision making - “This term refers to the processes commonly portrayed as occurring early in the “problem solving process” – the sensing, exploration, and definition of problems or opportunities – as well as the generation, evaluation, and selection of solutions” (Huber and McDaniel, 1986, p. 5)

B – Description of criteria (Bacon, 1992)

The **financial criteria** that were used by the CIO's in Bacons (1992) study are described below;

Net Present Value (NPV) is a discounted cash flow (DCF) method in that takes into account the time value of money. A specified rate of return is used to discount all cash flows as of time zero, i.e., the beginning of the cash flows (generally the point of initial investment outlay). The discounting process is usually done with the aid of present value tables or equivalent software. If the resulting Net Present Value is Positive (i.e., the present value of the inflows is greater than the present value of the outflows), then the go-ahead might be given for the project/investment.

Internal Rate of Return (IRR) is also a DCF method. However, compared to the Net Present Value Method, there is no directly specified rate of return. Instead, the objective is to find the rate of return for a project or investment, based upon the cash flows and respective time periods, that makes its net present value equal to zero.

Profitability Index method (PIM) is a third DCF method. When it is based in the NPV method it provides comparable profitability among different projects or investments by dividing the present value of the future cash flows of a project by its initial fixed investment. When it is based on the Internal Rate of Return method, the higher the rate of return the better the project is.

Average or Accounting Rate of return (ARR) for a project is found by dividing the average annual income after tax over the life of a project by the initial fixed investment,

Payback method (PBK) estimates the time required to recover the initial investment, i.e., how quickly a project or investment will pay for itself. The estimated net cash flows for each year are added until they total the initial investment. The time required is the payback period; the shorter it is the more preferable the project. There is also the discounted payback method, which takes the time value of money into account; each years estimated net cash flow is discounted at the required rate of return, and the resulting present values are added until they total the initial investment.

Budgetary Criteria or Constrains apply where project/investment go-aheads is subject to or influenced by pre-established funding allocations.

The **management and development criteria** used in the evaluation of IT-investments are described below;

Support of Explicit Business Objectives applies where a systems project or investment is given the go-ahead to fulfill business strategy or objectives that are articulated in some sort of plan, generally a corporate or business-unit plan

Support of implicit business objectives is the justification where a systems project or investment is given a go-ahead in recognition of business objectives/aims that are understood through not necessarily formalized/articulated in any plan.

Response to competitive systems is the justification when a project is initiated in direct or indirect response to the competition adopting, or appearing likely to adopt, new information systems and/or IT technology that is likely to bring about increased competitive pressure. It may also be the justification in a proactive sense, i.e., seeking

competitive advantage through the use of IT/IS.

Support of Management Decision Making is the main criterion when an important part of the projects justification is enhanced information for enabling more informed, more rapid, or easier management decision making and/or enhanced communication.

Probability of achieving benefits relates to the probability (or risk) of the planned projects achieving (or not achieving) what is intended to achieve in terms of its benefit and/or business effects. The factors and assumptions involved in this type of criterion might be included in a business analysis of the project.

Legal or governmental requirements refer to the justification when a project or hardware/software investment is undertaken primarily to meet governmental regulations or legislation, as for example with taxation or reporting requirements.

C – Description of the evaluation methods

Financial methods

Payback period is the amount of time required for an investment to generate cash flows to recover its initial cost. When you're using the payback method you calculate cash flows for the oncoming year's and compares them with the initial investment to see when an investment becomes profitable. Time value is ignored and you should use the model to calculate how long before reaching break-even. In financial terms, the biggest drawback is that the relevant issue is to see investments affection on stock value, not how long before reaching break-even. Payback periods simplicity fits well with minor investments (Ross, Westerfield and Jordan, 2001). However, small and short-lived projects with fast payback period may be favored and this does not comply with ICT (Information and Communication Technology) projects which usually have long payback period and are relatively long-lived (Milis and Mercken, 2003).

Return on investment is calculated by dividing the yearly average profit with its average investment cost. In this case, profit is prioritized over the cash flow generated. This type of valuation makes it possible to compare short- and long-term investments. The advantages with using ROI are that the company directly can see the return from the investment and that the result is something that is easily understood. The disadvantage with this valuation model is that ROI doesn't take inflation and current value of future cash flow into consideration (Drury, 2000).

In short terms, **Net Present Value** is the difference between an investment's market value and its cost. NPV gives an indicator of how much value is created today from a particular investment. A project should be accepted if the NPV is positive and rejected if negative. First, the cost is estimated then the discounted cash flow (DCF) valuation takes place which is the process where an investment is valued by discounting its future cash flows (Milis and Mercken, 2003).

Critics to the model claim that the model is adjusted for motivating stockholders to invest, others say that this type of investment is the best suitable for IT-investments because many IT-investments do not return any payback in the short-turn. The main reason for companies using NPV is to see if the risk in the investment is acceptable (Drury, 2000).

Strategic methods

The **strategic fit** of ICT investment primarily states that an evaluation of the investment should be aimed towards its contribution to the competitive advantage of the company. To understand technology and competitive advantage, Porter's value chain is used. A positive relation between the two issues is desirable in order to find and accept measures of performance. However, no financial analysis are taken into consideration which means that this methods are more like guidelines to select an investment but does not help when choosing between two project serving the same purpose (Milis and Mercken, 2003).

Wiseman (1992) argues in her article *Information Economics a practical approach to valuing information systems* that one must adopt a new way of thinking and leave the old cost-benefit analysis behind us. When evaluation projects, it is almost impossible to translate every benefit and value to cold hard-cash concepts. Benefits, in the world of information economics, are distinguished from value by definition. Benefits are hard cash flows and value is the total positive impact of the information systems in the enterprise. Further, Wiseman (1992) states that benefits can be quantified but how likely do these measurable effects occur? Factors such as staff attitudes, commitment of top management and educational plans must be considered. One can gain 5 min/order by upgrade old information systems but one also gains a higher level of staff competence. The major problem with information economics is that the disposition of weights is entirely based on subjective opinions. (Milis and Mercken, 2003) Further arguments against information economics include lack of independent authentication, blur or eliminate the possibility of accountability and it's impossible to link the weight to business plans and cash flow projections.

Mixed methods

The **multi-layer evaluation process** gathers the advantages of both financial and strategic models and put them into one model. Milis and Mercken (2003) states that there are two steps in a multi-layer evaluation process. In the first phase, investments which are not contributing to strategic or business aims of the organization are rejected. In the second stage the remaining investments are evaluated using financial models. Meredith and Hill (1987) suggest that the second step is divided in to three sub-steps:

1. Use the NPV techniques based on the tangible costs and benefits.
2. List intangible costs and benefits.
3. Make an analysis of the risks and uncertainties.

When accurate information has been gathered, management makes their investment decision.

The **balanced scorecard** has emerged because of the need to link financial and non-financial measure of performance and to identify key performance measure. It uses a set of measures that give the top management a fast but comprehensive view of the organizational unit. The balanced score card is used, among other things, to measure efficiency in the organization.

Mainly the balanced score card allows managers to look at the business from four different perspectives by seeking to provide answers to the following four basic questions (Drury, 2000):

1. How do customers see us? (customer perspective)
2. What must we excel at? (internal business process perspective)
3. Can we continue to improve and create value? (learning and growth perspective)
4. How do we look to shareholders? (financial perspective)

The scorecard provides a comprehensive framework for translating a company's strategic objectives into a coherent set of performance measure. Each organization must decide what its critical performance measures are. The choice will vary over time and should be linked to the strategy that the organization is following. The methods for how the balanced scorecard should be designed are different depending on the organization, its culture and its business concept.

The **PENG-model** is a Swedish model specialized on measuring IT-value. The model focuses on valuating both tangible and intangible benefits in monetary units. The PENG-model gives the decision-makers in the organization better ground when choosing an investment and increases the number of fortunate investments in the company.

The PENG-model is divided into three phases with totally 10 steps.

Preparation-phase	Step 1	Determine the purpose
	Step 2	Create insight
	Step 3	Determine and demarcate the object
	Step 4	Describe the object (processes/system)
Analyze-phase	Step 5	Identify the benefits effect
	Step 6	Structure the benefits effects
	Step 7	Value the benefits effect
Quality securing -phase	Step 8	Calculate the cost for benefits
	Step 9	Validate and assess risks and obstacles
	Step 10	Calculating the net-benefit

- *The Preparation-phase* – in this phase one must think of what the benefit analysis do, what is being valuated and in which time-aspect that the investment could generate benefits. A graph of how to reach the future objectives should also be drawn. The quality of the result from the benefits analysis is dependent of the persons involved in the analysis. The persons involved in the analysis should have great knowledge about the organization in order to get a fair judgment. The management shouldn't leave these types of questions to the IT-specialists. The management must be convinced that a PENG-analysis can handle the organizations objectives and not the technique. In order to determine and demarcate the objects, such as the sale-process, we need to gather all facts that we can predict that we will need. The goal is to describe benefits between two different conditions: IS- and SHOULD-position. The better we can describe the process before and after the easier the benefits analysis will be.
- *Analyze-phase* – this means to identify structure and to valuate effects from benefits and calculate how much IT-benefits cost. This is done by brainstorming in groups around which benefits are most wanted. These benefits are then valued in order to determine the most important ones. This is usually a difficult step and therefore, the use of a process leader with PENG - competence is important. The last thing in this phase is to valuate the cost against the benefits.

- *Quality securing-phase* is where estimation of future risks, determination of responsibility and calculation of net benefits of an investment occurs. In this phase the valuation is critically reviewed. The net-benefit is then calculated and the responsibility is the divided so that the benefits can be reached (Dahlgren, Lundgren and Stigberg, 2000).

D – Questionnaires

Utvärdering av IT-investeringar – vilken information behövs?

Namn:

Position:

Roll i beslutsprocessen kring IT-investeringar:

Företag:

Vi befinner oss i stadiet då ett förslag på en IT-investering har tagits fram och ett beslut skall tas om investeringen skall genomföras eller ej.

Fråga: Vad för information behöver du för att kunna fatta beslut om en IT-investering skall genomföras eller ej?

Svar:

Utvärdering av IT-investeringar – Enkät nr. 2

– vilka behov ligger bakom IT-investeringar?

Vi vill nu ta reda på varför ni genomför IT-investeringar. Därför tar vi ett steg tillbaka ifrån beslutsfattandet och ber er utgå ifrån den situationen där ett behov av en IT-investering uppstår.

1. Vilket eller vilka behov ligger bakom de IT-investeringar som du är med och beslutar om/är involverad i? (Nedan har du möjlighet att fylla i fem alternativ, men får gärna fylla i fler eller färre.)

1. Behov:
Förklaring:

2 Behov:
Förklaring:

3. Behov:
Förklaring:

4. Behov:
Förklaring:

5. Behov:
Förklaring:

2. I föregående enkät nämndes verksamhetsnytta som en del av den information som användes för att ta ett beslut. Vad är verksamhetsnytta för er?

Svar:

	Kriterier																				
	Orsakerna till organisationen	Produkt/värde	Support, felsökning, reparation	Lätlärdhet system	Känsla	Långsiktighet	Förhållna värdekedjan	Kryva kunden till sig	Konkurrensfördelar	Strategisk anpassning	Konsekvenser av att inte genomföra investeringen	Tidsbegränsningar	Säkerhetsaspekter	Besparingar	Tid	Arbetsbelastningsperiod	Intäkter	Driftkostnader	Införda investeringar/kostnader		
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Enkät 3