School of Economics and
Commercial Law
GOTHENBURG UNIVERSITY
Department of Informatics
2004-06-03

Evaluating Return On Information Technology Investment

Abstract

The purpose of this thesis was to develop a framework for evaluating the Return on Information Technology Investment (ROITI). The motive was to capture and measure the intangible benefits deriving from an IT investment and to contribute in making an IT project solid business case, in justifying the IT project budget and in obtaining the buy-in from the decision makers. To identify the key factors in evaluating the profitability of an IT investment, the theory section explored literature studies and articles, the concept of productivity and its relation to the Return On Investment (ROI) indicator, existing methods and metrics in the applicable area of interest. By using empirical information from a case study, a ROITI evaluation framework was constructed. Data collected in the case study was then used in the framework. Based on the results, the conclusion reached is that the intangible benefits deriving from an IT investment can be measured and need to be measured in order to have a realistic investment evaluation. The thesis further concluded that the ROI can be simply used as a financial measurement or more importantly be built-in in a framework that leads to develop a company's IT project solid business case, to create greater budget control, to increase management and investor confidence, which are all critical elements for a successful IT project.

Keywords: Return On Investment, ROI, Information Technology, Intangible benefits.

Author: Karl Westerlind
Examinator: Kjell Engberg
Supervisor: Faramarz Agahi
Master thesis, 20 points

CONTENTS

PICTURES AND TABLES INDEX.

1 Introduction

The use of Information Technology (IT) has since the beginning been targeted for evaluation whether it pays off or not. The research picked up to a new phase in the 1980s. This was mainly initiated with a statement from R. Solow (1987) that IT investments were not giving a return to its investors. This sparked further research and many jumped on the new hot area. Many researchers were following different approaches to investigate and research around this area, some agreeing to what R. Solow stated (Loveman 1994), and some not (Brynjolfsson 1993, Brynjolfsson & Hitt 1996, 1998 & 2003). From the many empirical studies, there are probably as many different viewpoints and findings to whether investing in IT is good or not. The one thing most researchers agree with is that the outcomes of investments in IT are difficult to measure. In other words, the benefits are many, but they are in some cases difficult to capture. When a business is looking to solve a problem or reach a goal state that involves IT equipment, an evaluation should be done in order to find the best possible approach. Different alternatives are evaluated and thought through, however there is no standardised method to ease the initial issues in this process. Many different methods have been developed to enable companies to make an evaluation of their IT investments. This might come in a service that the company would acquire from another company, or as software, where different anchor-measurements are evaluated over a period of time to visualise the changes. Many of the difficulties sprung from the fact that IT investments are considered as both tangible and intangible assets. This makes the evaluations more difficult to translate into a presentable value. The communication within the company, coordination, can increase, thus providing higher management a better view of what is going on in the parameters of the company, and the company as a whole are given a more effective way of communication. The benefits in terms of productivity can also increase when investing in IT, however in some cases the enhanced methods that are implemented are not being properly captured and are instead converted into slack, i.e. different solutions has different outcomes. These are all examples of scenarios that hopefully will happen, or hopefully not. In conclusion, as pressure on companies increase from share owners and others to be more productive, more efficient, more profitable, and so on, the importance of being able to demonstrate that an investment is profitable increase.

1.1 Research Definition

The aim of this thesis is to develop a framework that can be used as a base for companies that want to start evaluating their IT investments. Investments, whether made in IT or not, has one purpose: to generate a return. This return may be in the form of capital, saved time, happier employees, or other benefits. Calculating the saved money is usually straightforward, however calculating intangible assets are more difficult. In order to demarcate the thesis I have chosen to “transform” these intangible into a monetary equivalent. This is something that differs from company to company, as the investments made are most probably different.

1.2 Research Question

As companies invest in IT the question whether it pays off or not arises. Studies conducted in the mid 1980s, where showing that productivity and IT did not cohere. However a review of more than 50 empirical studies conducted by Dedrick, Gurbaxani and Kraemer (2003) shows that there is a link between the advancement in IT and the

profitability from IT investments. Nevertheless there is an issue concerning how benefits that sprung from IT should be measured. The intangible assets that sprung from IT investments are in some cases difficult to see and therefore difficult to capture. This may cause investors to make misjudgements on future reinvestments that might be mission critical to companies and organisations.

As companies want to increase productivity and coordination within the company they often look at an investment in IT. When the purpose of the investment has been defined, and the specifications of the equipments that are needed identified, the method of payment has to be decided. It is not only a question of buying the equipment but also how to finance it. Whether the investment in IT will produce a return immediately or after a lag is an important factor in the decision of form of payment.

IT often gives the advantage of businesses to stay flexible as the environments, both internal and external, are in often and constant changes. IT allows companies to develop *ad hoc* solutions in a more effective way to tackle these changes and to stay competitive. This can lead to that companies that are using information in order to predict customer trends holds a better tool to compete against other companies that are not treating information that used correctly will give increased advantages.

Productivity is the key essence when it comes to a business future. In order for a business to make more profit using its assets (tangible and intangible) one method is to increase the output without the increase of input. Investing in IT is one of the ways, as it might help employees producing the equivalent tasks in less time, or more tasks in the same time previously used.

As all companies and organisation are in some way different from each other, there lays a difficulty creating a measurement model that covers all angles of an investment in IT. The questions are therefore:

Can a framework of a Return on Information Technology Investments calculation be used in order to capture and measure tangible and primarily, intangible benefits, that sprung from these investments?

Can a framework of a Return on Information Technology Investment be used by the IT manager for building an IT project solid business case, for justifying the IT project budget and obtain the buy-in from the decision makers?

1.3 Method

This thesis has been mainly based on literature studies and previous research. In addition to that I have focused and concentrated on a case study of an Italian medium sized company that operates in the transportation section. This has been done in order to collect information, to build a framework, and data, to be used within the framework. Traditional research is often seen as a circular process where the different parts are connected. These parts are however not completely separated and can be intertwined with each other (Backman, 1998).

The literature study has been based on literature acquired from libraries. In addition, the theoretical studies have been based on articles and research that has been conducted in

the relevant area. Literature studies indicate earlier imperfections and gaps in the relevant knowledge and indicate relevance in a known issue. Further shall the literature study aim to give an overview of earlier collected knowledge in the area, show the significance of the issue, give a historical perspective, and give a variety of interpretation alternatives (Backman, 1998).

Using a deductive way of approaching the subject I have started with the existing method on how to measure return on investment. The Return On Information Technology Investment (ROITI) framework is based on partially literature studies and partially on my own experience in working in a large multinational IT-company with both selling and financing IT equipment to their customers. This experience has given me an insight in both day-to-day concerns of IT managers and financial managers working in companies that stand before an IT investment.

Further has interviews been conducted with the IT manager of the company that the case study is based on. This in order to make the framework reflect the structure of the company. Developing the framework is therefore also done through talks with the IT manager. Part of this has been focused on getting a balance between being enough detailed and not exclude any mission critical factors, and not being too complex, creating confusion between different departments that are effected from this calculation. Some authors say that there can be no standardised method for calculation ROI, this framework should however be taken as a foundation for further research in any of the applicable evaluation of investment in information technology.

The IT manager of the interviewed company holds enough knowledge to be able to give me information for the development of the Return On Information Technology Investment framework for the following reasons:

- By developing the ROITI framework I wanted to create a framework that can be used to help building an IT project business case, justifying the IT project budget and obtaining the buy-in from the decision makers. All these activities are responsibilities of the IT manager; therefore it is a natural consequence that the IT manager is the right person in the company to ask for information on return on information technology investment.
- The person is properly qualified as the interviewed has a solid education and long professional background in the area of interest.
- The person has been in the company from its start in the market covering the role as IT manager and the role as the business development manager. This has given the interviewed a broad knowledge of the growing process that the company has gone through and which are the company areas that still needs further information technology development and how they can possibly be supported by information technology.

1.3.1 Integrity of participating company

As some of the information and data that has been given to me is confidential to the company, a request of being anonymous has been taken into account. Information of this sort can be damaging to the company if they are released. I have therefore agreed to withhold the name of the interviewed and the company in question[1]. Reference made throughout the thesis to the person interviewed will be shown as: [interview]

[1] For further information regarding credibility of data, contact the author via email, kallewester@yahoo.se

1.4 Interview techniques

I have conducted interviews with the company's IT manager in order to collect empirical data as well as build the framework of ROITI. Interviews have been unstructured to that sense that no specific questions were written down before the interview was conducted. This has had the effect that the interviews were more regarded as conversations instead of the interviewee just answering questions. This method was preferred before using a questionnaire as I saw a risk in receiving less information than with an open interview in this context. It has also had a positive effect on constructing the framework that is presented in section four.

1.5 Disposition

Starting with the theory in section two that is based on literature studies and on articles written about the applicable area of interest. This highlights different areas that in some way should be included in an evaluation of an IT investment. The thesis then continues to section three with exploring more in-depth about ROI and different models on attacking the issue; this has been conducted to that sense that objectivity to other methods has been included in this thesis. In section four the framework is developed and presented together with the information and data received from the case study. The conclusion and future research is in section five. The last section deals with references used in the thesis.

2 Theory

This section is aimed to describe to the reader the different methods and techniques that are used to benchmark and evaluate an IT investment. Companies invest in IT for different reasons, but mainly IT is used to day to increase productivity and to let employees work more effectively. This saves companies both time and money. As of any investment, the investor is seeking a return on it, therefore the benefits should be visualised and categorised.

2.1 Productivity

In economics the term productivity is a concept, or measurement method, used to describe and compare an organisations economical effectiveness. The general calculation method used to calculate productivity is by dividing the quantity of output with the quantity of inputs that can be secured from the input per unit of time. (Drury & Farhoomand, 1999). When measuring the input, it does not only consist of raw material and labour hours but also quantity and quality of capital equipment used, worker training and education as well as the amount of what Brynjolfsson (1998) calls *organisational capital* (supplier relationship, investments in new business processes and so on. Organisational capital is further interpreted as decentralised decision-making by Dedrick et. al. 2003). With this comes the difficulty of measuring, as it is hard to determine in econometric figures what these relationships would mean. When measuring the output there are the some conditions that also remain difficult to measure, examples of these are quality of a product, when a product is introduced (market release timing), customisation, convenience, variety and other intangible assets. These intangible assets play an important role when it comes to the evaluation of a company. Usually it is represented in the term of *goodwill*, which describes the value of a company's intangible assets. Björn Thalberg [Nationalencyklopedin] argues that an increase in productivity is often ascribed to technological or organisational development, but if it is only the labour productivity that is calculated the increase depend on a larger capital increase per employee. Two highly related concepts are effectiveness and efficiency. Effectiveness is when a goal, objective, or target is met and efficiency, the degree to which inputs are used in relation to a given level of outputs (Horngren, Sundem, Stratton & Teal, 1998). A maxim credited to Drucker (1997) holds that effectiveness consists of doing the *right things* and efficiency of doing *things right*.

Most businesses strive after increasing its output growth. They would be doing this by increases in input levels, improvement in the quality of inputs, and growth in the productivity of inputs. Increasing productivity can be done in two ways (Dedrick et. al. 2003):

- *Capital deepening:* Labour productivity can increase when providing workers with more capital. Capital may include land, structures, equipment, or the relevant capital may be a more narrowly defined input (e.g. computer equipment).
- *Multifactor productivity* (MFP): Technical progress in the production process or in the quality of output can increase the level of output without additional investment in input.

An improvement in MFP is considered to be of great importance as it reflects structural gains that are permanent. Brynjolfsson & Hitt (2000) found that payoffs from IT

investments occurred not just in labour productivity increases, but also in MFP growth and that the impact on MFP growth is maximised after a lag of four to seven years. Research suggests that the unique value of IT is that it enables fundamental changes in business process and organisational structures that can enhance MFP (Dedrick et. al. 2003). Thus, working harder would only increase the output, but working smarter would enable the business to increase its productivity. Usually businesses provide new tools for its employees to achieve this productivity growth that is necessary for business to reach higher profitability. The tools might be in form of new machines that would reduce time and/or effort in producing, or information systems that would enable the business to share information, thus making the business for example more aware of what happens in other departments in a more effective way.

Computer technology has advanced at an exponential rate for several decades. Moore's law say that in every 18-24 months the amount of transistors per chip will double. However the computers, by generating information and making it more available, only provide greater inputs to production thus not contributing to productivity growth (Brynjolfsson, 1998). In order to make a return on IT investments, implementation of IT should be accompanied by other investments, such as, new strategies, new business processes, and new organisations. However, this is rarely not easy to accomplish in organisations, as these changes require time and resources for the reengineering, restructuring and organisational redesign.

> *"These additional investments in changes will position businesses to reap the benefits of continued technological progress, while others will not."* (Brynjolfsson: 1998, p 8).

The productivity impacts of IT investments vary widely among different companies (the variance of returns to IT capital is larger than the variance of returns of non-IT capital) In other words some firms use IT much more productively than others. There are two causes for these firm effects:

1. Specific firm characteristics such as market position, rigidities in cost structures (e.g. labour contracts), brand recognition, or the vision and abilities of key executives, which affect the strategic options of a firm and therefore its potential to derive benefits from IT investment. These can change over time but are not easily manipulated by management in the short run.
2. There are specific features of organisational structures, strategies and management that can be compared systematically across companies. The management of a firm, throughout restructuring new management control systems, the redesign of processes or by upgrading employee training, can directly influence these features.

2.1.1 The productivity paradox of information technology

In the 1980s, the first larger studies of IT in relation to productivity were conducted. Many of these studies did not find any relation between IT investments and productivity, whether being firms, industries or the economy as whole (Dedrick et. al. 2003). Many sceptics saw a relationship between heavy IT investments that had been conducted with a productivity slowdown that began in 1973 in the United States of America. This relationship was named the *productivity paradox.* Robert Solow (1987) stated "*we see the computer age everywhere except in the productivity statistics*". These publications lead to a significantly increase in research regarding IT versus productivity.

Brynjolfsson (1993) give some reasons why the productivity paradox exists. The main reason is likely to be due to *Measurement errors* of IT capital. This can be due to rapid price and quality changes, and failure of economic statistics to measure qualitative improvements in the output of service industries. Measurement errors can be divided in two categories.

The first is *"Output measurement errors"*. In order to compare output levels from two different periods a factor that represents inflation has to be included in the comparison. If this is overseen, the risk of incorrect price fluctuations is imminent. Moreover a price adjustment should also reflect quality changes. It was not always taken into account that the products that were produced were being better than previous versions. In addition to that the process of producing the products might be improved over time, thus making it possible for companies to offer consumers better products at a lower price than previously. New products might be introduced as well, if not taking this into account when looking at productivity of companies in the durable goods sector implies that measurements will be misleading. Problems that occur when trying to measure the value might be when new products or features are introduced. IT would also enable a company to keep better track of its inventory, and possibly increase it, offering a better variety.

The second category of measurement error is due to *"Input measurement errors"*. IT being both tangible (hardware) and intangible (information) producing information as an input is nearly impossible to measure. A more controlled method of data and information collection has to be in place in order to supervise and ensure that the inputs reflect the reality.

The second reason is likely to be *"time lags"*. Difficulties exist when trying to measure the return on an IT investment before it would be fully implemented and used to the extent as to reach the set goals that derived from the reason that the investment decision was based on in the first place (Paul David 1990). Benefits that derive from an IT investment can, depending on the nature of the investment, take several years to show result. An econometric research done by Bryjnolfsson et. al. (1994) found lags of two-to-three years before the strongest organisational impact of IT were noticed. Before a new tool can be fully integrated and used to its full abilities, the users need to be given the corresponding training in order to accept the new technology. As the users gain the adequate experience, then investors would be able to draw conclusions whether the investment had the wanted effect. Needless to state would a company that does not look after its own internal investments certainly have difficulties finding external investors.

The third reason brought up is *"Redistribution"*. IT might help individual firms relative to competitors but not increase productivity in the whole economy. This could be explained by companies introducing "Strategic Information Systems". These systems would shift benefits from competitors rather than to lower costs. This effect could show up in an increase of market share for example. Another example of this would be that market research intensification and marketing improvement that sprung from IT investments are beneficial to the company, and again would not appear as an increase of productivity.

The fourth reason that should be taken into account would be *"Mismanagement"*. Managers and decision-makers that are not acting in the best interest of the company could cause a substantial damage. Investment may, in a worst case scenario, end up creating more damage than good. Investments in IT that are made in such manner that they end up showing a negative ROI should not have been invested in, in the first place.

Another risk lies in that the benefits that sprung from IT investments are not fully captured. This may result in benefits that are converted into slack.

> *"In fact, there may be significant social benefits from IT investments that increase consumer welfare but are not captured by the firms making those investments. Therefore, it is of great concern to business and technology executives whether their IT investments are paying off at the level of the firm."* (Dedrick et. al: 2003, p. 7)

In conclusion, when considering the *productivity paradox,* it should be taken into account that the researches conducted in the 1980s were mainly focusing on an aggregated level in the United States. It could therefore be assumed that companies in a market economy would act and invest to their own benefit, rather than to benefit for an aggregated economy as a whole. It should also be mentioned that the advantage that US scientist holds before European is the information that is available to them is larger. This does not imply that that the outcomes from European research are significantly different than what the majority of US are (Dedrick et. al. 2003).

2.1.2 Measuring productivity

"Productivity is the fundamental economic measure of a technology's contribution" (Brynjolfsson: 1993, p. 2). However it might not always be a straight forward task to measure productivity. This is shown in the service sector, mostly due to the measurement of output is difficult. Manufacturing though is easier due to that one factor of the output is easily calculated. But it is not simply the number of output produced but also what the level of quality, the variety and so on. This would imply that measurement of productivity is more acute in the service sector, rather than in manufacturing, due to the characteristics of many of the transactions. This would make it difficult to include in a statistical analysis of the benefits that might sprung from an IT investment (Brynjolfsson 1993). The finding that return on most IT investments come after a time lag of two-to-three years would make the IT value studies difficult, as this time lag between IT investments and the benefit stream could cause divergent results (Brynjolfsson et. al. 1994). Time lag between investment and benefits varies depending to the type of the investment and how well the organisation absorbs the new technology. "Failure to recognise the presence of the time lag can lead to severely distorted investment decisions and under investment in IT infrastructure projects" (Jurison: 1996, p. 265).

In order to get a true overview of an investment, a set of operational indicators would be implemented into the organisation. These so called *"anchor measurements"* are used to measure the benefits that spring from investments. This calls for an organisation that already would be using detailed statistics to overview the day-to-day business. Furthermore it should be argued that these are companies that are more likely to be looking at implementing an investment evaluation measurement, but it does not mean that other companies, with less hierarchal structure of reporting, should neglect measuring productivity. Decision makers need to find how an investment would benefit the company and go through the decision making process evaluating alternatives as to what it would be worth investing in IT as to solve or prevent an issue, or to increase productivity. The investor should also do a thorough research of what benefits might spring from an investment in IT. As mention earlier, some benefits are difficult to capture and to get a higher ROI, the proper benchmarking and simulation of the scenario should be done. The benefits are simply not concentrated on one group of stakeholders. An

example might be the Automatic Teller Machine (ATM), which allows bank customers more flexible banking. Fewer checks would be used to complete transactions, however, some banking used check-processing as a measurement of the productivity. This led to that some banks were presenting information that stated a decrease of business when ATMs were introduced. This would have been avoided if the connection between the ATM and the productivity measurements were made earlier (Brynjolfsson, 1993). This would also imply that the measurements should not be static, as introduction of new technology seldom comes without additional benefits that sometimes are overseen. Jurison (1996) warned for evaluations based solely on standard financial measurements. He argued that they would likely understate the full value of IT and therefore lead to poor investment decisions. He continues to argue the importance of recognising that the pitfalls of highly effective areas create slack in other areas. In other words would an implementation of a new IT tool transfer effectiveness and productivity from one area, to another. Information must therefore be shared to avoid these situations.

2.2 Coordination

Coordination is necessary for a given level of firm output. Therefore would a higher level of coordination lead to an increase of a firm's output (Shin, 1997). Using IT as a tool for reducing coordination cost and improving coordination would reduce the firm's cost. The coordination costs refer to all of the information processing costs necessary to integrate the various activities of separate units of an organisation, and between separate organisations. These costs exist within the organisation as consist of acquiring and processing information for decision-making, accounting, planning, monitoring and control processes. Costs that occur in a market include the costs of searching and selecting suppliers, negotiating and enforcing contracts.

A broad definition of "coordination" means, "*the harmonious functioning of parts for effective results"* [Merriam-Webster Online Dictionary]. When breaking down that definition, there are four different components, goals (results), activities (functions), actors (parts), and interdependencies (harmonious). These four parts are all important when it comes to achieving efficient coordination. The basis of coordination could then be described in four components and respective associated coordination process:

1. Identifying goals – Document the optimal desired future state.
2. Identifying activities – Find what needs to be done in order to reach the optimal solution.
3. Identifying actors – Who will be working with the identified activities, and what activities will be assigned to who.
4. Identifying mutual dependencies – Making the different parts reach the goal state harmoniously.

When investing in IT, it must be made sure that systems are able to work harmoniously. Computer science does not deal primarily with people, but different computational processes must certainly "work together harmoniously", and certain kinds of interactions among computational processes resemble interactions among people (Malone et. al. 1990).

In coordination theory, the common problems have to do with coordination: How can overall goals be subdivided into actions? How can actions be assigned to groups or to

individual actors? How can resources be allocated among different actors? How can information be shared among different actors to help achieve the overall goals?

IT used as a reducer for coordination costs has three effects. Malone et. al. (1987) describes these as the *communication, brokerage and integration effect of IT*. In conclusion would IT enable more information to be communicated in the same amount of time or allow the same amount of information to be communicated in less time. Further would the cost of communication decrease, as some repetitive parts are handled by IT. The quality and the alternatives of products that are available would increase, as well as the reduction of inventory, due to the link between the final customers, the supplier, and the producer will work more harmoniously.

2.3 Information Technology investment

In general, an investment is made in order to generate something that is of higher value to the investor than the initial cost. The investment cost might be measured in time, money, or other metrics that are applicable to the situation. An investment would rarely lead to an immediate return. This has to be taken into account in the decision making process. When investing in IT, studies show that when investments of this sort are accompanied with restructuring in the organisation, the return occur faster (Brynjolfsson et. al. 2003). IT investments benefits can be divided into two parts: those that are unique to a particular firm and those that appear due to variation in spending across firms. A variety of case evidence as well as a direct survey of managers conducted by Brynjolfsson et. al. (2003) suggest that the provision of intangible outputs such as quality, convenience, variety or timeliness represent major reasons for investing in IT. Therefore when a problem area has been defined, and the use of IT is decided to be invested in in order to solve the problem and to reach a desired state, the management first has to decide clearly what the purpose of the IT investment is, secondly, who the stakeholders are and who will benefit from the investment and what their objectives consist of. When these two questions have been answered, the company should develop operational anchor measures for assessing the value to all relevant stakeholders. The next step is to overlook existing procedures and make the necessary changes for the investment to develop the desired return faster. This is also a factor that plays a significant role in calculating the risk that always comes with investments, no matter how small they might be. Lastly companies should manage both the cost and benefit side of the IT equation, making sure that the stakeholder's interest are being properly managed, with for example incentives (Jurison, 1996). When considering the end users, if this group only see costs of the new system (e.g. the need to learn new skills, potential loss of jobs, and so on) without any apparent benefits to them, they are likely to resist the new system, and with the indirect power that the end user has when it comes to utilising the systems it is important that these are also considered in the implementation.

> "*Implementation problems arise from situations where the benefit from new technology accrued to the organization and not to the individuals who were to use the system"* (Jurison: 1996, p. 271)

In order to get the buy-in and agreement to changes that comes with IT investments, some of the returns can be distributed to the stakeholders. This is kind of benefit-distribution is visible in grocery stores that offer customers a "membership card". This card is then presented to the store when the customers do their shopping. In return for the very detailed and specific information that the store would receive regarding the

customers purchases, the customer is then “rewarded” with points that can be used as a discount for the next purchase. Information of this kind would make it possible for companies to analyse process in order to visualise buying pattern of customers. This would enable directed commercial to specific groups, and maybe attract more customers at the bottom line. It would also give customers that voluntarily joined the “membership”, a stronger reason to stay loyal to that specific store, as the more they shop, the more points they would be rewarded with, and the more they save.

2.4 Evaluating information technology Investments

Daniels (1993) argues that two important factors need to be taken into consideration when investing in IT. First, the term or length of the investment and when the return is expected, secondly the inclusion of all tangible and intangible benefits. However an investor that stands before the task of doing an evaluation of the investment must consider a complexity factor. Making the analysis too complex can result in a time demanding and cost consuming process that could lead to a conclusion that is difficult to interpret, however leaving out too many factors would lead to misleading results. It is depending on the nature of the investment a decision on what the analysis should reflect a single or many projects, which the factors included in the analysis, should be based on. (Nievelt, 1999)

Evaluating IT investments should according to Daniels (1993) consist of the following steps:

- *Currency* – the information available is up to date and the data accessible and reliable
- *Content* – this refers to the accuracy
- *Quality* – this term must be defined in context. Quality considerations are concerned with the degree to which the system helps the managers to do his or her job well, or alternatively, inhibit the business process.
- *Flexibility* – the ease of use of the system, the ability to generate changes or *ad hoc* requests, and the business manager’s involvement in the systems process.
- *Importance* – the dependence of the business on the system and the level of security required
- *Scalability* – A judgement of how the system will serve future business needs.

Companies that are only using financial data to evaluate IT investments are likely to understate the true output (Brynjolsson et. al. 2003). There would also lay a risk in underestimating the cost versus the benefit of an IT investment. The investment could become a “black hole” that will pull increasingly more of the company’s resources into it. (Daniels, 1993)

By examining the measurable variations in output among competing firms, investors can indirectly measure the value of intangible performance. Brynjolfsson et. al. (2003) found that firms that invest more heavily in computers than the firm’s competitors should achieve greater levels of intangible benefits. They further conclude that customers will recognise and value these benefits. A wise IT investment will therefore tie customers to the company brand, product, or service tighter than their competitors.

2.5 Trends in Information Technology investments

As IT is going through an exponential development, making the transistors and the distance between them smaller, the technology also get less costly. As companies goes through the acquisition decisions, they have to consider the scalability. Companies should try to answer the question if the investment in IT has the possibility to cover future needs that the company would have to deal with. Gilchrist, Gurbaxani, and Town (2001) see a trend in firms exchanging mainframes and a centralised computer structure, for a decentralised structure of personal computers. This has the effect that computing power is distributed out in the organisation giving the employees the possibility to use more demanding applications that would suit their needs better than a solution based on an overall structure. In addition, Gilchrist et. al. (2001) discover that between 1986 and 1993 US companies on the magazine Fortunes list of a 1000 manufacturing firms increased spending on IT from $4000 to $27000 per worker. This resulted in an average of 1.3% growth per year in productivity. Estimates indicate that expenditures on SW (including maintenance and new development) are 25% less than on HW (Gurbaxani, 2000) and the ratio are constant over time. The exponential price decline in hardware shows that the ratio of the stock of SW to the stock of HW declines exponentially over time (Gurbaxani, 1987).

Jurison (1996) argue that many new systems are no longer introduced for the purpose of improving operation efficiency, but for creating competitive advantage or strategic opportunities in the future. Such benefits derive from improved quality, increased variety of products and services, as well as better and faster customer service with a quicker response to fluctuations in the market. The benefits are therefore either internal, a majority of benefits are accredited to the investor, or external, where the majority of benefits are directed outside the company creating indirect benefit to the investor. It is obvious that systems can be classified as both internal and external at the same time. An example of this might be an order entry and distribution system. Customers would benefit from reduced transaction costs, reduced wholesale prices, reduced inventory holding costs and various value-added management services. The company would benefit from significant cost reduction in order entry, sales, and warehouse operations, leading to improved market share and profitability.

2.6 Organisational Changes

Research show that planned organisational changes will together with IT investment likely show a return faster. IT is then used as a catalyst for the restructuring, making the changes effect faster (Brynjolfsson, 1998). Only by introducing computers to a business does not automatically increase productivity, but it is an essential component of a broader system of organisational changes, which does increase productivity. Brynjolfsson (1998) consider this to be increasingly important to consider these organisational changes as an integral part of the computerisation process. IT is not simply a tool for automating existing processes but is more importantly an enabler of organisational changes that can lead to additional productivity gains. These findings are confirmed by Gilchrist et. al. (2001). They argue that returns in IT investment are correlated with decentralised computing architectures and suggest that the communication and networking of computing throughout the organisation contributes substantially to the payoff. Brynjolfsson et. al. (1998) predicted that firms that invest and hold plenty of technology will be structured in less hierarchical types of organisations. These firms would also tend to distribute the decision-making on highly skilled workers.

It is not sufficient that only the software (SW) is tailor made for a business, but also the organisation has to go throught changes for an IT investment to pay off. When introducing new IT, the people, such as employees, suppliers, and customers, affected by the changes need to get rid of their old habits that come from old ingrained procedures. Technology and new tools should be made as to enable improvement, not just move the same, perhaps ineffective, procedures onto a keyboard and a computer screen. New technology often provides flexibility as an additional benefit, but if the surroundings are static, these benefits will be difficult to capture. It should be argued that if the implementation of a new IT based tool lead to a total restructure of the employees work, this could of course be treated with scepticism from the employees. A problem can simply not be resolved by "computerising" it. A "computerisation" of the problem *together* with the proper reengineering of process, for example, would much more likely lead to a resolution of the problem and increased benefits.

The use of IT can result in benefits in several different segments of a business. IT can be used to automate work, enabling the users to complete their tasks in a faster and more accurate way. For example, a cashier use and EAN-scanner to register customer's purchasers. In this way the cashier will be able to complete it's task faster. As EAN codes are specific to the product the stores manager will get a more detailed view of what has been sold, enabling him or her to optimise the stores stock level. Benefits are also in this example visible outside the business, as the customer would benefit from less queue time, provided that the cashier has got the proper training for the new tools and are able to fully utilise them. This in its turn would then give the business a better market position, provided that the business is somewhat alone with this new technology.

A company that is able to combine management methodologies together with IT investments more often result in higher success rate and shows higher ROI than others that are overlooking this possibilities to structure and organise the company. It has been found through large empirical studies that companies with traditional centralised organisations doing large investments in IT often do worse than companies with similar organisational structures that invest less in IT. However it is not advised that these kinds of companies restructure and implement a decentralised organisational structure due to possible characteristics of the companies that make these restructuring unwise (Dedrick et. al. 2003). Furthermore, Loveman (1994) did not find evidence that IT investments leads to an increase in productivity, and argued that management fails to effectively integrate IT with the firm's business strategy, human recourse management strategy, and efficient resource allocation. I.e. management did not implement changes that should accompany IT investment in order to create value. Jurison (1996, p. 264) saw this issue and promptly stated that *"IT benefits depend to a large degree not on the size of the investment, but on management effectiveness in converting the investment into business results. Organizations differ vastly in their conversion effectiveness."*

Daniels (1993) highlighted this as well, urging companies that invest in IT to look after the usability of the system, so that complexity do not interfere with the users adopting a new tool and in some cases a new processes that should be implemented along with it. Further should the increased technology skills that sprung from the a new IT investment be captured in order to be reused, as similar investments might take place in the future and the experience that has been gained is used in order to not repeat mistakes done in previous projects. The informational flow that is created should also be made available to

other employees in the network, thus creating a knowledge sharing throughout the organisation. This flow would then lead to enhances in the corporate culture.

A literature study done by Dedrick et. al. (2003) concluded that several empirical studies found IT investments to contribute to a firm's productivity, and show higher gross marginal returns than non-IT investments. The fact that these researchers found a strong relationship between IT capital and productivity that was not evident in earlier studies may partly reflect the fact that the data was more recent, that levels of IT investment had increased, making it easier to distinguish its contribution, and that over time firms were learning to apply IT capital more efficiently. They may also simply reflect better data sets and analytical tools that make it possible to isolate and measure the true impacts of IT investment.

Most of the studies found that IT investment were associated with higher marginal product than other capital investments. These are translated into "excess returns" by some authors, who pointed out that, in theory, all investments should pay the same risk adjusted return of the margin. These returns do need to be adjusted to account for the high rates of obsolesce of IT capital so that the net returns are much lower.

Brynjolfsson & Hitt (1996) found that after subtracting standard estimates of the cost associated with the obsolesce of IT capital of up to 42% per year from IT the gross net returns from IT were still higher than those of non-IT investments. With this in mind Dedrick et. al. draws the conclusion that firms sometimes are systematically under-investing in IT, given the high marginal returns to such investments. However in order to get a true figure of the investments all of the spenditure has to be included in the formula including, except for the HW also, SW, education, consultancy and services.

One example to this is the significant productivity improvement of electric motors that did not emerge until almost 40 years after their introduction to factories. When engines where exchanged for electrical engines, no specific redesign in work process where made. Thus making no specific contribution to productivity growth. The breakthrough came first after engineers realised that the layout of the production floor could instead be fit so that the machines, now powered with smaller electrical engines - instead of one big steam engine powering them all - could be arranged in accordance with the logic of work flow, instead of the proximity to the central power unit. (David 1990)

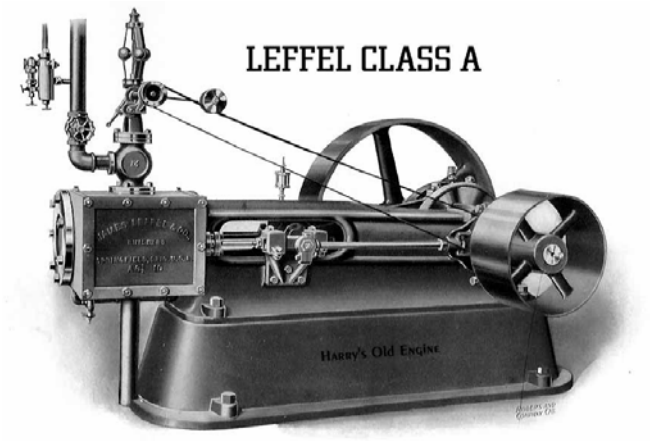

Fig. 2.1 Typical massive steam engine. [Harry's Old Engine]

2.7 Profits from Information Technology

Brynjolfsson & Hitt (1996) argue that many of the profits that sprung from IT investments end up at the customer as a form of better service or lower prices for example. These are regarded as social benefits. It is important for the companies that most of these benefits are captured. By not doing so would make the investments return part hidden or non visible. A survey conducted by Economist Intelligence unit (1999) indicates that only about 50% of business executives use some kind of benchmarking to evaluate what effect IT projects would have. Even fewer evaluate projects after implementation. Kraemer et. al. (2001) try to explain this as there lays a difficulty in measuring IT returns and therefore are IT spending often treated as a budget item rather than an investment.

Roadmap to IT investment success (Kraemer et. al. 2001):

- *IT investments should be aligned with the business strategy* – A company's IT manager must be aware of what the strategic goals of the company consist of in order to make the appropriate IT investments to enable these goals.
- *Decentralising the organisation* – By decentralising the company internally and encouraging strong links to external suppliers, customers, and business partners, the company would gain a flexibility and responsiveness to a dynamic market. In addition it would allow companies to maintain their attention on core strategic functions while leveraging the capabilities of business partners for other activities.
- *Decentralised IT organisations coordinated by a strong IT manager* – In a decentralised structure, the different sections should be given the ability to choose applications relevant to their own operations.
- *Process redesign mandatory with IT implementation* – Returns occur faster, and benefits are made more visible to stakeholders.
- *Compare results* – The company should investigate whether the investments are corresponding to the needs. Comparison should be made both on other companies and internally.

Returns on IT investment might be similar to non-IT investments. However considering the risk that is involved in IT investment, due to the higher factor of obsolesces, firms invest when the net return is sufficient to cover the risk adjusted cost of capital, an investment must then provide higher returns in order to compensate for the additional risk involved considering risk strategy management (Ropponen, 1999). Moreover there might be adjustments costs. It is difficult and costly for firms to introduce new IT innovations. With the decreasing price for IT, the optimal level of IT investment and capital stock increases in steady state. However firms face real costs and delays due to the duration of SW development, retirement of old systems, and changes in practices that suggest that firms might not achieve these optimal levels in the short run. It is therefore difficult to conclude that the "excess returns" found in firm level studies imply that firms are systematically under-investing in IT, or that managers are acting irrationally. Some systems will realize immediate payoffs while others will realize payoffs after a lag.

The impact of IT on the business can be difficult to predict or track. One major problem is managing business IT comes from the fact that most managers today are function-oriented. Managers are essentially specialists in their own areas. The strategic benefits of IT however are often process-oriented, running across functions. For example, by making

customer service information available to product designers, companies can more accurately design products to anticipate their customers desires. (Daniels 1993)

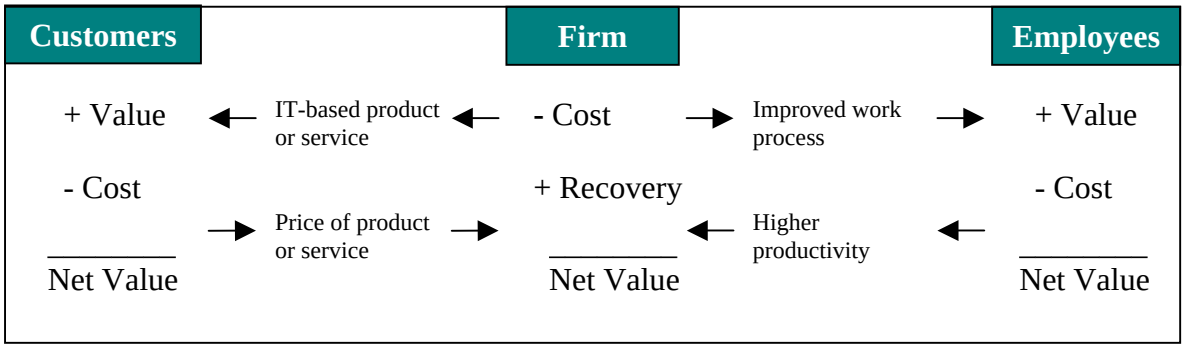

Fig. 2.2 Stakeholder based information technology value model (Jurison 1996).

Taking the assumption that an IT investment is made in order to create values, both tangible and intangible, the values are likely to be distributed over the stakeholders. The employees would be given the possibility to reduce their time spent on re-work and repetitive task that are often seemed as uninteresting and perhaps dull. However, should the prime reason for investing be to recover some of the value, in order to earn sufficient return on the investment. This can be accomplished through cost displacement (performing the same work with fewer employees) or cost avoidance (performing more work with the same number of employees) (Jurison 1996). A shift in values and cost within and outside a firm is illustrated in *Fig. 2.2*.

> *"It is important to note that for a firm to receive the expected payoff from its investment, the system must first create sufficient benefits that can be recovered in the bottom line"* (Jurison: 1996, p. 269)

3 Basics of Return of Investment

3.1 Introduction

Return on investment is often used in order to calculate whether an investment is paying off or not. If the value that appears from the calculations is negative the investment is undesirable and would use more resources than it would produce.

The returns are usually divided in “hard-” or “soft returns”. Hard returns are easy to calculate, while there lies more of a challenge to calculate soft returns. Soft returns are usually intangible assets. Based on information collected during the interview, *fig 3.1* shows how a grade of returns could be listed.

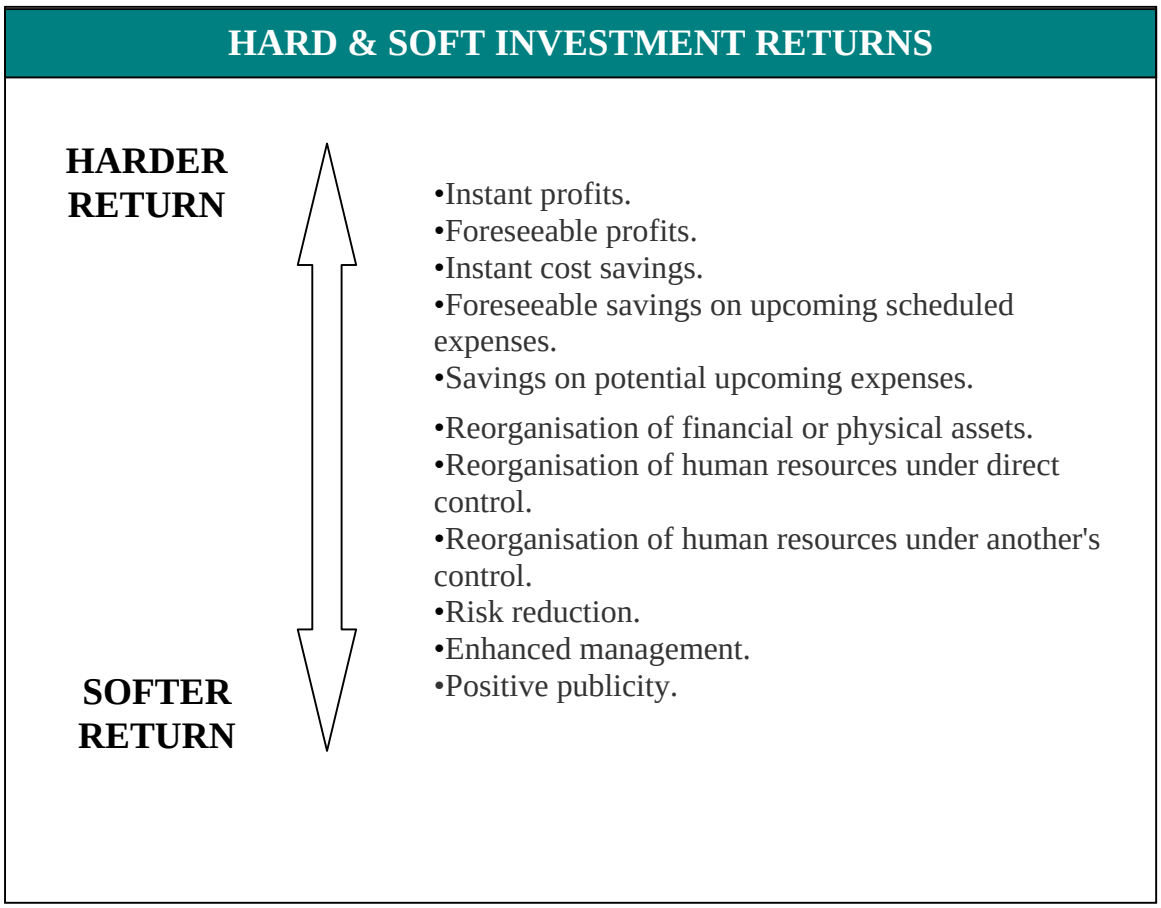

Fig. 3.1 Hard & Soft Investment Returns. [Interview]

3.2 Return on Investment

Return on Investment indicator (ROI) conveys gain (capital remuneration) against total investment as a ratio. The Return of Investment indicator measures the productivity of an investment. The latter affirmation can be explained and demonstrated by a detailing process that starts from a company’s productivity concept.
A company’s productivity is the ratio between the total output and the total inputs, the total inputs being the external resources and the internal resources used by the company

to make its activity work and the total output being the value of the production (see *Fig. 3.2).*

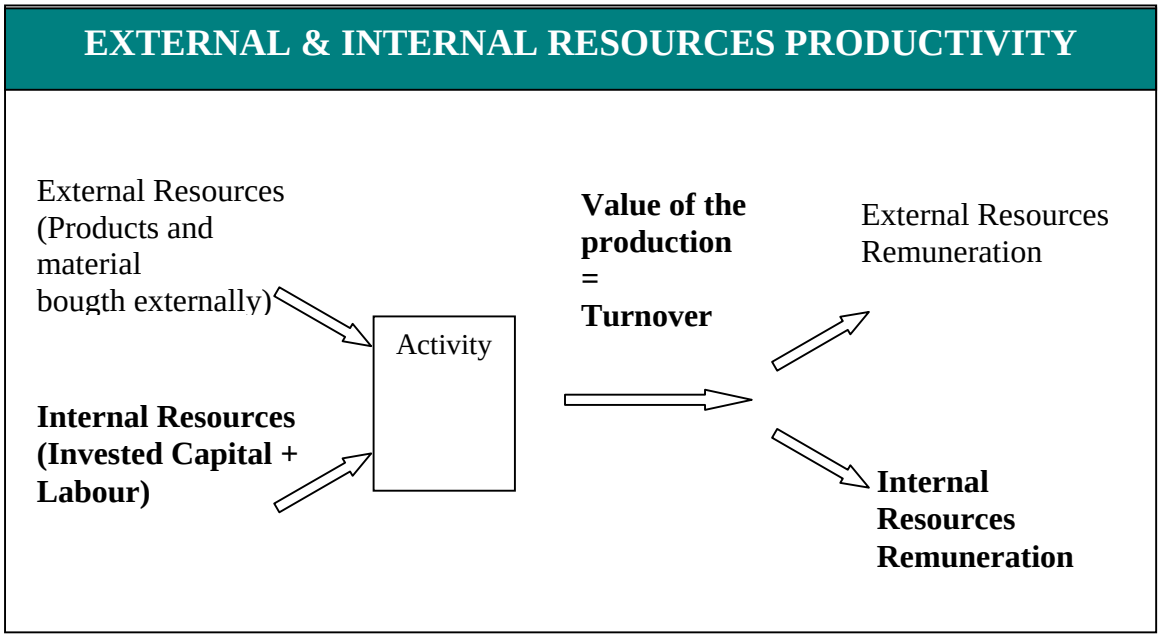

Fig. 3.2 External & Internal Resources Productivity.

Detailing the bottom part of the scheme shown in *Fig. 3.2* (and not considering the capacity of the company of buying externally) it is possible to describe the internal resources productivity (see *Fig. 3.3).*

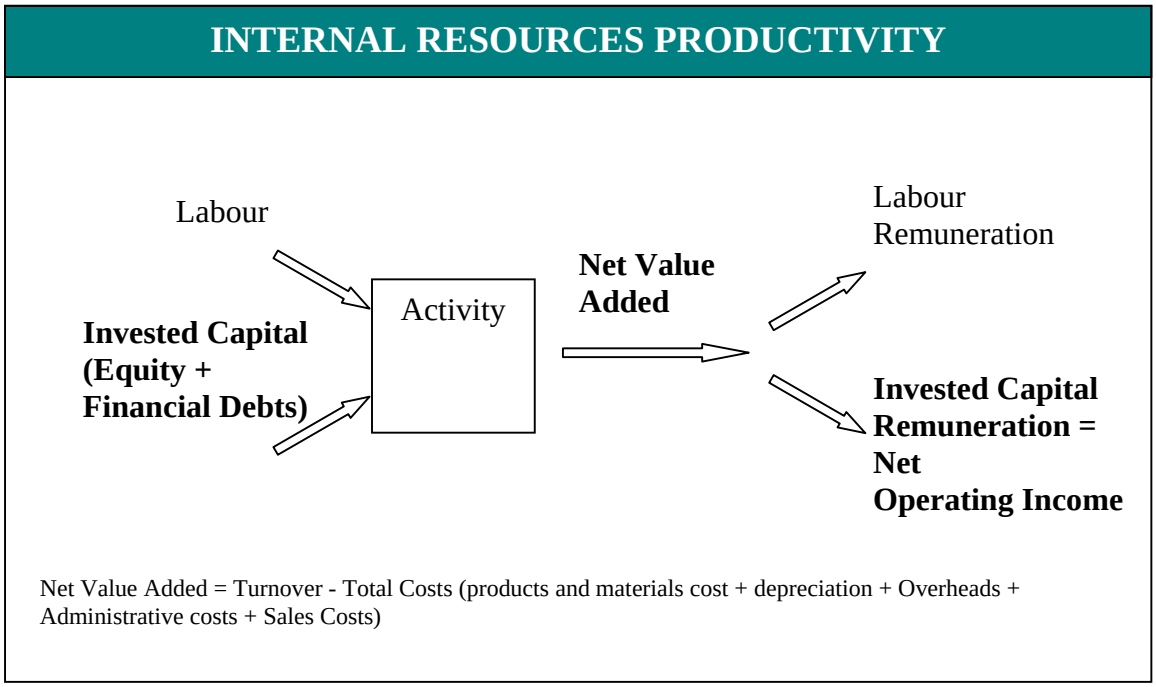

Fig. 3.3 Internal Resources Productivity.

Detailing the bottom part of the scheme shown in *Fig. 3.3* (and not considering the capacity of the company of paying for the workers labour) it is possible to describe the invested capital productivity (see *Fig. 3.4*). The investment's productivity is the ratio

between the output “Net Operating Income” and the input “Invested Capital”, the invested capital being the equity and the financial debts used to make the investment.

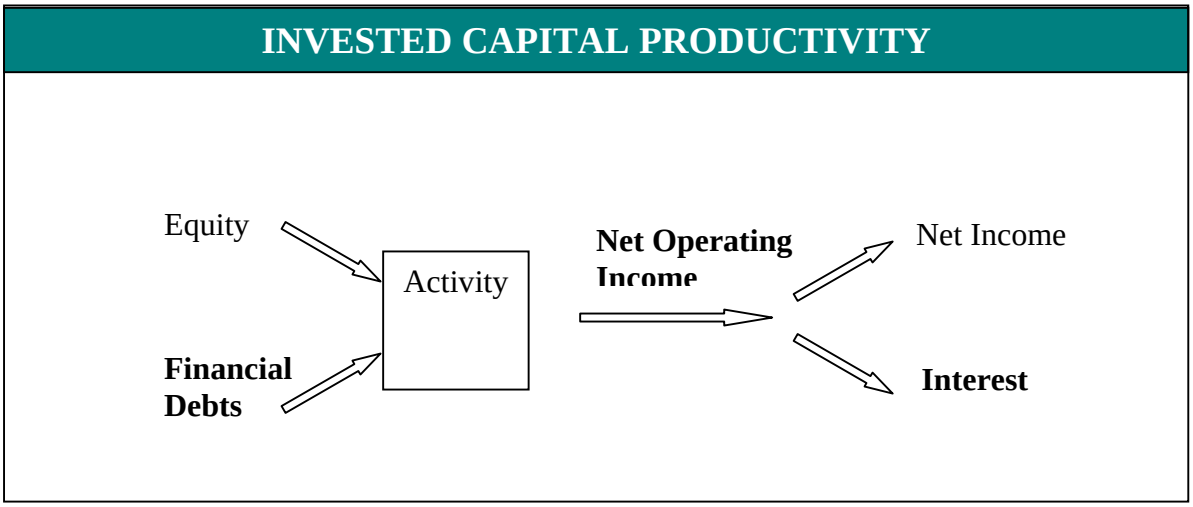

Fig. 3.4 Invested Capital Productivity.

As Return on Investment indicator (ROI) conveys gain (capital remuneration) against total investment as a ratio, through the process above described we have obtained that ROI measures the productivity of an investment. The ROI formula is described in *Fig 3.5.*

RETURN ON INVESTMENT

$$ROI = \frac{\text{Capital Remuneration}}{\text{Invested Capital}} = \frac{\text{Net Operating Income}}{\text{(Equity + Financial Debts to do the investment)}}$$

Fig. 3.5 Return On Investment.

In terms of finance ROI is one of the most important indicators. It clearly indicates how well money is used. ROI also helps determine whether it is wise to invest in a project or in something else.

3.3 Payback Period

In everyday life it is easy to calculate the payback period. For example, if one person would buy a weekly bus ticket for $4 instead of a daily ticket for $1, the person would start saving money when he travels more than four days in the same week. This example evaluates by how long it would take to achieve a cost saving.
When it comes to IT investments this is a factor that will be measured in usually a time unit. Payback period is therefore a key measurement of risk calculations. The shorter the period, the better. This becomes important as technology changes rapidly.

3.4 Internal Rate of Return (IRR)

Internal Rate of Return (IRR) is often used in order to decide in which alternative to invest in. Using IRR involves calculating an investments expected return and can be used to compare different investment alternatives. The choice might stand between investing in a machine and simply investing the money in a bank account that in return gives an interest on the money. A comparison is done by calculation the IRR factor between different alternatives using a discount factor. Should only one alternative exist, it is usually compared to the bank account. The outcome of the calculation should equal zero and therefore the better of the alternatives is then likely to be invested in. There is no one perfect discount factor, and therefore different companies use different discount factors as they believe fit their organisation and investment tactic best.

3.5 Total Cost of Ownership (TCO)

TCO is a metric often used by companies when they want to evaluate the running costs of equipment. TCO is the total cost of owning a particular item over some time horizon and includes both the acquisition cost and the total cost per year. The costs are divided in hard and soft costs. Hard costs are costs that are direct, tangible, obvious and easily accounted. Soft costs are indirect, intangible, not so obvious and often overlooked in budgets because they do not occur at acquisition time. Soft costs often lead to unforeseen increase or worse, and a shift of management and sustained responsibility to end-users. A three-year or five-year period is used in some cases to show the TCO against depreciation of the equipment. When ROI is calculated on IT investments, TCO as a metric has a significant role. As any metric TCO has strength and weaknesses. These need to be understood if it would be used to show the status of a project by its own. Companies that use TCO solely, end up minimising the costs rather than maximising the return for the company. These companies are ensuring they purchase the least costly application, but they are rarely choosing the application that provides the greatest impact for the bottom line.

3.5.1 Calculating TCO

In order to calculate how much the TCO will be, a fairly straightforward method is used. By adding up the expenses, including the cost of acquiring the technology (or non-technology) the cost of the investment is shown. With the high depreciation on IT equipment, it is usually calculated over a three year period and this is done in order to get a full understanding of the ongoing costs. The main costs include acquisition costs, control costs and operation costs. Cost factors of acquisition costs are hardware and software. Centralisation and standardisation are cost factors for control costs. Cost factors for operating costs include support, evaluation, installation/upgrade, training, downtime, auditing and documentation of the technologies. In some cases the rent of space that the equipment physically would take up is also taken into calculation in order to give a more detailed view.

TCO as a metric shows the cost without explaining how the cost is being divided. One example might be that a product with a low initial acquisition cost that requires a high maintenance cost is likely to be less attractive than one with higher acquisition and lower operating costs could have similar TCO over the period analysed. Therefore there lies an issue with TCO if it is used alone; it provides only the information about cost of a system, and by that ignores the benefits that may spring from an IT investment. The principle for a business should be to choose the IT solution that provides the greatest benefit or return

for the company, not to choose the less costly alternative. However, the absolute optimal would be if these two were combined.

	PRODUCT COMPARISON	IT BUDGETING	FOCUS
TCO	**POOR** Highlights only the lowest cost solution	**BEST** Accurate indicator of future expences	Very quantifiable metric for the cost conscious
ROI	**BEST** Provides an accurate balance of cost versus return	**POOR** Little indication of actual expenses per year	Tries to indicate the best solution for the corporate bottom line
Payback Period	**GOOD** Best indicator of a risk associated with an application	**POOR** As a derivative of the ROI calculation it does not show expenses	Used with ROI it can help assure maximum flexibility and return

Tab. 3.1 Comparison between TCO, ROI and Payback Indicators. [Interview]

3.6 Time Saving Times Salary

Another theory that deals with collecting the productivity that is generated from new technology and organisational changes is Time Saving Times Salary (TSTS). This approach considers the value of an office information system as a percentage of a worker's time saved by the system multiplied with the worker's loaded salary. This approach is considered to be intuitively plausible and simple to compute. In 1987 TSTS was probably the most frequently used office system justification methodology. However, according to Peter G. Sassone (1987), TSTS it has some down sides, for example assuming that a worker's loaded salary is the measure of that worker's value to the organisation, further it states that loaded salary multiplied by percentage time savings measures benefits. When using TSTS, one has to take into account that the benefits are automatic, which in some cases is not correct. The saved time that comes with an investment might be wasted on non-work related activities and not necessarily spent on doing critical work; moreover TSTS does not take into account that a value of the system might be low or high depending on how the organisation is managed.

3.7 Critical Factors in a ROITI calculation

3.7.1 People

As companies invest in new IT, education is certainly going to be an expense. Whether it is done in-house or externally, the users and the people managing the investment need to develop skills in order to fully utilise and reap the benefits of the new system. As people will spend time on getting the relevant skills, which result in the main duties are being put aside.

One example might be that 10 people would have to receive training for one week; this training could cost $1400 per person in tuition and travel costs. The total cost would not only be $14000, the business would loose 400 hours of work time and 400 hours of personnel costs. At a rate of $35 per hour, this would result in $14 000 of cost for the business. All together the cost would be $28000. Unless this investment returns $28000,

or enables to 10 persons to be productive enough to make up two weeks of work to pay for the training, justifying the training can become difficult.

Apart from the cost of training and the lost work time, time needs to be invested on overcoming possible resistance to change. This investment has to be considered into the calculation of ROI. In order to do this at the most effective way it has to be done proactively, rather than reactively. Managers need to be trained to facilitate meetings, analyze procedures, communicate effectively, and solicit the feedback from all stakeholders to build trust and confidence in the change process. The most common stakeholders are customers, engineers, product marketers, and people in operations and service, and, of course, senior management.

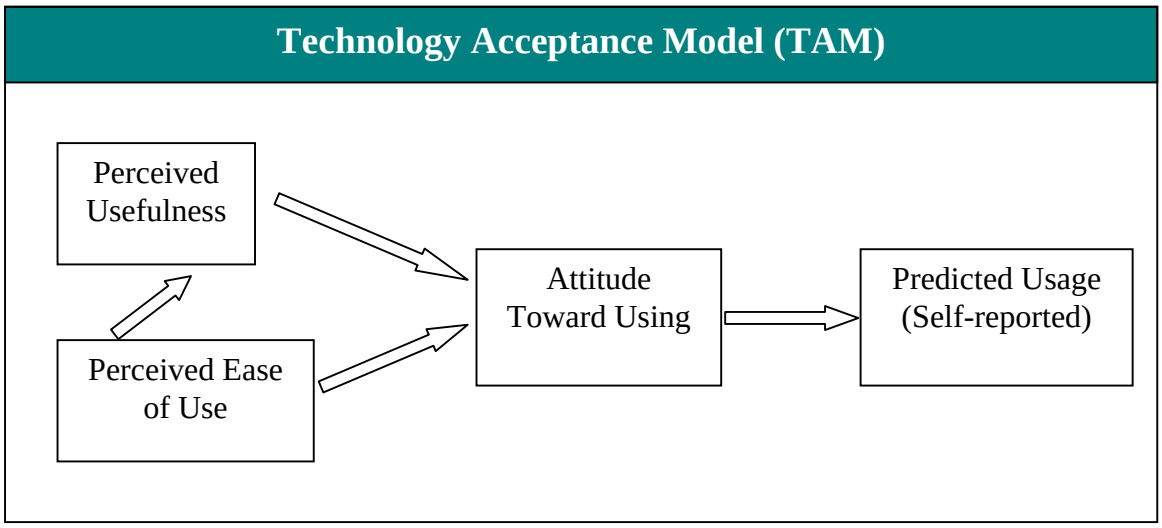

Fig. 3.6 Technology Acceptance Model (Hodgson & Aiken 1998).

Changes occur when an organisation replace something established in favour of something new. Changes are often problematic in large complex organisations due to the large number of components within the organisational system, and because of the need to interact in business environments, which are constantly changing themselves. The inevitability of change and its complexity explain why change management is an important challenge for all organisations. This is illustrated in *Fig 3.6*

There are three different "causal structures" associated with technological change:

- The technological imperative.
- The organisational imperative.
- The emergent perspective.

In the technological imperative, the development of new technologies initiates change in the organisation as a response to competitive forces or opportunities. The technological imperative threats Information Systems (IS) as an independent variable that impacts the behaviour of organisations and the people in them. These changes in technology occur first, which then "drives" organisations to make changes to utilise the technology to their best advantage.

In the organisational imperative, organisations need to initiate changes in technology, rather than the other way around. It recognises that people, in the organisation, design

information systems to satisfy organisational needs for information. In this perspective, IT is the dependent variable and the focus is on identifying determinants of IT use. With an organisational imperative, the organisation recognises the need for the change before there is an IS or technology to facilitate it. These changes generally cannot happen effectively without first implementing an appropriate IS technology.

The emergent perspective proposes that not all changes are either technology or organisational driven. Instead, there can be a complex interaction between IS and people from which changes naturally emerge. As businesses deal with day-to-day events, smaller changes create an evaluation in both IS and business practices.

3.7.2 Processes

IT projects needs a clearly defined focus on results in order to make a ROI calculation accurate. If this is not done the calculation would either under-deliver or over-promise. A tighter control will also enables a better view of where a project is going, giving a better predictability and offer higher precision if a simulation is was done before and during the project.

Among the many different schools of applying business processes, the Six Sigma, invented by Motorola in the late 1980s and Business Process Management (BPM), are worth mentioning.

3.7.2.1 Six Sigma

Six Sigma is a method of designing efficient business processes that run as error-free as possible. It measures how many defects are inherent in a process so that they can be systematically targeted and eliminated to get as close to zero defects as possible. Adapting this consists of four steps [Motorola]:

1. *Align* – The senior executives put strategic goals, metrics and initiatives to identify the improvement points that will have the most effect on the organisation's bottom line on a balanced scorecard. See *fig. 3.7*.

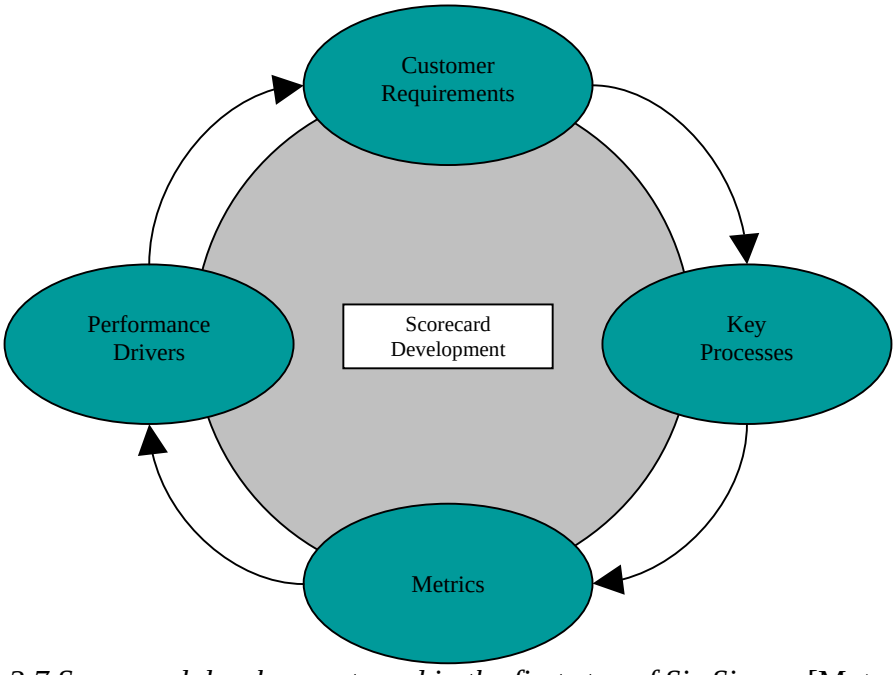

Fig. 3.7 Scorecard development used in the first step of Six Sigma. [Motorola]

2. *Mobilise* – Project teams are formed and tasks are sequenced. Problem solving techniques are based on a process called *DMAIC:*

    - *Define opportunity* – encapsulate the problem to determine what needs to be improved. In this phase, a problem statement, a goal statement, constraints assumptions, and a project plan is documented.

    - *Measure performance* – compare the current state against the wanted state. Going deeper into the problem and trying to answer why it exist bring a more detailed understanding of the problem area brought forward.

    - *Analyse opportunity* – by analysing the information that has been acquired from the previous phase, the aim is to confirm why the problem exist.

    - *Improve performance* – based on all the earlier phases a list of actions and methods are documented. If there are different ways to attack the problem, an evaluation is made so that the better of the alternative is chosen and implemented.

    - *Control performance* – the problem area that has been discovered in the *Define*-phase is being monitored in order to ensure that the problem does not reoccur.

3. *Accelerate* – Change is best accomplished in sprints rather than marathons, so "aggressive clock management" is key to driving projects toward the desired results in time to make a difference.

4. *Governance* - Leaders actively and visibly sponsor the key improvement projects required to execute the strategy. Leaders need to share the gained knowledge about improvements among other parts of the organisation so they can benefit from it.

3.7.2.2 Business Process Management

Business Process Management (BPM) is another approach for refining processes in a new IT project. BPM contains workflow but also encompasses several technologies, including integration software, business rules engines, modelling and analytics. Information systems dealing with the definition, administration, customization and evaluation of tasks evolving from business processes as well as from organisational structures are called Business Process Management Systems (BPMS).

Some of these BMPS are based on workflow-based technology, called Workflow Management Systems (WMS). These products have the ability to define and control the workflow in an organisation, transfer data, and integrate legacy information systems, existing programs and program modules with the goal of facilitation transformation to a "professional services" focus.

Dimitris Karagiannis (1995) describes WMS as: “Existing Workflow Management Systems are the first Generation of BPMS and have the ability to delegate business tasks to the right people at the right time using the right information resources. “

When handling complexity in Business process modeling, there are two different approaches. The traditional approach based on analysis and modern approaches based on the idea of synthesis. The initial objective of both approaches is to capture the guidelines and business rules of an enterprise, which administer the way it functions: how a task is processed, which jobs have to be performed, responsibilities and qualifications of actors and so forth. Guidelines and rules of this sort are often general and may be applied to different situations. The differences between the approaches lie in the way information is captured. Traditional approaches consider in advance all possible combinations of conditions as well as all possible exceptions of the enterprise’s guidelines and business rules and these are then represented in a scheme (e.g. Petri nets based models). This leads to a large number of conditional branches resulting in very complex representation models. In order to reduce the complexity, various techniques, such as decomposition, are used. The complexity is not reduced by traditional approaches during the first phase of business process requirements capture, but rather influences the capturing and recording of business process requirements and increases the complexity of the information to be modeled.
The synthesis approach overcomes deficiencies by postponing the analysis and interpretation of business rules and guidelines, to be handled by the system that is to be implemented when a task is initiated. When the task is initiated, when the actual situation is known, all necessary conditions become known by the system. When this is done, a context-sensitive plan is generated which is used for the execution of the task at hand. Dimitris Karagiannis (1995) argues that in this way, the resulting representations become much simpler not because of the use of any composition or decomposition technique but because of the way the requirements are viewed.
The two different approaches are summarized in *Tab. 3.2*

	ANALYSIS APPROACH	SYNTHESIS APPROACH
Phase 1: BP Requirements Capture	Inherent in the way of thinking & reflected in capturing process	Dealing with complexity is in their philosophy
Phase 2: BP Requirements Modeling	Handled with decomposition techniques, etc.	Remains low by using appropriate representation schemes

Tab. 3.2 Analysis and Synthesis Approaches to Business Process (Karagiannis 1995).

3.7.3 Technologies

In addition to the direct cost of acquiring IT technology there are four other costs that should be included under this subject.

- Maintaining legacy systems. According to research, some 70% to 80% of the IT budget has to be allocated to service old systems.
- Enterprise application integration: When new information systems is introduced as a complementary to older, there lies a cost in making these communicate with each other, provided that the systems are not stand-alone.
- Infrastructure: In order for a business to utilise an IT investment, a share of the budget has to go to the maintenance and further development of architectural measures. By not doing so it could endanger support of current technology foundation and restrain growth of future business.
- Competitive measures: Research and development, cost and price benchmarking measures and other items that help companies stay competitive must be included.
- Differentiating measures: ROI must also include costs for features that make a company's offer unique to their customers and create brand loyalty.

3.7.4 Data integrity and data quality

The quality of data is of great importance to a business. Data and information is used to base strategic decisions on that will take the business to new heights. Using bad data will lead to failure of IT projects, wasted investments, and unhappy investors. As today businesses and companies merge and create new subsidiaries, the information that is generated as well as the information that has to be merged in order to make the new companies work are under the risk of being duplicate on one hand and incomplete on the other. Leaving out these factors in a ROI calculation could lead to a misjudgement of the investment. Most IT projects will have an impact on data and a project that takes this into account with some sort of data quality policy.

The concerns are many when it comes to the data quality. Data has to be consistent with the environment. Should this be ignored, the data is not trustworthy and will result in incorrect decisions based on this data. Should the data is be unavailable when needed this could result in wasted time, which in its turn leads to monetary loss. Further it is of importance that data is secure and private, meaning that it is protected against hardware failure, as well as being protected against theft. Redundant data should be considered so it does not overlap other data. Organisations that are storing data and information decentralised are most likely to be using the same information for different purposes in different departments. Importance lies in being able to share this information and to use it without creating inconsistency, complexness, volatility, or simply loss of information and data. IT projects should therefore contain the following elements when dealing with data and information; match, link and remove duplicate entries; clean and normalise; share and update; integrate and make accessible; fill and extend. (Magoulas & Pessi, 1998)

3.8 Metrics

When assessing the return of an IT project it can help justifying the project by calculating a ROI indicator. Along with the ROI indicator, relevant and consistent metrics can be used in order to measure how the IT project fits into the company's overall business, to understand how to obtain from technology implementation the greatest return across the company and to tie the performance of the technology to the performance of the overall business. IT metrics can be useful tools to help a company aligning investments in IT with the business goals and the company strategy.

Below described are 6 examples of metrics that has been developed by *Gartner Inc., The Alexander Group, Cisco Systems, Patricia Seybold Group, NetGenesis, Harte-Hanks Inc., MIT Sloan School of Management*. These metrics can be used to evaluate technology implementation in terms of IT return for the whole company business, IT efficiency and IT innovation.

An important factor to be considered when using IT metrics is that, as each company is different from the other, not all IT metrics apply and not all have significance. The below described metrics can be used as a base for finding other, and if necessary be re-designed to capture the specific element of a company.

IT RETURN METRICS

Metric 1: Percentage of Revenue-related IT Projects.
Definition: The percentage of IT projects, begun and completed within the past five years, which were critical components of the new products or services that are producing revenue. For example, the IT project that contributed to the creation of a Web storefront that generates sales.

Example:

METRIC 1: Percentage of Revenue-related IT Projects
$\frac{\textit{(Number of revenue related IT projects)* 100}}{\textit{Number of IT Project}}$

Significance: How IT has contributed to the business' financial success.

Metric 2: Payoff of IT Amount.
Definition: The ratio of the amount of money spent on the IT projects that were critical components of new revenue-producing products or services, to the revenue amount received to date from those products/services.

Example:

METRIC 2: Payoff of IT Amount
$\frac{\textit{Amount spent on revenue related IT projects}}{\textit{Amount generated by parent projects}}$

Significance: The payoff of discretionary IT funds. Tracks the efficient use of IT spenditures; a lower ratio is better.

Metric 3: Knowledge Management Payoff.
A: Employee Suggestion Payoff
Definition: The payoff of IT support of employee suggestions. Divide the annual revenue or cost savings generated by employee suggestions by the number of employee suggestions; divide this number by the annual IT costs used to support the employee suggestion system (which might be e-mail, an intranet site, the telephone, a database and so forth).

Example:

METRIC 3-A: Employee Suggestion Payoff
Amount saved or created by employee suggestions
(N.° of employees)(Costs of IT to support employee-suggestion system)*

B: **Patent Payoff**
Definition: The payoff of IT support of company innovation. Determine revenue of products or services that are protected by patents; divide by the number of patents involved. Divide again by the annual cost of the IT employed to serve the company's research and development efforts.

Example:

METRIC 3-B: Patent Payoff
Amount generated by patented products and services
(N.° of patents)(Cost of IT to support R&D department)*

Significance: The return on IT assistance in the creating of new knowledge that generates products or services or saves money.

IT EFFICIENCY METRICS

Metric 4: Technology Core Business Spending.
Definition: The amount of technology spending versus the main unit of work, or type of transaction, in a given line of business. In the package delivery business, for example, divide the number of packages delivered by the amount spent on IT for those divisions and projects related to package delivery; in the auto business use the number of cars produced and so forth.

Example:

METRIC 4: Technology Core Business Spending
$$\frac{\textit{Units of work}}{\textit{Amount spent on IT}}$$

Significance: Judging spending against the main way of a company's product or service is consumed by its customers shows the effectiveness and efficiency in which IT is being applied. If the percentage is in decline, the company is getting more efficient.

Metric 5: IT Productivity Support Metric.
Definition: The productivity of IT in supporting the main unit of work in a particular line of business. Divide the units of work by the number of employees; divide again by the IT spending (including training) related to that line of business

Example:

METRIC 5: IT Productivity Support Metric
$$\frac{\textit{(Units of work)}}{\textit{(N.° of employees)*(Amount of IT spending related to units of work)}}$$

Significance: This tracks the ability to support overall productive operations of a company. A lager number is better: If the output is more packages, with fewer employees and less technology spending, this trend is preferred.

IT INNOVATION METRICS

Metric 6: IT Based Product Launch Ratio.
Definition: The percentage of product or service launches planned for the upcoming 24 months in which IT is a key component of the offering. (The personalisation software in a new targeted marketing campaign on a Web site, for example)

Example:

METRIC 6: IT Based Product Launch Ratio
$$\frac{\textit{(Number of IT based product launches)* 100}}{\textit{Total number of product launches}}$$

Significance: Shows the focus of the IT department on ensuring near term success of the company in the marketplace.

4 Empirical Discussion

When developing a framework, the question that arises is how the process should be illustrated in the best possible way. I chose to use a pragmatic approach by developing the Return On Information Technology Investment framework (ROITI) in parallel with using the data that has been collected from the case study. The process on how to apply the developed framework will be shown as well as the framework through the analysis of the ROITI for a real case IT system investment of a company working in the transport sector.

4.1 Case presentation

The company is a railway undertaking based in Italy dedicated to the international transport of goods by rail. It was amongst the first railway company to exploit the opportunities resulting from the rail transport liberalisation in Italy and soon imposed itself as a competitive partner of quality in the European market. It manages today a consolidated network of traffics from Italy to north European destinations always guaranteeing complete customized services.
Having a series of partnerships with foreign railway operators to introduce new international services in a short time, it can offer a wide and complete range of freight transport services meeting the requirements of different industry and product typologies. It aims to provide customized services from the study of the logistic model and of its feasibility to the concrete realization of the project and the monitoring of the train during the goods transport.

In order to be able to manage an increasing number of traffics, to face up the competitors, to support its growth, to meet ever-increasing and ever more complex customer demands the company knows that it is necessary to have an integrated information system to support all the operations of the company (demand generation, planning, production, customer service and reporting).

After an accurate benchmark activity made to understand the information system state-of-the-art for the railway market, the company has decided for a tailor-made web-based open standard solution that will be able to grow together with the company.

To better understand and verify *a priori* the value of the investment and give to the company a better understanding of the investment that it was going to be undertaken I decided to apply to this real case the theory described in the previous chapters of this essay. With this application I want to test, with real figures taken from a company, the theoretic method and the metrics studied and analyse the factors that need to be taken into account when calculating the ROI of an IT investment.

4.2 Framework development and applying approach

Before calculating the ROI of the IT investment and gather the costs and “benefits” data, I asked the Information Technology manager of the interviewed company some questions in order to understand how the company works in its day by day activity and in order to outline the functional areas and the category of employee the IT system investment will

affect. In fact, understanding what is obtainable at the conclusion of the project is crucial to determine the possible benefits derived from the project and to calculate the estimated income used in the ROI formula. In fact, to analyse how technology fits into the overall vision of where the business is going is the first step of understanding how to implement successfully technology.

The main reasons why the interviewed company decided to develop and implement an integrated tailor-made information system are:

- to be able, for each single type of transport, to plan and plot the most suitable railway route according to the specific needs expressed by the customer;
- to better allocate the production resources and increase its productivity;
- to guarantee the constant monitoring of the goods through the on line track and trace system for 24 hours a day, 7 days a week, and to provide customers with up-to-date information and assistance by monitoring all the various phases of transport, and the state of customer's goods.

The criteria that I used to assess the project and the likelihood of a positive ROI are:

- *Breadth:* The benefits lies in proportion with how widely spread the new tool is.
- *Repeatability:* The more often a new tool is used, the greater the ROI. A higher repeatability would also shorten the time it takes for an investment to show return.
- *Activity Costs:* Activities done manually without technology support is costly, rework that is done by an employee is costly; minimising them would therefore enable a higher ROI.
- *Knowledge:* Information that is reused for other purposes than originally created for could lead to a leveraging of ROI.
- *Communication:* New IT tools that enable better communication and less confusion reduces cost and therefore leverages ROI.

After assessing the objectives of the project and the above mentioned criteria, I started to gather the costs of the investment and to estimate the potential benefits.

4.2.1 Investment Costs for ROI calculation

The cost model used to gather all the costs associated with the project divided the costs between “one-time costs” and “recurring costs”.

One-time costs or Initial Investment Costs. They occur only once during the deployment of the project.
The initial investment costs have been divided into four categories (see *Tab. 4.1 Initial Investment Costs*):

- *Software Cost.* This includes the cost for the development of company’s *ad hoc* application software for planning, production, customer service and data management centre (to gather, manage and store localisation information coming from the satellite devices on board on the train) and all software purchase for the project.
  As the project consists of a tailor made solution, the software cost counts for more than the half of the total investment costs.

- *Hardware Cost.* This includes servers purchased to support the applications, any new desktop systems and upgrade to existing systems, any additional hardware to support databases and connectivity (printers, cables and so on) and the cost of the satellite localisation devices.
  Hardware cost count for a bit less than 10% of the total investment costs.
- *External Services/Consulting Cost.* This includes the outside help for the project, the installation and the testing, the integration with existing applications, the training (external courses), data cleansing and conversion, business re-engineering, customisation, users manual and documentation, travel and expences.
  This cost count for 30% of the total investment costs.
- *Internal Cost.* This includes the cost for the software selection, the project management, the internal training and the support during the roll-out phase.
  Internal cost count for a bit more than 10% of the total investment costs.

ESTIMATED COSTS	
INITIAL INVESTMENT COSTS (One Time)	
Cost Type	**Cost Type Items**
SOFTWARE	Application Software for Planning, Production & Customer Service
	Data Management Center / EDI Software
	Operating System Software
	Database Software
	PC's Client Software
	Adhoc Reporting
	Other Software (Localization Software)
TOT SOFTWARE	**€ 330.000**
HARDWARE	Web Application Servers
	Database Servers
	PC's Clients
	Cables
	Racking
	Printers
	Scanning Devices
	Localization Devices
TOT HARDWARE	**€ 50.000**
EXTERNAL SERVICES/ CONSULTING	Project Management and Consulting
	Installation
	Integration
	Technical Training
	End User Training
	Data Cleansing and Conversion
	Business Re-Engineering
	Modifications and customisations
	Manuals and documentation
	Travel and Expenses
TOT EXT. SERVICES / CONS.	**€ 190.000**
INTERNAL	Software Selection and Benchmarking
	Project Management
	Training
	Support during roll-out
TOT INTERNAL	**€ 65.000**
TOT INITIAL INVESTMENT COSTS	**€ 635.000**

Tab. 4.1 Initial Investment Costs.

Recurring Annual Costs. They are on an on-going bases and occur every year after the project implementation for how long as the software and hardware deployed with the project are used.

The recurring annual costs are (see *Tab. 4.2 Recurring Annual Costs*):

- Software maintenace cost. It has been estimated that the software maintenance costs is per year 10% of the total software investment cost.
- Hardware maintenance cost. It has been estimated that the hardware maintenance costs is per year 15% of the total hardware investment cost. The bigger part of the hardware maintenance software is due to the maintenance of the satellite localization devices.
- Personnel/System administrator cost.
- Housing/Facility.
- Help Desk and Technical Support.

ESTIMATED COSTS	
RECURRING ANNUAL COSTS (On-Going)	
Cost Type	**Amount**
SOFTWARE MAINTENANCE (10% annually of the total software investment cost)	**€ 33.000**
HARDWARE MAINTENANCE (15% annually of the total hardware investment cost)	**€ 7.500**
PERSONNEL/SYSTEM ADMINISTRATOR	**€ 30.000**
HOUSING/FACILITY	**€ 0**
HELP DESK & TECHNICAL SUPPORT	**€ 20.000**
TOT RECURRING ANNUAL COSTS	**€ 90.500**

Tab. 4.2 Recurring Annual Costs.

Technology rarely covers its costs in the first year. However, for the purpose of this business case ROI calculation, it has been assumed that all investment costs occur during the year after the starting date of the project that for simplicity is called “year 0”.

Based on the number of employee working in each work category and based on an average annual fully loaded cost for each employee type, I calculate the annual totals full loaded cost per category of employee (see *Tab. 4.3*). This information is necessary to be able to calculate the benefits deriving from “Increased employee productivity and reduced headcount” (see *Tab. 4.5*).

AVERAGE ANNUAL FULLY LOADED COSTS PER EMPLOYEE CATEGORY			
CATEGORY OF EMPLOYEE		**EMPLOYEE**	**TOTAL FULL LOADED COST PER CATEGORY**
OPERATIONS & SERVICES	**Employee in operations**	20	€ 810.000
	Customer services personnel	3	€ 120.000
	Drivers and station personnel	100	€ 4.700.000
MERKETING & SALES	**Product marketers and sales**	6	€ 320.000
IT	**IT personnel & engineers**	4	€ 210.000
ADMINISTRATION & FINANCE	**Admin. & finance personnel**	7	€ 380.000
SECRETARIAT	**Secretarial Staff**	4	€ 160.000
MANAGEMENT	**Management and senior management**	5	€ 500.000

Tab. 4.3 Average fully loaded costs per employee category.

4.2.2 Investment Benefits for ROI calculation

The method followed to gather the information necessary to calculate the benefits related with the company IT project has been to review the original reasons for entering into the project and the desired outcome of the project. Although these reasons may be both tangible and intangible in nature, they provide a basis for measuring the possible financial benefits deriving from the project.

To measure the benefits, first of all it needs to be considered that there are two types of benefits: direct and indirect.
Direct benefits include items such as decreasing paper or express mail costs, reducing or reassigning staff and so on. These are savings that originate from direct reduction in budget or costs.
Indirect benefits occur when an employee saves time or is more productive thanks to the new IT system. Indirect benefits provide returns not directly measurable and for this reason they are more difficult to be measured.

To calculate the direct benefits I follow the following steps:

- On the basis of the collected information, I value for each benefit the activity affected by the benefit deriving from the project implementation;
- Then, I value each direct benefit by multiplying the annual activity valorisation per the estimated percentage (the benefit factor) by whom the activity will be affected due to the project implementation. As for the benefit factors, the estimate of the

correction factors (see *Tab. 4.5*) has been done together with the IT manager and the controller of the company and has been done as much as possible taking into account the company reality and its specific characteristics.

The measured approach that I used to calculate the indirect benefits related with a change in productivity can be described as follows:

- Based on the number of employee working in each work category and based on an average annual fully loaded cost for each employee type, I calculate the totals annual fully loaded cost per employee category (see *Tab. 4.3 Average fully loaded costs per employee category).*
- Together with the Information Technology manager of the interviewed company, that has a deep knowledge of the company business, I estimated the expected increase in productivity as a time saved percentage of the total work done by each employee category.
- I valued the increase in productivity by multiplying the estimated time saved percentage of the total work done by each employee category per the total annual full loaded cost of the employee category. I obtain the value of the indirect annual benefits.
- Once the value of an indirect annual benefit is measured, the measurement of the saving needs to be corrected for inefficient transfer of time, in fact in general an hour saved is not an additional hour worked. To obtain the indirect annual benefit corrected, I multiply the indirect annual benefit with a correction factor representing the saved time that is estimated to be used as a working time. As for the estimate of the benefit factors, the estimate of the correction factors (see *Tab. 4.5*) has been done together with the information technology manager and the controller of the company and has been done as much as possible in a coherent manner to the company reality.

Most of the indirect benefits fall in the third category of benefits above named “Benefits from increase in employee productivity and reduced headcount”.

Once the direct and indirect benefits values have been calculated I grouped the benefits in three key areas where the interviewed company is expecting to achieve benefits from the project implementation. The three key areas are:

- Improved financial and operations management (see *Tab. 4.4 Valorisation of benefits from improved financial and operations management)*;
- Increase in employee productivity and reduced headcount (see *Tab. 4.5 Valorisation of benefits from increase employee productivity and reduced headcount)*;
- Improve information organization and access for decision making (see *Tab. 4.6 Valorisation of benefits from improved info organization and access for decision making)*.

ESTIMATED BENEFITS				
BENEFIT FROM: Improved financial & operations management				
Direct Quantifiable Benefits (annual average)				
Benefit Type	**Activity affected by the benefits (by reduction in cost or by increase in value)**	**Annual Activity Valorisation**	**Benefit Factor**	**Annual Benefit**
Reduction in Premium Customer Contracts Cost from Increased Order Fill Rates and Improved Cycle Times (increase in order to fulfillment rate)	Premium Customer Contracts Cost	€ 75.000	5%	**€ 3.750**
Reductions in Printer Supplies and Express Mailing (Paper, Toner, Custom Forms)	Printer Supplies & Express Mailing	€ 30.000	40%	**€ 12.000**
Financial benefits/increase in working capital due to Reductions in Accounts Receivable expired	Interest Rate on Accounts Receivable expired	€ 525.000	20%	**€ 105.000**
Increased Sales due to Improved customer Service and the ability to meet customer requirements	Sales	€ 30.000.000	2%	**€ 600.000**
Increase compliance with supplier contracts for automation of document exchanges	Suppliers cost	€ 13.000.000	0,50%	**€ 65.000**
TOT BENEFITS FROM: Improved financial and operations management				**€ 785.750**

Tab. 4.4 Valorisation of benefits from improved financial and operations management.

ESTIMATED BENEFITS						
BENEFIT FROM: Increased employee productivity and reduced headcount						
Direct and Indirect Quantifiable Benefits (annual average)						
Benefit Type	**Activity affected by the benefits (by reduction in cost or by increase in value)**	**Annual Activity Valorisation**	**Benefit Factor**	**Annual Benefit**	**Correction Factor (efficient transfer of time)**	**Annual Benefit Corrected**
Operations Personnel Productivity Improvements	Operations Personnel Activity	€ 810.000	20%	**€ 162.000**	70%	€ 113.400
Drivers and Station Personnel Productivity Improvements	Drivers and Stations Personnel Activity	€ 4.725.000	10%	**€ 472.500**	80%	€ 378.000
Customer Service Personnel Productivity Improvements	Customer Service Personnel Activity	€ 121.500	30%	**€ 36.450**	60%	€ 21.870
IT & Engineering Personnel Productivity Improvements	IT & Engineering Personnel Activity	€ 216.000	10%	**€ 21.600**	70%	€ 15.120
Reduced Headcount	Admin. & Finance Personnel Activity	€ 378.000	15%	**€ 56.700**	100%	€ 56.700
TOT BENEFITS FROM: Increase employee product. and reduced headcount				**€ 749.250**		**€ 585.090**

Tab. 4.5 Valorisation of benefits from increase employee productivity and reduced headcount.

ESTIMATED BENEFITS				
BENEFIT FROM: Improved information organisation & access for decision making				
Direct and Indirect Quantifiable/Tangible Benefits (annual average)				
Benefit Type	**Activity affected by the benefits (by reduction in cost or by increase in value)**	**Annual Activity Valorisation**	**Benefit Factor**	**Annual Benefit**
Better business decisions for standardisation of data and improved access to information and reporting and Increased visibility in business operations	Full Loaded Cost of Admin. & finance personnel and Management and Senior Management	€ 884.250	20%	**€ 176.850**
Increased internal organisation and integration	Income lost for shifting starting date of new traffics	€ 3.000.000	15%	**€ 450.000**
Reduced document rework	Full Loaded Cost of all employee category except Cost for drivers and station personnel	€ 2.517.750	5%	**€ 125.888**
TOT BENEFITS FROM Improved info organisation & access for decision making				**€ 752.738**

Tab. 4.6 Valorisation of benefits from improved info organization and access for decision making.

ESTIMATED BENEFITS	
Direct and Indirect Quantifiable Benefits (annual average)	
Benefit Type	**Annual Benefit**
Improved financial and operations management	**€ 785.750**
Increase employee productivity and reduced headcount	**€ 585.090**
Improved info organization & access for decision making	**€ 752.738**
TOTAL BENEFITS	**€ 2.123.578**

Tab. 4.7 Total benefits value calculation.

4.3 Metric used and Return On Investment calculation

Return On Investment (ROI) is the average of the Net Benefits ("Benefits Annual Average" less "Recurring Annual Costs") divided by the Initial Investment Cost of the project .

Return On Information Technology Investment FORMULA
$ROITI = \frac{Net\ Benefits}{Investment\ Costs} = \frac{(Benefits\ Annual\ Average - Recurring\ Annual\ Costs)}{Investment\ Costs}$

Fig. 4.1 ROITI formula.

Technology rarely covers its costs in the first year. However, for the purpose of this business case ROITI calculation, it has been assumed that all investment costs occur during the year after the starting date of the project that for simplicity is called “year 0” and that the company can count on all the benefits deriving from the project starting from “year 1”. The company starts as well to have recurring annual costs from “year 1”.

When calculating the Return of Investment of a project the wanted result is a positive number, in fact a ROITI above zero means that it is worth to deploy the project as the expected outcome is going to be bigger than the resources that are going to be put for the project implementation (see *Tab. 4.8 ROITI Result).*

Return On Information Technology Investment RESULT		
$ROITI = \frac{Net\ Benefits}{Investment\ Costs}$	< 0	The project is not convenient. The costs requested for the project implementation are higher then the expected benefits value deriving from the project.
	$= 0$	The costs requested for the project implementation have the same value as the expected benefits.
	> 0	The project is convenient. The costs requested for the project implementation are lower then the expected benefits deriving from the project.

Tab. 4.8 ROITI Result.

To calculate the IT project’s potential ROITI for the considered transport company, I put in the ROITI formula (see *Fig. 4.1*) the gathered data on the total investment cost, the annual benefits value and the recurring annual costs calculated in the previous paragraphs and I obtain a positive ROITI of 3,2 as shown in table *Tab. 4.9*.
An ROITI of 3,2 means that the net benefits obtainable by the project implementation are 3,2 times the investment costs, in other words for 1 unit of invested capital in input the company will obtain from the project implementation 3,2 units of capital remuneration in output. The ROITI shows therefore that for the company it is very convenient to invest in this IT project.

ROITI CALCULATION FOR THE IT SYSTEM OF THE TRANSPORT COMPANY	
INVESTMENT COSTS	€ 635.000
ANNUAL BENEFITS	€ 2.123.578
RECURRING ANNUAL COSTS	€ 90.500
NET BENEFITS	**€ 2.033.078**

$$ROITI = \frac{€\ 2.033.078}{€\ 635.000} = 3{,}20$$

Tab. 4.9 ROITI calculation for the project for the interviewed transport company.

The high return of the considered IT project can be explained by the following considerations:

- The interviewed transport company does not have any dedicated information system, the software used by the company's employees consists of spreadsheets and databases developed in-house using Microsoft Access. The implementation of a tailor-made IT system is going to deeply change the way of working of the company and to introduce technology in areas of the business that were not previously touched by information technology, such as the management of the drivers and the rolling stock material;
- The implementation of the IT project is going to increase the coordination amongst the considered company, its customers and its international railway undertaking partners. Coordination is a vital and fundamental element for a transport company, in fact for its nature the transport business can not exist without a higher integration and coordination amongst all the actors of the logistic chain involved in the "production" of a train and sometimes geographically located very far away from each other. A web-based IT system like the one the company is going to implement will allow different users located in different places to communicate faster and more effectively increasing the coordination necessary to put in place new international transport services.

4.4 Theory consideration

As mentioned before there are many ways of calculating the possible benefits that sprung from an investment. The complexity of including too much factors in an evaluation is taken up in the theory section, as the risk of making an evaluation, first, difficult to conduct in a reasonable time perspective and, secondly, the outcome could be difficult for the involved parts to understand. Difficulty lies in balancing and giving the "right" information in "correct" contents. Based on my own experience, the communication between the IT manager and the financial manager could be seen as complicated as they are likely to have different education. They are in other words not speaking the same language. Therefore some of the theories in section two have been left out in order to bridge a possible gap, that in some cases are bound to exist. This would also lead to that

the complexity for all parts concerned is reduced as well as a consideration for the time spent on doing the evaluation, and therefore the actual cost.

Benefit factors that are taken into account of the evaluation and transformation of intangible assets into tangible should spring from the knowledge of the IT manager of the company. The importance of getting this right can not be stressed enough as they represent the outcome of the calculation and evaluation of an IT project. It is as with any forecast a number that is in changes. Therefore these numbers are possible to change as the project is implemented and made a part of the organisation. One example of how important it is to get numbers of this kind a correct assessment are seen when companies noted on the exchange release information regarding a possible result. If the forecast that has been made previously are inconsistent with the actual result, the outcome is likely to be a surprise to the market. This has both positive and negative effects. However if the effects are negative, i.e. the forecast that is higher than the actual result, the market is likely to interpret this as an ill managed company, making investors reconsider their investments. The same is for when the effects are positive, i.e. the forecast is less than the actual result. Therefore should any number that is not “exact” to that meaning that it has to be predicted, be as close to the reality as possible. This would show investors that the company is well managed and therefore a “safe” investment.

5 Conclusion

By applying the studied framework of a Return On Information Technology Investments calculation to a real case study of an Italian company operating in the transport company the lesson learned is that although at first it appears tough to measure the return of the examined IT project, starting from analyzing how technology fits into the overall vision of where the business is going is the first step of understanding what is obtainable at the conclusion of the project and so to determine and calculate the tangible and intangible benefits derived from the project and to calculate the estimated income used in the ROI formula.

The first question that this thesis wants to address is listed below together with my conclusion.

Can a framework of a Return on Information Technology Investments calculation be used in order to capture and measure tangible and primarily, intangible benefits, that sprung from these investments?

Yes, justifying the implementation of an information technology investment is a very demanding task that lies on the IT manager. Not only would the IT manager have to explain what the costs are going to be, but also explain what and when the returns are expected. The investment is therefore first a technical issue, then an economical, or vice versa, considering the viewers perspective. However, findings show that a lot of the intangible benefits can be translated, using formulas and methods into measurable ones. It has been argued that some benefits from IT investments might be transformed into slack, however if all benefits that might sprung from investment are treated with this sort of scepticism, no investments would be considered in the first place and therefore not enabling a company to grow, increase market share, and/or increase stock market value. In general the indirect benefits are related with an increase in productivity. Understanding how potential timesavings affect the employee work is key to a realistic ROI calculation. When measuring potential timesavings, the importance to do it correctly and not double count productivity increase. If the employee are more productive as a result of the project and the company increases its sales or output, these are related like cause and effect and it would be a mistake to include in the savings estimate both increased employee productivity and related increase in sales. Moreover, time saving is not equal to a productivity increase; in fact it is not for all the time saved that employee are doing more with the saved time. For this reason, when measuring indirect benefits, a correction factor for efficient transfer of time needs to be taken into account.

When measuring the return of an IT project, not to take into account the intangible benefits will bring to a misleading investment evaluation and a ROI less then expected. Intangible benefits deriving from an IT project needs to be visualised and then it is possible and necessary to measure these benefits.

The second question brought up is listed below together with my conclusion;

Can a framework of a Return on Information Technology Investment be used by the IT manager for building an IT project solid business case, for justifying the IT project budget and obtain the buy-in from the decision makers?

Yes, most of the businesses today need information technology not only to work more efficiently, but more important, to remain competitive in a changing environment. Too often, businesses spend money on technology without understanding what the expenditures are for, what the benefits to be received are, or how that technology will make the business more money. The solution to avoid this is to focus on the type of business the company will become, and then create a strategic plan of how to get there. Once the strategy is clear it is important to understand the current information infrastructure and the "future" infrastructure based on today's technology and to align the information infrastructure to the company strategy. In fact, when doing an IT investment ROI analysis it is essential to go back to business basics and take the essential business processes as a starting point. Evaluating IT investments becomes easier becomes easier and more structured once it is initiated. This would ensure an ongoing awareness of IT projects in the future. Both the IT and financial department would be relying on the same information to ensure the success of investments.

The importance of ROI analysis on an IT investment lays on the fact that, in order to be able to calculate this indicator, the benefits as well as the costs of the investment need to be defined in detail and measured. As a consequence of the ROI calculation the costs and benefits are linked into one comparison so that a company better understands the scope and the return of a project for the company business and can better address the available resources in the areas where problems need to be solved and where improvements are needed. Knowing in detail the costs and the benefits deriving from an IT investment allow a company to set priorities on implementation of the different IT projects. Projects or even parts of projects might be given a higher importance and implantation of these parts is prioritised, and projects with less proceeds given a later implementation date. When prioritising IT investments it should be taken into consideration that these investments could, considering the nature of them, be mission critical. The absorption rate and the lag of proceeds would then be given the highest priority, as without a working IT solution the company would face significant risks of obliteration.

ROI analysis can be a powerful methodology to help a company analysing information technologies implementation and how they fit into the overall vision of where the company business is going and a valid indicator to select value-added and potentially successful IT projects. In this time of increasing communication needs, different departments that exist in a decentralised organisation must be able to communicate. If an IT manager needs to justify an IT project, the chances of the Chief Financial Officer will relate to ROI better than other methods that are not as well known.

A realistic and accurate ROI analysis by requiring the measurement of costs, tangible and also intangible benefits forces the IT manager to thoroughly research the impact on the company of a new IT project implementation, to justify all significant expenses and to demonstrate on paper how the IT investment will be of added value for the company's business. To use a framework of a Return on Information Technology Investment leads to develop IT project solid business case, greater budget control and increased management and stakeholder's confidence; these, are necessary elements for a successful IT project.

5.1 Additional findings

As always when it comes to this kind of research, a question arise about how complex a framework should be. I have chosen to develop a framework along with my studies, adding criteria that I found important. The balance between complexity and usefulness, together with making the framework span over different business structures has been important. In regards to the examined methods and anchor measurements my additional findings are that:

- Companies that want to measure a return on IT investment should develop their own method, as every company is unique. Ignoring this may results in imminent risk of getting incorrect feedback of the evaluation. A true ROI calculation should be based on real life business scenarios, and there is no single way to calculate a project's potential ROI. The best method is to use a formula that best fit the organisation.
- Anchor measurements should be considered and reconsidered during the evaluation of ROI. Static anchors are not suitable in a world of constant changes. There are standard anchor measurements that would be applicable to a majority of companies. These can be used as a base for finding other, and if necessary be re-designed to fit the company better.
- Using too many anchors can result in a complex calculation that in its turn will be time consuming. Using few well-identified anchors thoroughly analysed should be the best alternative.

5.2 Future Research

Future research in this area is important to give an accurate view of how IT investments are paying off. It is not enough stating that something has been proved once. In order to prevent new "productivity paradoxes" and avoid scepticism towards IT, research must prove and prove again the possibilities that lie with an IT solution. The research would be of gain to not only the academic world but would also enable the public to have an objective view of how IT investments are paying off, be it companies noted on the exchange or government spending. It would be an additional indicator on how well an economy is performing. However it should be mentioned a warning regarding the generalisation that may lie in such an index.

5.3 Acknowledgement

My thanks goes out to the company and in particular to the IT manager that patiently let me ask the necessary questions in order to build, rebuild, and finally put the framework into use.

References

Backman J. (1998) *Rapporter och uppsatser,* Studentlitteratur, Lund, Sweden

Brynjolfsson, E. (1993) The Productivity Paradox of Information Technology, *Communications of the ACM*, Volume 36, Issue 12, Pages 67-77.

Brynjolfsson, E. (2003) The IT productivity Gap, *Optimize magazine*, Issue 21

Brynjolfsson, E. & Hitt L. M. (1996) Paradox lost? Firm-level evidence on the returns to information systems spending, *Management Science,* Volume 42, Number 4, Pages 541-558.

Brynjolfsson, E. & Hitt, L. M. (1998) Beyond the productivity paradox *Communications of the ACM*, Volume 41, Issue 8, Pages 49-55.

Brynjolfsson, E. & Hitt, L. M. (2000) Beyond Computation: Information Technology, Organizational Transformation and Business Performance, *Journal of Economic Perspectives,* Volume 14, Issue 4, Pages 23-48.

Brynjolfsson, E. & Hitt, L. M. (2003) Computing Productivity: Firm-level Evidence, Review of Economics and Statistics, *In Press.*

Brynjolfsson, E., Malone T., Gurbaxani V., & Kambil A. (1994) Does Information Technology Lead to Smaller Firms? *Management Science*, Volume 40, Number 12, Pages 1645-1662.

Daniels, H. C. (1993) *Information Technology: The Management Challenge*, Addison-Wesley Longman Publishing Co., Inc.

David, P. A. (1990) The Dynamo and the Computer: A Historical Perspective on the Modern Productivity Paradox, *American Economic Review Papers and Proceedings*, issue 1, Pages 355-361.

Dedrick, J., Gurbaxani V. & Kraemer K. L. (2003) Information technology and economic performance: A critical review of the empirical evidence. *ACM Computing Surveys (CSUR)*, Volume 35, Issue 1, Pages 1-28

Drucker, P.F. (1997) The Future that has Already Happened, *Harvard Business Review*, 75(5), Pages 20-24.

Drury, D.H. & Farhoomand A. (1999) Knowledge worker constraints in the productive use of information technology *ACM SIFCPR COMPUTER PERSONELL*, Volume 19/20, Issue 4/1, Pages 21-42.

Gilchrist, S., Gurbaxani, V., & Town, R. (2001) Productivity and the PC Revolution. *Preliminary Draft*.

Gurbaxani, V. (2000) Executives' Perceptions of the Business Value of Information Technology: A Process-Oriented Approach, *Journal of MIS*.

Gurbaxani, V. & Mendelson, H. (1987) Software and Hardware in Data Processing Budgets, *IEEE Transactions on Software Engineering*.

Hodgson L. & Aiken, P. (1998) Organizational change enabled by the mandated implementation of new information systems technology: a modified technology acceptance model *Special interest group on computer personnel research annual conference*, Pages 205-213.

Horngren, C.T., Sundem, G., Stratton, W. O., & Teal H.D., (1996) *Management Accounting*, Prentice Hall, Scarborough, NY.

Jurison, J. (1996) Toward more effective management of information technology benefits, *The Journal of Strategic Information Systems 5 (4)*, Pages 263-274.

Karagiannis D. (1995) BPMS: business process management systems *ACM SIGOIS Bulletin*, Volume 16, Issue 1, Pages 10-13.

Kreamer, K. & Dedrick, J. (2001) The Productivity Paradox: Is it Resolved? Is There a New One? What Does It All Mean for Managers? *CRITO Consortium Industry Advisory Board Panel: The End of the Productivity Paradox?*

Lawrence, P. R. & Lorsch, J. W. (1967) *Organization and Environment*, Boston: Graduate School of Business Adminsitration, Harvard University.

Loveman, G. W. (1994) An assessment of the productivity impact of information technologies. *In Information Technology and the Corporation of the 1990s: Eds. Oxford University Press, Cambridge, U.K.*, Pages 84-110.

Magoulas, T. & Pessi, K. (1998) *Strategisk IT-management*, Institutionen för Informatik vid Göteborgs Universitet, Göteborg, Sweden

Malone, T. W. & Crowston, K. (1990*) What is coordination theory and how can it help design cooperative work systems?* Proceedings of the 1990 ACM conference on Computer-supported cooperative work, Pages 357-370.

Malone, T. W., Yates, J. & Benjamin R. I. (1987) Electronic Markets and Electronic Hierarchies, *Communication of the ACM*, Volume 30, Number 6, Pages 484-497.

Nievelt, M. C. A. van (1999), Benchmarking organizational and IT Performance. *Beyond the IT Productivity Paradox*, Pages 99-119, Weily

Ropponen, J (1999) Risk Assessment and Management practices in Software Development, *Beyond the IT productivity Paradox*, pages 247-266, Wiley

Sassone, P. (1987) Cost-benefit methodology for office systems, A*CM Transactions on Information systems*, Volume 5, Issue 3, Pages 273-289.

Solow, R. (1987) We'd better watch out. *New York Times Book Review* (July 12).

Shin, N. (1997) The impact of information technology on coordination costs: Implications for firm productivity, *International conference on information systems*, Pages 133-146.

Web sources
Harry's Old engines – Accessed 15:36 2004-03-07
www.old-engine.com

Merriam Webster Online Dictionary – Accessed 11:24 2004-03-01
www.merriam-webster.com

Motorola – Accessed 10:14 2004-03-10
www.motorola.com

Nationalencyklopedin – Accessed 18:15 2004-03-17
www.ne.se