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A new approach for IT audit? : Testing the theory of technology debt in an IT audit setting

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1

Abstract

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Background and problem: *The amounts companies spend in IT investments have increased greatly the last couple of decades. To control IT the companies perform IT audits. This is a complicated and expensive procedure which lack common standards. To contribute to the research stream within IT audit this thesis' purpose is to test the recently proposed theory of Technology Debt in the process of performing a simple IT audit.*

Purpose: *The objective is to test the theory of Technology Debt in an IT audit setting to evaluate the usefulness of the theory.*

Method: *To test the theory the authors did three studies: A literature study to gain a wider understanding of the subject and to create a simple IT audit process. A secondary analysis of qualitative data to test the theory and finally an interview study to further test the theory potential.*

Results: *The literature study complemented the theory of Technology Debt and provided the authors with an easy IT audit process. In the secondary analysis the theory was useful as a tool for identification and categorization. Finally in the interview study the theory provided a valuation criterion to evaluate the IT environment.*
The thesis contributes to the knowledge base of IT auditing by supplying a new angle of approach and try a new area of application for Technology Debt.

Keywords: IT audit, Technology Debt, IT investments, Secondary analysis of qualitative data

Table of Contents

1. Introduction

The value of Information Technology (IT) has been measured at various levels in companies (Davern & Kauffman, 2000). IT has changed the way organizations perform and work (Gjersvik, Krogstie, Følstad, 2005) and IT is important in an organization (Leimeister & Krcmar 2008). The quick changes in technology requires that managements constantly strive for new directions to accomplish operational efficiency and to support decisions (Yang and Guan, 2004).

The amounts organizations spend to keep up with the technology are considerable (Luftman & Ben-Zvi 2010), and increasing (Nicho & Cusack 2007). Previous research has provided a link between IT investments and productivity, but little is actually known about what these investments provide in general (Kleis, Chwelos, Ramirez & Cockburn, 2011). A difficult challenge for managers and researchers is to justify IT investments (Shao & Lin, 2002).

Identifying and addressing risk is one of the business most important issues and IT is central to any organization (Ernst & Young, 2013) and for a company to evolve it is necessary to have performance management and, audits are a necessary part of that (Flowerday Blundell & Von Solms 2006). Because of the amounts invested into IT and the risks connected there is a need to audit IT as well (Ratih, Bayupat & Sukarsa 2014).

An IT audit can be described as a process developed to identify risks and for controlling and understanding IT (Petterson, 2005). The IT auditor helps companies to manage and respond to risk (KPMG, 2014), but there is no universally accepted method to perform an IT audit since there are many different angles of approach (Grenough, 2006). There is a lack of accounting standards for how to perform an IT audit and thus mitigate the organizational risk (Moorthy, Mohammed, Gopalan and San, 2011). Some research implies that the focus on IT related risks is outdated (Hadden, Hermansson and DeZoort, 2011) and sometimes overlooked by management even though IT audit activities can provide additional value (Merhout & Havelka, 2008).

The field of IT auditing is complex and there is a need for further research to increase the quality of IT audits (Merhout & Havelka 2008). To build on this research stream, there is the newly proposed theory of Technology Debt. This theory takes into consideration that all IT investments can be a potential restrain for future decisions and was designed to help understand that sub-optimal IT investments lead to future limitations (Magnusson & Bygstad, 2014).

There are different methods and processes to value IT in organizations. Researchers have tried different approaches, but to try to control these investments by performing an IT audit is vaguely accepted and there is a lack of a commonly used method.

The purpose of this thesis is to contribute to the development of knowledge within IT auditing. This will be achieved through testing the theory of Technology Debt in an IT audit setting.

The test is done by following a simple IT audit process of **identification**, **categorization** and **valuation** of Technology Debts through a case study.

The thesis starts with a presentation of the method, followed by a review of previous research related to the fields in focus. Later the results from the case studied are presented and also an analysis of these results. The thesis ends with a discussion of the findings.

2 Method

2.1 Research design

To fulfill the purpose a case study was conducted, as the method for theory testing. The test was performed in the case by following a three step process. (1) The Technology Debts were **identified** in the case, (2) **categorized** according to the typology of Technology debt (3.3.2 Previous research) and (3) **valued**, by respondents through interviews.

The steps in the aforementioned process were derived from a literature study and applied to a secondary analysis of qualitative data and an interview study.

Study/Process	Identification	Categorization	Valuation
Literature study	**X**	**X**	**X**
Secondary analysis of qualitative data	**X**	**X**	
Interview study			**X**

Table 1: The contributions of the studies to the process

2.1.1 Literature study

A literature study was performed to find support for our purpose, create a better understanding of the important fields of the thesis and to allow us to find ways to supplement the theory of Technology Debt in the process. The literature study has thus been a basis for the whole IT audit process in the case. The references for the previous research used in the thesis are published scientific articles (some popular-oriented articles) collected through public sources. The articles were found by searching on keywords necessary for the thesis. The total collection of references consists of over 50 articles from the year 1989 to 2014.

2.1.2 Secondary analysis of qualitative data

A secondary analysis of qualitative data was performed. This data is a collection of a previous set of interview transcripts that concerns the case studied (see Appendix B). This data was processed in order to **identify** Technology Debts in the case and from that the **categorizations** were made. The transcripts are further described in the data collection (2.3.2).

2.1.3 Interview study

The interview study was performed after the identification and categorization. The respondents in the interviews were asked to **value** the identified Technology Debts in the case. The interviews are also described further in the data collection (2.3.3).

2.2 Empirical selection

To be able to perform a case study there was a need of an organization with a large enough IT infrastructure to have the need of IT auditing, but not too large for the study to be comprehensible. The organization would need to allow us access to their data and employees.

After investigating and contacting several companies, Company AB was chosen as an environment. It is a Swedish international company with roughly 1450 employees (Company AB official website, 2014). Over the years the company has acquired several entities without consolidating the IT which has led to a lot of complexity in their IT structure. The internal control has thus been loose. The management had a positive attitude towards contributing to the field of research and allowed us to interview one key employee.

Recently, the company hired a management consultancy firm (Consultancy firm AB) whose task was to compile IT related information and investments in the company and through this develop a strategy on how the company should move forward regarding IT. Data was gathered by the management consultants through interviews with key personnel and existing documents. The collected data contained information regarding the company IT environment and was gathered very recently.

2.3 Data collection

2.3.1 Websites and documents provided by the company

A small part of the data was collected through the company website. IT related documents constructed by the consultancy firm were also provided. Those documents were created to explain their findings to the management of the company.

2.3.2 Transcripts

As the company had recently begun working on their new IT strategy the management consultants had conducted 22 interviews with 35 key employees to find the problems that existed within the company. The interviewees worked in different countries and entities within the company as shown in Table 2. Their areas of work differed from R&D and sales to finance and IT, giving a broad representation of the company management structure. Depending on the

Sweden	19
Italy	4
Germany	3
France	3
Denmark	2
Great Britain	2
Finland	1
Schweiz	1

Table 2: Respondents in secondary interviews

assignments of the interviewee, the quality of the interviews regarding IT varies. As the purpose of the original interviews was to find IT related issues the answers were very different depending on the current situation in each area. Most of the interviewees however experienced similar problems. The material provided was the transcripts from these interviews as they were written down by the interviewers at the management consultancy firm. The observed material is classified and not official to the public. There is an example of the interview questionnaire in Appendix B.

2.3.3 Interviews

The interviews were held to obtain qualified opinions and valuations of the identified debts as these respondents have knowledge of IT in general, but also of the observed secondary data. Two interviews were held in total, one with an IT director at the company and one with two of the management consultants that had worked closely with the company IT strategy.

Interview 1	IT-Director	An IT-Director at Company AB Central IT department, employed at the company for five years. He has up until now been responsible for the central IT structure and knows the current situation very well.
Interview 2	Senior management consultant	A Senior Manager in IT effectiveness at Consultancy firm AB. He has over a decade of experience of working with IT strategy.
	Management consultant	A Management Consultant in Strategic IT at Consultancy firm AB.

Table 3: Respondents to the primary interviews

2.4 Method of analysis

To test the theory, a case study was made. This was considered the best way to explore a new use for a theory (Yin 1994). There is a loss of generality and a risk of creating an overly complex theory as a result of this (Eisenhardt 1989).

After the empirical setting was chosen there was an opportunity to gain access to some of the raw data collected by the management consultants. This opportunity required a secondary analysis of qualitative data.

A secondary analysis of qualitative data is when researchers re-use qualitative data collected by other researchers. This is a very common practice when working with quantitative data and has only recently become more common within qualitative studies (Hinds, Vogel, Clarke-Steffen, 1997) (Corti & Thompson, 1995).

The usefulness of this approach is significant. It shortens the time needed to collect data greatly which is a huge advantage when doing research within a limited timeframe. It allows access to a research population which is elusive (Fielding, 2004), in this case the key personnel, and it allowed the obtaining of answers to questions that the population might not have answered coming from bachelor students.

When performing a secondary analysis of qualitative data it is important that the purpose and approach of the secondary research is similar to that of the original one. The more similar they are the greater the usefulness of the data. (Long-Sutehall, Sque & Addington-Hall 2010)

To analyze the use of Technology Debt throughout the thesis it was decided to focus on three areas of application in a simple IT auditing process: Identification, Categorization and Valuation. In each of these areas there is a discussion of the contributions and limitations of the theory.

The analysis of the interview transcripts was based on an inductive approach to identify recurring issues within the company. "Inductive analysis means that the patterns, themes, and categories of analysis come from the data; they emerge out of the data rather than being imposed on them prior to data collection and analysis" (Patton, 1980).

To analyze the use of limitation as a new valuation criterion two interviews were conducted. They were performed as semi-structured interviews focused on the valuations of identified debts (DiCicco-Bloom & Crabtree 2006). The respondents were selected because of their experience, accessibility and knowledge of the case.

2.5 Limitations of the thesis

There are two points which need to be discussed as they have impacted on our thesis.

The data provided is mostly secondary data from the management consultants. That data is influenced by the purpose of the original collection and the perceptions of the consultants. The focus of this thesis was very similar to the original one, but some questions that would have been interesting in this thesis were not in the original focus.

There was only one case in the study. This deprives our results the generality which comes with several studies. To allow focus in this first testing it wasn't considered a priority to perform more cases.

3. Previous research

3.1 IT & IT investments

IT is technology used to process information (March & Smith, 1995) and the IT is supposed to facilitate the recording and retention of this information (Lloyd, 2011). The value of IT has been measured at various levels in companies (Davern & Kauffman, 2000) and an objective of IT research is to assess and understand the value of IT to a company (Taylor & Todd, 1995). It is clear that IT offer new ways to create values in financial and human resources and the value of IT is becoming increasingly important, but the outcomes are generally not completely satisfying (Bilbao-Osorio, Dutta and Lanvin, 2013).

Within the last four decades, researchers have shown a growing interest in this area, which is a result of companies continued investments in IT. It is important to understand how these investments provide advantages for the company (Karanja & Bhatt, 2011). Prior research has provided a link between IT investments and output productivity, but little is known about IT and how these investments provide knowledge and chances for innovation (Kleis, Chwelos, Ramirez and Cockburn, 2011).

One of the difficult challenges for managers and researchers is to justify IT investments even though ITs impact has been huge in almost every part of business (Shao & Lin, 2002). IT investments have increased because of the belief that IT has a positive impact on organizational performance. Researchers have attempted to contribute with validity to this belief, but failed to show evidence of IT investments impact in organizations (Osei-Bryson & Ko, 2003).

The complexity around IT makes it difficult to distinguish between good and bad investments. This is a problem because IT is a tool for rapid action in a changing business environment. If the IT is optimal the company can survive even in the most chaotic times (Maizlish & Handler, 2010). The IT can be seen as a base of development and a benchmark for leading and successful organizations (Tohidi, 2011) and the acceptance of new IT persists as an important issue for researcher/practitioners. Several processes and models have been developed to facilitate the understanding of IT and its adaptability (Agarwal & Prasad, 1998).

3.2 IT Audit

Audit can be defined as a systematic, independent and documented process for obtaining audit evidence, to set goals and objectives, outline strategies and tactics, develop plans, schedules and necessary controls to run the organization (Domingues, Sampaio, Arezes, 2011). Internal audits are designed to add value and improve an organization's operations. It helps an organization accomplish its objectives, to evaluate and improve the effectiveness of risk management, control, and governance processes (IIA, 2014).

IT audit is a form of internal audit and it has evolved through recognition of the need for strong IT controls for business operations as global economies are more interdependent today and risks have more impact in business (Stoel, Havelka and Merhout, 2012). IT audit is usually observed from a risk based approach to identify the threats within IT and is supposed to provide support for IT governance, system security (operating systems, networks and database systems) and system development (Hall, 2011). It is important that an IT audit provide an understanding of the business role and the assessment of information security that can put the organization at risk (Senft & Gallegos, 2009).

Some of the world leading audit firms explains their modern definitions of IT audit:

Identifying and addressing risk is one of the business most important issues and IT is central to any organization. The IT audit ensures that these risks are addressed quickly and carefully (Ernst and Young, 2013). The need for IT auditing is a result of the companies increasing risks with IT and the internal auditors need to assure that technology is operating effectively (Deloitte, 2014). The IT auditor plays an increasingly important role in helping companies manage and respond to risks (KPMG, 2014).

The IT audit is in more detail described as a process, developed to identify risks and for controlling and understanding IT. IT audit is needed to assure that the information gathered through systems is controllable, secure and functional (Petterson, 2005). The process of an IT audit is a complex activity that demands planning, managing and is supposed to induce sustainable changes in the companies processes (Neto & Neto, 2013). A precondition for effective IT auditing is that the process is done independently of the company (Petterson, 2005).

Several issues on IT and internal audit have been addressed and the necessity of IT auditing has increased along with the use of IT in companies, but there is no universally accepted method to perform an audit since there are many different angles of approach (Grenough, 2006). It is obviously clear that the process of establishing an environment for information security governance is important for the overall corporate governance in organizations. The two processes of COBIT and ISO 17799 are common approaches. The downside of these is their limited usability in other areas than governance (Von Solms, 2005).

In recent years the COSO model has received attention and increased usage in IT audit (Singleton, 2007). It was developed as a framework because of the heightened concern and focus on risk management and is used to effectively identify, assess and manage risk (COSO, 2004). It is also designed to provide effectiveness of operations, reliability of financial reporting and the compliance of applicable laws and regulations (COSO, 2012). Critics state that the framework is outdated, onerous and overly complicated to be used in the internal control monitoring (Shaw, 2006).

A problem is the lack of accounting standards and guidelines for how to perform an IT audit and thus mitigate the organizational risk. The role of an internal auditor is not specified properly and the performance of the auditing task may not be effectively done (Moorthy, Mohammed, Gopalan and San, 2011).

There is a perceived importance for IT audit in companies, even though the importance is not understood (Janvrin, Bierstaker and Lowe, 2008). There is also research indicating that little is known about the audits role in overseeing IT risks and the focus is wrong as the auditors focus on traditional risks and not the risks that is relevant today (Hadden, Hermansson and DeZoort, 2011).

It is noticeable that IT risks have become increasingly important, firms have grown more sensitive to organizational overall IT risks and managers demand more risk analysis methodologies (Kelly Rainer, Charles Snyder, 1991). However, IT auditing is often seen as a "necessary evil" and is sometimes overlooked by managements even though IT audit activities can provide additional value (Merhout & Havelka, 2008).

3.2.1 GAIT

Different trade associations have developed their own methods to scope the risks of IT into audit processes and the Institute of Internal Auditors (IIA) has developed a guide to a methodology called Guide to the Assessment of IT (GAIT) (IIA,2007). It was developed to help management and auditors in companies with the challenge to define an efficient internal control over financial reporting regarding IT.

The generally accepted recommendation for finding an effective and efficient valuation is to observe the ITGCs (IT general controls) in a company. Most IT related controls fall into the categories of ITGC (Riesner & Pernul, 2010) and these controls support IT-based business processes in general. ITGC processes are general to software applications and can be categorized into different processes (3.2.2) that can come with values and benefits to business (Wing Han Brenda & Son Kai, 2009).

3.2.2 The principles of GAIT

Number	Principle	Explanation
1	Identification of risks and related controls in ITGC processes.	**ITGC:** Change management, operations and access security.
2	The ITGCs processes identified are those that affect IT functionality.	This is, in financially applications and related data.
3	The ITGCs processes exist at various IT layers.	Application programs, databases, operating systems and networks.
4	Risks in ITGCs are mitigated by the achievement of IT control objectives.	

Table 4: The principles of GAIT

3.3 Technology Debt

Technology Debt is a recently published theory, but the metaphor of Technical Debt has been along for about two decades and it implies that it is necessary to restructure the existing codes in programs as a part of the development process to prevent an internal debt. The debt can be defined as the concept in programming that reflects the <u>additional work</u> that occurs when a code is implemented because of its simplicity in the short-run, even if it's not the optimal solution in the long-run (Magnusson & Bygstad, 2014).

Technology Debt is an extension of Technical Debt and is based on the fact that today's companies have a large part of their IT tied up in an "installed base" (Magnusson & Bygstad, 2014). The base comprises of all previously developed and acquired systems, applications, networks, servers and storage, user communities and support functions. This is a heritage that can create value, but it will also constrain the company ability to adopt new technology as the CIOs sometimes are stuck in positions where the inheritance limits their possible actions. These situations occur, because there is a constant short-term pressure for IT-functions efficiency and productivity and the CIOs may not have any other choice than to remain on this path due to lack of time and resources. The authors refer to this as a "dead end street" (Magnusson & Bygstad, 2014). Technology Debt is defined as past and present decisions in IT that limit future decisions (Magnusson and Bygstad, 2014).

3.3.1 Switching cost

High switching costs has become endemic to the IT sector (Magnusson & Bygstad, 2014) and is defined as the onetime costs that are associated with the process of switching from the current situation to another and the wider the reach of a situation the larger the costs of switching. The costs are not limited to financial costs, these can also be considered loss in time, efforts and discomforts. The costs vary depending on many factors, one of which is the level of implementation of the situation (Burnham, Frels & Mahajan 2003). The difference between the sub-optimal situation and the optimal situation is the ground for Technology Debt and there are different types of Technology Debts, occurring in different areas of the company.

3.3.2 The typology of Technology Debt

This typology is an important part of Technology Debt and it aims to simplify IT investments to a more manageable structure. In the article, the authors conclude that Technology Debt can be divided into three main areas (staff, users and systems) and they in turn can be divided into nine subareas (ideology, competence, working environment, user satisfaction, reputation, infrastructure, shadow IT, technical and governance) explained in the following figure (Magnusson & Bygstad, 2014).
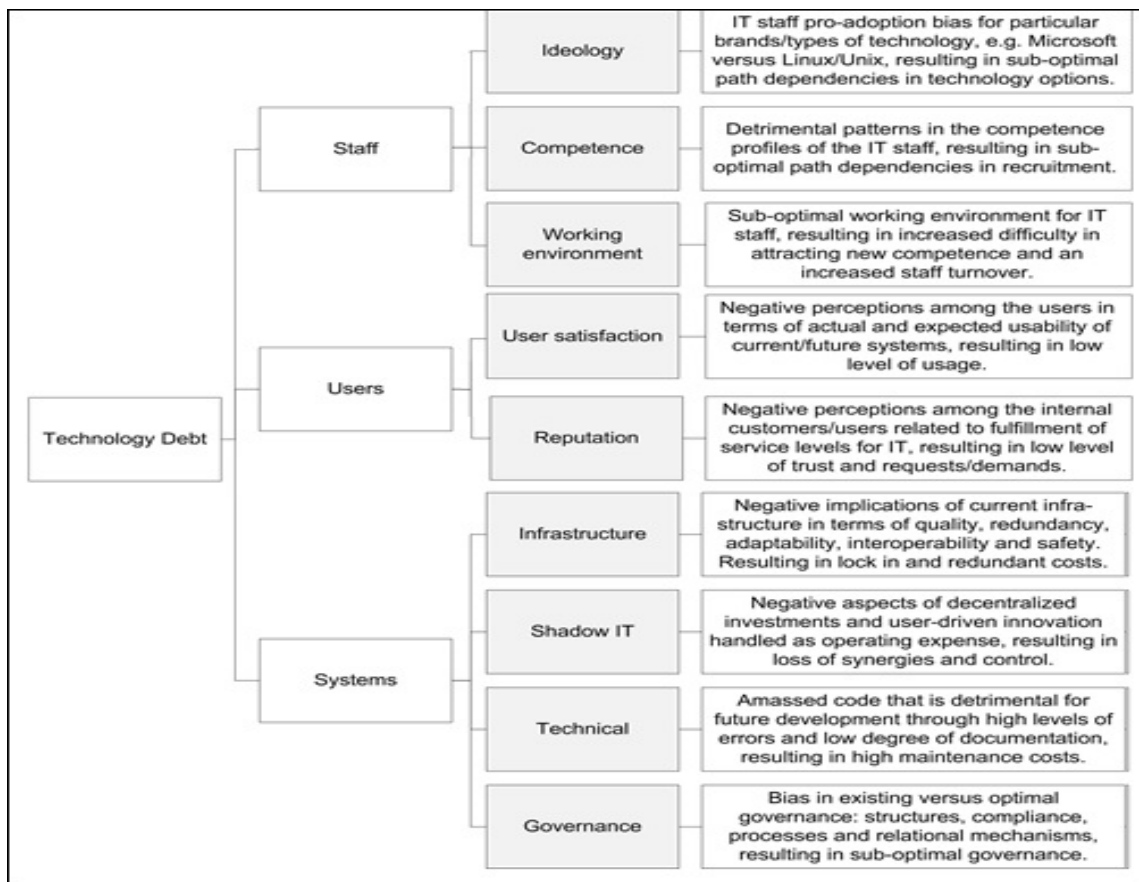

Figure 1: The typology of Technology Debt

The subareas have been important for the thesis. Some of these areas were more relevant to describe the company IT environment and are presented in more detail. The point of doing this is to present a wider description of the subareas to match these with the identified Technology Debts in the case.

Ideology

As the use of IT is rapidly increasing in society the related risks are more clearly visible (Sjöberg & Fromm, 2001). Some risks can be identified through path-dependencies that are firm's ability to adopt newer technology, which are dependent on the previous experience of prior technologies (Zhu, Kraemer, Gurbaxani and Xu, 2005). A sub-optimal pattern arises when IT staff bias technology adopted because of its brand, although it's not optimal for the company (Magnusson & Bygstad, 2014).

Working environment

Evidence has proved that an efficient use of human IT resources is a key factor to differentiate successful companies from less successful counterparts and it is also fundamental for their survival and growth (Bharadwaj, 2000). The concept of "information overload" has become more widely recognized during recent years as the world has turned into an "information society" (Edmunds & Morris, 2000). A sub-optimal working environment for IT staff (Magnusson & Bygstad, 2014) can be connected to this problem, as the IT staff is handling a lot of information which must be readily available for the whole company. Areas of relevant information may be endless and are preceded by a long and intensive process of learning development (Beath, 1991).

User satisfaction

The main challenges of new technology are not the technology itself, but people perceptions as they don't want to use it, don't understand it and don't know how to use it. In most cases these perceptions are built on the fact that the users simply expect something else from the technology than what it actually provides (Teittinen, Pellinen and Järvenpää, 2012). User beliefs and attitudes are key perceptions driving IT forward and change is an inevitable part of the human life (Bhattacherjee & Premkumar, 2004). Our attitudes and beliefs about the usage of IT changes (Legris, Ingham and Collerette, 2002) and when these perceptions are negative it will results in low level of usage (Magnusson & Bygstad, 2014).

Reputation

Negative perceptions of the service, results in low level of trust and request/demands (Magnusson & Bygstad, 2014). Trust is important to mitigate information asymmetry and the lack of trust will lead to bigger business risks and constrain organizations (Ba & Pavlou, 2002).

A huge part of IT services is the overall communication and this plays a central role in organizations for the continued development. It is important that the business communication is considered sufficient and that learning for the communication is not inhibited by individual defense and organizational routines (Argyris, 2000). The negative perceptions will end in lower trust of IT and its services (Magnusson & Bygstad, 2014).

IT infrastructure

Organizations IT infrastructure is the foundation of reliable service and includes both the technical and managerial expertise required for the IT services, internally and externally (Broadbent, Weill and St.Clair, 1999). An effective IT infrastructure is among the top concerns in IT managements (Byrd & Turner, 2000).

The lack of infrastructure and the negative implication of current infrastructure in terms of quality, redundancy, adaptability, interoperability and safety, result in lock in and redundant costs (Magnusson & Bygstad, 2014).

Shadow IT

The main problem is not whether a specific service should be provided locally or centrally, but how to organize what comprises the service (Prudhomme, 1995). The decentralized decisions can sometimes lead to redundancy within IT and it is the negative aspects of these decentralized decisions handled as operating expenses that result in loss of synergies and control (Magnusson & Bygstad, 2014). The lack of control can be due to the decentralized decision making and can lead to that the systems are not used as intended (Grabski, Leech and Lu, 2001).

IT governance

The concept of IT governance is wide and the description of the IT governance debt follows; "Bias in existing versus optimal governance: structures, compliance, processes and relational mechanisms, resulting in sub-optimal governance" (Magnusson & Bygstad, 2014).

Factors have shown that impacts on corporate governance will cascade to IT governance and a combination of leadership, structures and processes should ensure that IT and business are integrated (Ko and Fink, 2009). The integration will ensure that IT and business are in line with the company's strategies and objectives. IT is an important part of corporate governance today and will be important in the future (Van Grembergen, 2002).

IT has a profound effect on business performance and stronger IT governance correlate positively with better IT outcomes (Marks, 2010). An important question for the company and especially its internal auditors are if IT projects (operations and spending) are controlled and in line with the strategies and objectives. This is critical for the organizational performance (Milne & Bowles, 2009).

IT governance has become crucial in the support, sustainability and growth of the business and an effective governance can help ensure that IT adds value for the company (Reinhard, 2012). The understanding of IT in the overall company, as well as an active participation among corporate executives, IT management and business management are important for this fulfillment. These "relational mechanisms" are crucial for the IT governance framework and to sustain business/IT alignment (De Haes & Van Grembergen, 2009).

Standardizations are in general underestimated even if it sometimes could be the optimal alternative for the company and its business (Hanseth & Monteiro, 1997). Although standardization could lead to business benefits, it could also bring disadvantages in form of reductions in variety and this limitation ends in larger costs (Farrell & Saloner, 2004).

4 Results of the Case study

The case study was performed through a simple IT audit process. The data collected in the literature study provided support for a process of doing an IT audit influenced by Technology Debt as seen below. By applying this process to the secondary analysis of qualitative data and the interview study we were able to assess the potentials of Technology Debt in an IT audit setting.

Identification → Categorization → Valuation

Study/Process	Identification	Categorization	Valuation
Litterature study	X	X	X
Secondary analysis of qualitative data	X	X	
Interview study			X
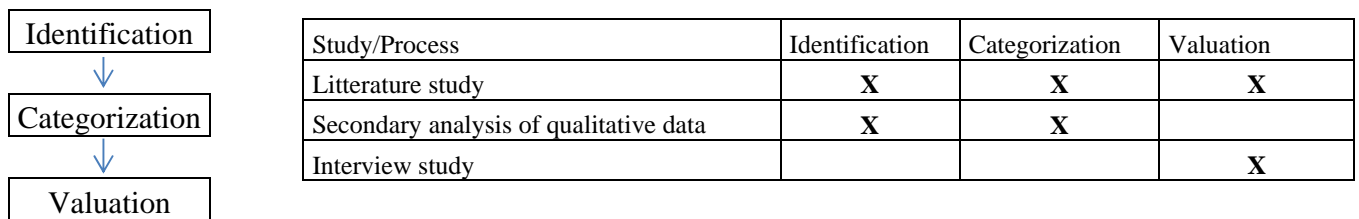
Figure 2: The simple IT audit process and the contributing studies

4.1 Identification

4.1.1 Literature study

The GAIT methodology and its principles influence the first two steps in the above process, identification and categorization of the debts. The principles of GAIT have been reformulated to better explain how these steps have been performed in the studied case. The identification of ITGCs processes are the purpose in the GAIT methodology, but the aim in this case is to identify Technology Debts. These are then categorized according to the definitions of the Technology Debt subareas.

The debts are first identified together with all IT related problems and risks in the company, but are then distinguished as a debt from other problems and risks if a future limitation for the organizing of IT is brought. The Technology Debts bring future limitations at different areas in the company and the debt can also be further divided into the subareas. The fourth and last principle was not applied in process as it wasn't relevant to this particular case.

Number	GAIT principles	Process of Technology Debt identification
1	Identification of risks and related controls in ITGC processes.	Identification of ALL problems/risks related to the company's IT environment.
2	The ITGCs processes identified are those that affect IT functionality.	Those problems/risks identified that affect future actions (future limitations) for the organizing of IT in the company are Technology Debts.
3	The ITGCs processes exist at various IT layers.	The Technology Debts exist in various main areas and can be further divided in their subareas.
4	Risks in ITGCs are mitigated by the achievement of IT control objectives.	The Technology Debts can be mitigated, but first the company in question must identify the debts and understand how to gain control over these.

Table 5: Translations of GAIT to Technology Debt

4.1.2 Secondary analysis of qualitative data

In this step all collected data concerning the company IT environment was observed and from this information related risks and problems were identified. If the risk/problem identified included a possibility for future limitations in the company it was in turn identified as a Technology Debt. A few of the problems didn't qualify as debts, even though they were serious problems. 27 different debts were identified and are presented on next page with selected citations from the transcripts. The names of some systems, applications, suppliers and management tools were anonymised.

No.	Debt	Citations from transcripts
1	New systems are insufficient to replace the old systems	"ERP does not allow financial control for each specific order (ERP cannot handle salaries). Will try to implement ERP for Revision control system, although salaries are not possible in the ERP".
2	Work overload on IT, both local and central	"IT is an operative unit that puts down fires, there are no resources to work with development issues" "The IT-department is way too small. A problem in Company AB is that we are supposed to do everything, but lack the manpower to do so".
3	IT is given work that should be resolved at lower instances	"There is no formal way to go when it comes to IT and to get new or improved functionality of systems and applications are the IT department always the first instance for help".
4	Negative attitude towards some systems	"ERP does not work very well for us." "It could be more effective "."ERP is totally useless, have not received any information on when or what will happen".
5	IT is not regarded as user friendly	"Should be a kind of support function enabling managers to take the right decisions etc. Important information should be available in a simple way at all times. This is not always the case today. More user friendly, not easy to find what you want".
6	Negative attitude towards IT	" I am not a nerd like the IT department so I do not know. But I wish that we work on the same program that will help us become the biggest company".
7	Systems important to the business is perceived as often indisposed due to updates	"ERP is often down due to updates".
8	The quality of the communications between Sweden and the foreign offices is perceived as unreliable	"Sometimes we have some problems with the connection to Sweden".
9	Resistance towards change within the company	"I am very satisfied with ERP, all main processes are based on this ERP. Some of the selection tools will be in another ERP in the future. I want these to be connected to the good ERP as well for follow up purpose".
10	Lack of systems important to the business (Different systems and areas)	"We have no apps at all today but appsd are certainly smart solutions we should have". "We have not properly Product information management systems today, should have it but we don't have a database to handle this in a good way".
11	Low quality of the communications between Sweden and foreign offices	"Sometimes we have some problems with the connection to Sweden (the server in Sweden), I know people sometimes are not very happy when they have to fill in their passwords several times".

12	No general collaboration tool/cloud	"We need to be able to hold video-meetings with the capability of file sharing."
13	Outdated technology	"Have had it for a few years, needs to be refreshed."
14	Decentralized IT investments and operating expenses	"Laptops and printers are rented from (doesn't know who). "
15	Redundant systems	"Too many systems make it difficult to connect the processes between the systems".
16	Several different databases with the same information in different structures	". It is better to have one system with common solutions, but three different systems doing exactly the same thing".
17	Use of systems not owned by the company	"Not easy today to share files with my colleagues in Belgium, Spain etc. So we use drop box".
18	Locked in an unfavorable supplier contract of a system	"We gather ideas and pose the question to our supplier to find out about what it costs and then we add it as a project. The supplier uses their own servers and has locked Company AB".
19	No standardized distribution key of central IT-costs	"There is no financial model for IT costs".
20	Lack of control of IT-costs and projects	"I don't know what goes on at the local level or how IT projects and IT spending are measured and followed up upon".
21	Lack of an IT-strategy on acquisitions	"Some acquisitions will be made, what will happen with the ERP then? We need a strategy on that".
22	Implementation/development of new systems is not given adequate resources	"We received ERP as a "present" from Sweden, the training was not very strong, we had to learn ourselves by doing and we have never been asked what we need. This is also why some functionality in ERP is not used because we do not understand how it works".
23	No formalized process on requests within IT on a strategic level	"There is a lot we can't see, we have no management reporting and are in need of a good data warehouse".
24	Uncertainties regarding ownership of responsibilities and systems	"All programs are completely stand alone. "Computer aided design" is "stand alone", but should be connected to ERP, but ERP is not capable of performing what is acquired. We have hired a consultant and he is working with the continuous improvement, but he works separated from the IT department".
25	No general IT-Policy/Strategy	"Do not have a clear IT strategy and not enough height at managerial level in IT so everything goes up to management. Unclear governance. We have to lift ourselves and turn professional and start working with professional agencies".
26	Standardized systems are not optimal in a business where specialized products is the norm	"You can't build IT systems for standard products when selling mostly specialty products".
27	Business lacks knowledge on that IT is	"The IT department only develops for ITs' sake and not for the business".

Table 6: Identified debts

4.2 Categorization

4.2.1 Literature study

The typology of Technology Debt is very important as it explain where the debt occurs. The identified debts in the company were more clearly visible in some of these areas than others and most of the found Technology Debts are already well suited for the descriptions mentioned in the original article of Technology Debt. These results are a brief complement for better understanding of some of the Technology Debts identified in the company.

Ideology

A Technology Debt in the subarea of ideology implies that the IT staffs have a pro adoption bias for particular brands/types of technology. This technology might not be the optimal adaption for the business and this new technology is insufficient to replace the old one already existing.

Working environment

A suboptimal working environment for IT staff can be connected to the problem of "information overload". The IT staff is handling a lot of information and the areas of relevant information for business may be endless. When the endless amounts of information leads to an overloaded information environment it can lead to work overload for the IT staff. A work overload for the IT staff can also be a consequence of lack of human IT resources.

User satisfaction

It is clearly obvious that users and their usage of IT are a big challenge and their attitudes and beliefs are mainly built on perceptions. The perceptions are important to drive IT development forward, but when these perceptions are negative it will result in lower usage of IT. Such perceptions could also lead to a negative attitude towards IT and its usability.

Reputation

The major difference between the users' perceptions of IT is that the perceptions of the service are related to **reputation** while the perceptions of its usability are related to user **satisfaction**. Negative perceptions of service results in low level of trust and it will lead to larger business risks, resistance towards new technology and constrain the company. The internal communication is important to counter this. Negative perceptions will end in a lower trust of the IT services.

IT infrastructure

The definition of a Technology Debt in the subarea of IT infrastructure is very wide and there is no need to describe it further for the case sake. The IT infrastructure consists of reliable services such as systems and collaboration tools. The lack of IT services in terms of quality, redundancy, adaptability, interoperability and safety results in a Technology Debt.

Shadow IT

The definition of a Technology Debt in the subarea of shadow IT is also very wide. The decentralized decisions regarding systems and databases can lead to redundancy of IT and the negative aspects in loss of synergies and control result in a Technology Debt. The result is that technology is not used as intended.

IT governance

The concept of IT governance is very wide and a big challenge in the case studied. The following statements are related to the debts identified in the case.

- The control of IT projects and thus their costs is critical for the organizational performance.
- An understanding of IT in the business is important for effective governance. This can help to make sure that IT adds value in a company.
- IT and business should be integrated as the integration ensures that these are in line with objectives and strategies. It is important with a strategy for IT as IT is important in the corporate governance and will be important in the future.
- Governance towards standardization is underestimated in general, but can be a good solution. One disadvantage on the other hand is reductions in variety, which is unfortunate in an organization with many different products. The IT governance of standardization has clearly both its advantages and disadvantages and the previous described bias of optimal and existing governance decides if it is a Technology Debt.

4.2.2 Secondary analysis of qualitative data

The identified debts were categorized according to the main areas and then further divided into each subarea. This categorization was made to conclude where the debts occurred in the company. Some of the debts, although clearly debts, were difficult to sort as they qualified to multiple areas depending on what the cause was.

As the focus of the secondary data was to find issues within the governance and infrastructure of the company, the questions left out some parts of the typology of Technology Debt. This made it impossible to identify any debts within the areas of Competence and Technical.

No.	Debt	Area	Subarea
1	New systems are insufficient to replace the old systems	Staff	Ideology
2	Work overload on IT, both local and central	Staff	Working enviroment
3	IT is given work that should be resolved at lower instances	Staff	Working enviroment
4	Negative attitude towards some systems	Users	User satisfaction
5	IT is not regarded as user friendly	Users	User satisfaction
6	Negative attitude towards IT	Users	User satisfaction
7	Systems important to the business is perceived as often indisposed due to updates	Users	User satisfaction
8	The quality of the communications between Sweden and the foreign offices is perceived as unreliable	Users	Reputation
9	Resistance towards change within the company	Users	Reputation
10	Lack of systems important to the business (Different systems and areas)	System	Infrastructure
11	Low quality of the communications between Sweden and foreign offices	System	Infrastructure
12	No general collaboration tool/cloud	System	Infrastructure
13	Outdated technology	System	Infrastucture
14	Decentralized IT investments and operating expenses	System	Shadow IT
15	Redundant systems	System	Shadow IT
16	Several different databases with the same information in different structures	System	Shadow IT
17	Use of systems not owned by the company	System	Shadow IT
18	Locked in an unfavorable supplier contract of a system	System	Governance
19	No standardized distribution key of central IT-costs	System	Governance
20	Lack of control of IT-costs and projects	System	Governance
21	Lack of an IT-strategy on acquisitions	System	Governance
22	Implementation/development of new systems is not given adequate resources	System	Governance
23	No formalized process on requests within IT on a strategic level	System	Governance
24	Uncertainties regarding ownership of responsibilities and systems	System	Governance
25	No general IT-Policy/Strategy	System	Governance
26	Standardized systems are not optimal in a business where specialized products is the norm	System	Governance
27	Business lacks knowledge on that IT is	System	Governance

Table 7: Categorized debts

4.3 Valuation

4.3.1 Literature study

To value the debts size in the company four different valuation criteria were compiled with the theory as support. These criteria were ranked on a scale from Low-High (1-3) and the debt could get a maximum valuation of 12 and a minimum valuation of 4.

	Impact	Temporal	Spatial	Cost
Low (1)	Limits future actions	1 year	Local units	Low
Medium (2)	Limits future actions moderately	3 years	Central units	Medium
High (3)	Limits future actions severely	5< years	Entire company	High

Figure 3: Valuation criteria

"Impact" addresses the situation where a past decision limits future actions. For instance when a new contract is signed it may force one party to abstain from certain future actions. This is a requirement in the Technology Debt theory when defining a Technology Debt. The scale grades the severity of the impact.

"Temporal" grades the length of time it would take to completely amortize a debt and "Spatial" shows which entities are affected by the debt. If it is a long time-span and a lot of entities are affected, the debt is larger. "Cost" is the cost needed to pay to completely amortize a debt. Cost, Temporal and Spatial are all parts of switching cost. These three were used as complements to Impact.

4.3.2 Interview study

The valuators were asked in an interview to value the identified debts with the valuation criteria. Their valuations were compiled into a score between four and twelve where twelve is the most severe. Most of the debts were understandable to the respondents and those that weren't, were explained with examples from transcripts. The results from the valuations can be seen below.

Generally the respondents found it hard to generalize the debts because every situation is unique. The size of the debt, the cause and solution all played into the valuations. When uncertain, we asked the respondents to apply the questions to what they believed was the most ordinary case. They found it easier to value debts within the systems area. Three of the debts identified were considered too complex to value by either the IT director or the consultants. They have been removed from the comparisons to provide a more accurate result.

Assigned no.	Debt	Category	Subcategory	Valuations by IT director	Valuations by external consultants
1	New systems are insufficient to replace the old systems	Staff	Ideology	7	6
2	Work overload on IT, both local and central	Staff	Working enviroment	7,5	8,5
3	IT is given work that should be resolved at lower instances	Staff	Working enviroment	5	8,5
4	Negative attitude towards some systems	Users	User satisfaction	5	5,5
5	IT is not regarded as user friendly	Users	User satisfaction	N/A	7
6	Negative attitude towards IT	Users	User satisfaction	8	7
7	Systems important to the business is perceived as often indisposed due to updates	Users	User satisfaction	8	7
8	The quality of the communications between Sweden and the foreign offices is perceived as unreliable	Users	Reputation	4	4
9	Resistance towards change within the company	Users	Reputation	12	10
10	Lack of systems important to the business (Different systems and areas)	System	Infrastructure	12	10,5
11	Low quality of the communications between Sweden and foreign offices	System	Infrastructure	6	6
12	No general collaboration tool/cloud	System	Infrastructure	9	8
13	Outdated technology	System	Infrastucture	6	8
14	Decentralized IT investments and operating expenses	System	Shadow IT	7	7,5
15	Redundant systems	System	Shadow IT	7	8,5
16	Several different databases with the same information in different structures	System	Shadow IT	10,5	7,5
17	Use of systems not owned by the company	System	Shadow IT	6	5
18	Locked in an unfavorable supplier contract of a system	System	Governance	N/A	9
19	No standardized distribution key of central IT-costs	System	Governance	5	7
20	Lack of control of IT-costs and projects	System	Governance	7	8
21	Lack of an IT-strategy on acquisitions	System	Governance	5	6
22	Implementation/development of new systems is not given adequate resources	System	Governance	8	7
23	No formalized process on requests within IT on a strategic level	System	Governance	7	8
24	Uncertainties regarding ownership of responsibilities and systems	System	Governance	7	7
25	No general IT-Policy/Strategy	System	Governance	7	9
26	Standardized systems are not optimal in a business where specialized products is the norm	System	Governance	6,5	N/A
27	Business lacks knowledge on that IT is	System	Governance	7	6

Table 8: Valuations of debts

In the following two tables are the valuations summarized in each subarea and each valuation criterion. The respondents' answers were remarkably similar within each area and criteria, but seen to the answers and valuations in every individual debts (Appendix A), there are greater differences.

	Governance	Ideology	Infrastructure	Reputation	Shadow IT	User satisfaction	Working environment
IT Director	53	7	33	16	30,5	21	12,5
Consultants	58	6	32,5	14	28,5	19,5	17

Table 9: Valuations within each subarea

	Impact	Temporal	Spatial	Cost
IT Director	43,5	37,5	53,5	38,5
Consultants	47	35,5	57	36

Table 10: Valuations within each criterion

The results from the interviews and the valuations were very similar. The IT director gave the total amount of debt to 173, whilst the consultants gave a value of 175, 5. The distribution of debts is also quite similar. The similarities is not as great when we look at each individual debt, there the respondents rarely give the same value. To easily visualize these scores we have created the diagram below. This diagram clearly shows the areas where the company had the largest debts according to the valuators valuations.
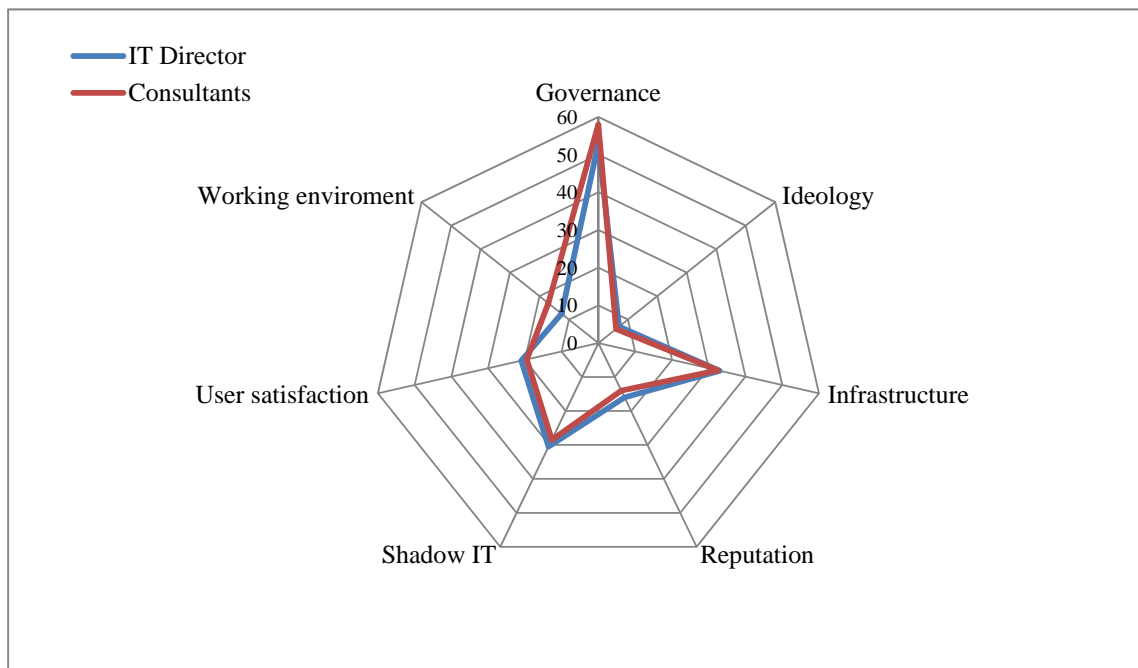

Figure 4: Distribution of debts

5. Analysis of Technology Debts use in the case study

A case study was performed as it was considered the best way to explore a new use for a theory (Yin 1994). An analysis of Technology Debts use in the case study can help to explain how the theory was applied in the case, but even more importantly, to provide a focus for further research. This focus should be on the resulting limitations with the theory and try to mitigate these.

To test the theory of Technology Debt it was applied to the three steps of our IT audit process

- Identification of IT issues
- Categorization of IT issues
- Valuation of IT issues

5.1 How was Technology Debt applied to the case?

The idea to think of IT issues as debts was not something that the respondents were used to, but they could intuitively understand what was presented to them as the concept was explained. As they were further involved in the process they became more accustomed to it.

5.1.1 Identification

When we went through the transcripts provided to us by the management consultants we identified debts first through looking for potential issues within the company, with the process of GAIT as an influence (IIA, 2007). Then we sorted all the issues on whether they were potentially any "Limits to future actions" (Magnusson and Bygstad, 2014) or not. This criterion allowed the removal of some issues.

5.1.2 Categorization

Technology Debt has a typology (Magnusson & Bygstad, 2014) which allowed categorization of the debts identified through the process. By structuring the debts into areas it was easy to find which area had the largest debt. If we hadn't had this structure to rely on it would have been a lot harder to point out where the debt was the greatest. Some of the debts were complimented with other research for a wider explanaition of the debts (see 3.3.2)

Some of the areas are well known as IT governance and Shadow IT, which made it easier to explain each area to the respondents of our primary interviews. For example were the

respondents familiar with that IT governance had impact on corporate governance and that IT and business should be integrated (Ko and Fink, 2009), but also the fact that lack of control can be due to the decentralized decision making (Grabski, Leech and Lu, 2001). Here we could find support from the literature study.

5.1.3 Valuation

The criteria used to value the debts were quite simple, but considering the complexity of every debt it would have been impossible to gain a generalized valuation with more complex criteria.

Technology Debt provided us with the criterion, "Impact" (The degree of limitation) (Magnusson and Bygstad, 2014), which was interesting to see the valuators try and grade. They liked the concept as it gave focus to the necessity of long-term planning when investing in IT. This would allow a CIO to motivate long-term investments to the management and not be forced to continuously make short-term decisions for the daily operations.

In the valuations the total sum given to Impact on all of the debts was almost the average of the other three found criteria related to switching costs (Burnham, Frels & Mahajan 2003). This might indicate that Impact is a sufficient measurement, at least in this case.

5.2 Limitations of the theory

Naturally there are always limitations in using a new theory in a setting it wasn't developed for. These limitations were found in the case study.

5.2.1 Identification

To use the criterion of "Limits future actions" as a guide to sorting issues was difficult. There are very few issues that don't limit future actions in any way, leading to a lot of negligible debts initially. There were difficulties in deciding where the negligible debts became significant debt as the line between negligible limitation and significant limitation is subjective.

A few issues were serious, but as there was no limitation they didn't qualify and were lost in the identification process. Using the "Limits future actions" criterion alone could unfortunately allow some important issues to be missed.

5.2.2 Categorization

When we had identified all the debts in the transcripts we started to sort all of them in the areas of the typology. Some of the areas weren't applicable to our case (Competence and Technical) most likely because the transcripts we analyzed had a focus on the infrastructure and governance of IT. As the secondary data had a more narrow focus we couldn't conclude that the company does not have any debts within these areas.

The typology, as presented in the original article, didn't elaborate much on each area. To give our categorization more validity we did extended research into the areas of Technology Debt where we identified debts. Because the original typology was very short we needed this to be sure we categorized correctly.

The relations between the debts were strong and we thought that it was very difficult to sort them easily into the typology. To be able to sort the debts easily we would need to de-construct them to find the unique cause to the current situation. An example is the debt of "Negative attitude towards some systems" (see 4.1.2). In the original interviews performed by the consultants some of the respondents had the opinion that some of the systems used by the company were incomplete or insufficient to fulfill their needs, this would indicate a debt within Infrastructure. When we later interview the IT director about the debts and go through this debt he responds that the systems are actually sufficient for their needs and that the users just lack the knowledge of how to utilize them and the desire to obtain that knowledge, which would make it a reputational debt. The ambiguity of the generalized debts could be solved through creating more specified debts as in debts eight and eleven. Debts eight and eleven are very similar, but there is one significant difference in that eight is an opinion and eleven is a fact. To dissect every debt into every aspect of the debt to be able to sort them easily is however a time-consuming enterprise and there might be less complex ways of sorting them.

5.2.3 Valuation

Technology Debt as it is has only one valuation criterion, "Impact". This is indeed a very useful criterion for a CIO to motivate long-term investments, but it doesn't give a nuanced picture when performing an IT audit. It would perhaps be useful to explore more criteria. It is also very difficult to assess the potential limitation of a debt in the future, which forces a very limited scale of valuation.

6 Discussion

Previous research concluded that there exists different IT audit methodologies (Grenough, 2006) (Von solms, 2005), but these are pretty complicated (Shaw, 2006). The focus on traditional risks is outdated (Hadden, Hermansson and DeZoort, 2011) and there are negative perceptions of IT audit, even though it can provide additional value (Merhout & Havelka, 2008).

To test Technology Debt a new simple process was developed, as the existing IT audit processes are complicated (Shaw, 2006) and also difficult to apply to this new theory. This can be used as a guideline, but there is a need for further research on this area. The focus on risks is exchanged by a new focus on future limitations, thus a new approach towards IT audit is presented. There are several other problems within IT audit presented in the previous research that still needs researching.

As previously stated, IT investments are often very difficult to justify (Shao & Lin, 2002). The fact is however that IT investments have increased because of the belief that IT has a positive impact on organizational performance and researchers have attempted to contribute with validity to this belief, but failed to show evidence of IT investments impact in organizations (Osei-Bryson & Ko, 2003). This new focus of IT auditing gives CIOs a new tool to manage IT investments.

Technology Debt is not a complete tool to perform a professional IT audit, but through testing and development it might reach there.

The purpose was to contribute to the knowledge of IT auditing by testing the theory of Technology Debt in an IT audit setting. The testing was conducted in an IT audit setting (case study), through a simple IT audit process. There is a need for further research in Technology debt and IT auditing to mitigate the limitations with the test.

6.1 Contributions for research

This study contributes to the research stream on IT auditing through introducing a new angle to perform a valuation of IT issues. By combining existing processes with the new theory of Technology Debt we create a new alternative where the value of a debt is measured in limitations to future actions (Magnusson & Bygstad, 2014). Furthermore we empirically test the theory of Technology Debt in practice.

6.2 Contributions for practice

The thesis contributes mostly to practice through introducing the new theory of Technology Debt as a tool to be used by IT auditors in their work. We also gave the company a nuanced picture of their current IT environment.

6.3 Directions for further research

We have three areas where we think further research is needed. Firstly there is a need of further studies into what constitutes as a significant debt as opposed to a negligible debt. The term "Limits future actions" needs defining. Secondly we found that there are heavy dependencies between the debts. Studying these further may improve the typology of Technology Debt. Lastly there is a need of exploring more valuation criteria, to give a more accurate valuation.

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Appendixes

Appendix A: Individual valuations of debts

1. New systems are insufficient to replace old systems

The respondents felt that, while this could be an effect from a biased staff, this was not a large debt in the case of the company. In general however they thought this

1	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	1	1-2	2-3
B	1	2	1	2

could be a serious and complex debt to amortize; the lack of competence of an intended improvement could have very negative effects on the reputation of central IT.

2. Work overload on IT, both local and central

2	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	1-2	3	1
B	2	1-2	3	2

According to the respondents, this debt is medium large. They agreed that it would take quite some time (1-3 years) to recruit personnel and redirect the workflow. As the debt implies it affects the entire company. It is, however, relatively cheap to fix.

3. IT is given work that should be resolved at lower instances

3	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	1	1	2	1
B	2	1-2	3	2

Considered by the respondents as a cause to the previous debt it was valued similarly. The IT director believed that the timespan could be significantly lower than the consultants, as he stated that the quickest fix was to stop doing the work that wasn't supposed to reach IT. This would not be an optimal fix he also stated.

4. Negative attitude towards some systems

4	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	1	1	1
B	1	1	1-3	1-2

The score was mostly dependent on the systems importance. Worst case it could lead to a halt in the development of the company. All the respondents agreed that the cause was most likely lack of communication and education. The IT director felt unsure about how to value this debt mostly due to the fact that he hadn't experienced it.

5. IT is not regarded as user friendly

5	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	N/A	N/A	N/A	N/A
B	1-2	1	3	1-2

 In this, as in most other debts, the valuation depended on whether there was an actual lack in the systems which needed fixing or if it was just an opinion that needed to be educated away.

6. Negative attitude towards IT

6	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	1-2	2	3	1-2
B	1-2	1	3	1-2

Believed to mainly be an effect of several other debts ("Negative attitude towards some systems" and "The quality of the communications between Sweden and the foreign offices is perceived as unreliable." etc.). Mostly an educational fix.

7. Systems important to business is often perceived as indisposed due to updates

7	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	3	1	2
B	2	1	3	1

 This debt is very hard to amortize as there will always be a need for updates and so the perception would never completely be removed. The best fix to affect the opinion would be to communicate clearer when and why there are updates.

8. The quality of communications between Sweden and the foreign offices is perceived as unreliable

8	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	1	1	1	1
B	1	1	1	1

If there is any cause for this opinion this would be more difficult, but as with most of the debts within the users' area this is mostly an educational fix. And as such it would be easily and quickly fixed.

9. Resistance towards change within the company

9	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	3	3	3	3
B	3	2	3	2

Considered as the second largest debt by the respondents, this debt can seriously constrain future actions. The IT director saw this as rather cultural dependent and thought the fix could potentially take more than five years. They also differed in their perception of the effect in the company, the IT director saw this as a company-wide debt where the consultants thought of this as more localized. Fixing this would take large amounts of time.

10. There is a lack of systems important to the business (Different systems and areas)

10	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	3	3	3	3
B	2-3	2	3	3

The largest among the identified debts, this debt was difficult to value as it is very dependent on the importance of the systems lacking. To fix it completely in the case of the company would take quite some time. The cost was mostly based on the previous IT environment.

11. The quality of communications between Sweden and foreign offices is low

11	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	1-2	1	1-2
B	2	2	1	1

Essential to keeping an international company together, this debt can affect other debts within the reputation sub-area. In most cases this is a quick and easy fix, but if the problem is due to insufficient infrastructure in the countries affected it is more expensive to fix.

12. No general collaboration tool/cloud

12	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	2	3	2
B	2	1	3	2

All the respondents agreed that the entire company is affected by this debt, they disagree however on the time scope. It was considered a medium debt. The largest impact from this debt would be the inability to properly communicate within the company, which has been stated as the solution to most of the debts within the Users area.

13. Outdated technology

13	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	1	2	1	2
B	1-3	2	1-3	1-3

Like many other debts the size of this one is very different depending on how crucial the technology is for the company. The respondents believed that in some cases it can be a very large debt.

14. There are decentralized IT investments and operating expenses

14	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	1	3	1
B	2	1-2	3	1

This debt has a very easy amortization, cut the budgets for local spending on IT. It was considered a potentially serious debt as rampaging local costs "steals" from the centralized budget in the eyes of the IT director.

15. Redundant systems

15	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	2	1	2
B	2-3	2	1-3	1-3

In the case of the company the excess of ERP systems has led to the inability to gain a complete overlook of the production. All the respondents felt that this was a very serious debt. Generally speaking the existence of several redundant systems is expensive and makes any move towards one common system harder.

16. Several different databases with the same information in different structures

16	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	2-3	3	3
B	1-2	2	2	2

Mostly an effect from the different production systems, this debt is however easier to amortize. The respondents thought that it could take quite some time however.

17. Use of systems not owned by the company

17	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	1	2	1	2
B	1	2	1	1

Not really a limiting debt this does however constitute a huge risk to a company. A clear sign that the intended systems are insufficient this is either solved through blocking access or developing a complete system.

18. Locked in an unfavorable supplier contract of a system

18	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	N/A	N/A	N/A	N/A
B	3	1-3	1-3	1-3

Potentially a completely limiting debt, this debt can be very serious. But as always this varies very much with the size and length of the contract. The respondents had a hard time valuing the debt in a general aspect.

19. There are no standardized distribution-key of central IT-costs

19	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	1	1	2	1
B	2	1	3	1

A lack of a distribution key for centralized IT costs wasn't considered a large debt. The ones that were affected by this in the company simply lacked the knowledge of the existence of such a key. It would be a more serious debt however if the local entities start questioning what

they are paying for. Amortizing it was considered to be easy and quick.

20. Lack of control of IT-costs and projects

20	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	1	3	1
B	3	1	3	1

A complicated debt that creates other debts, this debt could be very limiting if left unchecked. It is rather easy to amortize however. The timespan is very dependent on the specifics of the projects as it might be more damaging to stop half-way than to complete it.

21. Lack of an IT-strategy on acquisitions

The lack of a clear IT-strategy on acquisitions is the main reason that the company faces the current IT-environment. In itself this debt is amortized quickly

21	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	1	1	2	1
B	2	1	2	1

and cheaply, but those acquisitions made during a period without a strategy will still take a long time to consolidate.

22. Implementation/development of new systems is not given adequate resources

22	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	1	3	2
B	2	2	1	2

The lack of resources when new entities receive/develop new systems seriously limits the usefulness of the systems. Even though they might be all the users need, they won't know how to utilize them. The respondents agreed that it was an expensive debt to amortize.

23. No formalized process on requests within IT on a strategic level

23	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	1	3	1
B	3	1	3	1

The lack of clear paths within the IT structure can create a lot of Shadow IT. The reputation of the central IT will most likely decline as the users feel that their opinions are not valued as they can't communicate them properly. This frustration in turn the consultants believed could create a very limiting climate and structure.

24. Uncertainties regarding ownership of responsibilities and systems

24	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	1	3	1
B	2	1	3	1

This debt had a short time span, the respondents felt that it was easily amortized. In the case of the company it has only taken a couple of month to almost complete the clarifications. The time consuming part is educating the new system owners, which they think will be complete within a year.

25. No general IT-Policy/Strategy

25	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	1	3	1
B	3	2	3	1

Similarly to a few of the other identified debts, this debt is mostly amortized through the drafting and implementation of the lacking policy/strategy. That is a relatively cheap and quick task, even though it has a company-wide effect.

26. Standardized systems are not optimal in a business where specialized products is the norm

26	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	1	2	1	2-3
B	N/A	N/A	N/A	N/A

The respondents didn't have much to say about this debt as they felt their answers were covered in some of the previous debts (Implementation/development of new systems is not given adequate resources/No general IT-Policy/Strategy). The consultants did however state that this is the reality for most producing companies.

27. Business lacks knowledge on that IT is

27	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	2	1	3	1
B	1	1	3	1

The business sides' lack of knowledge of IT makes it very hard for them to be competent users and commissioners of IT. The consultants considered this debt quite low in the case of the company compared to other companies.

Appendix B: Interview questionnaire

Questionnaire Interviews as constructed by Consultancy firm AB

Introduction

1. **Name, role/title and organisation?**

2. **Please describe your role in short, for example which areas do you work with?**

Questions related to current situation of IT

1. **Which systems/applications do you use in your role to support your work?**

2. **Which tools or databases do you use today to follow up on customers, products etc.?**

3. **Who maintain and supports these systems/applications?**

4. **Who do you contact if IT does not function or work as it should?**

5. **What works well in terms of IT?**

6. **[For all people outside IT] Do you have any IT staff/personnel of your own?**

7. **[For all people outside IT] Do you have any IT contracts with external suppliers of your own?**

8. **[For people in IT] Are there any IT resources, IT personnel, IT equipment outside the IT department managed by business?**

9. **How do you get new or improved functionality/systems/applications in place?**

10. **Please describe how IT projects and IT spending are measured and followed up upon?**

11. **Please describe the financial model for IT costs. How much do you spend on IT in total?**

12. **What is the role of IT today according to you?**

Questions related to business

1. **Please describe business goals and strategy in short?**

2. **Please describe Company AB and your business area in 5 years? (Same customers, changed customer needs, same products/solutions, changes in the business model?)**

3. **What are the main challenges and improvement areas?**

4. **Which are the critical success factors for you to deliver the business strategy and business goals?**

5. **What are the key drivers for change, internally and in the external environment (main trends externally that affect Company AB)?**

6. **What do you measure and follow-up on?**

7. **What kind of steering/guiding documents are important for your area?**

Questions related to the future position of IT

1. **What are the main challenges in terms of IT? Main improvement areas?**

2. **Which are the critical success factors for you (in terms of IT) to deliver the business strategy and business goals?**

3. **What should the role of IT and the IT organisation be according to you (ref. Gartner quadrant model)?**

4. **What should (needs to) be done to achieve business and IT-alignment? Who should drive or enables the IT development?**

5. **What should the financial model for IT costs look like?**

6. **What should the decision model or decision structure regarding IT and IT spending (budgets, projects, change/improvement initiatives) look like? How can sufficient coordination be provided for?**

7. **Which IT technology/technologies should Company AB invest in the next coming years?**