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# **Crossing the chasm between industrial and software companies**

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| Abstract<br><br><p>Very few of the enterprise resource programme implementations put into action manage to meet their requirements satisfyingly yet the critical failure factors as well as critical success factors have been studied very narrowly. The role and the point of view of the employees who use the software has not been studied extensively throughout this operation and possibly holds some answers.</p> <p>To discover whether there is a gap in understanding from the software developers to the final users of the programme, a thorough inspection into the past research was required to gather a holistic picture. The objective was to define this gap in understanding and define what it would mean if it was there.</p> <p>The numbers of the failed and struggling implementations of different ERPs are too high to be accountable by the previously claimed issues such as cultural differences, top management support and ERP vendor support. These factors play a big role between complete failures and successful implementations by the vendors' standards but are still far from the desired benefits desired within the procuring companies.</p> <p>A possible solution to the issue of implementing and operating an ERP better might lie on the software side of things instead of on the procuring companies. Gamification is a rising topic in many software fields and has already begun to show in the ERPs as well. Future studies are needed to test the real potential this newish field of software promises.</p> |  |  |
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| ERP (Enterprise Resource Planning)       | Software to manage operations of a company.  |
| CFF (Critical Failure Factors)           | Important aspects of a company, which lead most likely to a failure.   |
| CSF (Critical Success Factors)           | Important aspects of a company, which lead most likely to success.   |
| BOM (Bill of Materials)                  | A product structure, which shows the relation of parts to one another.   |
| MRP I (Material Requirements Planning)   | Control system used to manage processes in manufacturing.  |
| MRP II (Manufacturing Resource Planning) | The effective planning of all the resources of a company.  |
| Game theory                              | The study of mathematical models of conflict and cooperation amongst decision makers who are rational and intelligent. |
| RTS (Real Time Strategy)                 | A software which operates at a predetermined speed and requires strategic inputs from the user to function correctly.  |
| APM (Actions Per Minute)                 | The average keystrokes in a time interval of one minute.   |

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## 1 Introduction

The implementation of an enterprise resource planning system or an ERP has long been an issue in any modern field of business, where such systems are required for more optimal operations. Historically, the track record has not been favorable for the implementation and changing of a system such as this. In its simplest form, an ERP system is a software that allows the tracking, managing and storing of information throughout an organization in an optimal way. Studies on the matter have shown that the failure rates of implementations are from 67% all the way up to 90%. Out of all implementations, 35% are cancelled, and the rest 65% that do manage to go through the whole operation do so with an average over budgeting of 178% and running overschedule for 230%. Despite these numbers, the critical failure factors or the CFF of this implementations are poorly studied and understood and much more effort has been put on the critical success factors or the CSF. Over the period of 1998-2007 only 6% of the articles were dedicated towards the CSF. More notably is the amount dedicated to CFF which is less than 1%. This area is not studied to the extent that it deserves and the employees will take the focus among these factors Amid *et al.* (2011, 228).

To understand why these numbers are as high as they are, a number of studies has been done on these issues. With that said, they are broad and often leave out a critical point of view out of the picture: the employee's view. The literacy review here takes a thorough inspection on the matter as a whole and to get a more holistic view, the experts' introspection is aimed and designed to address the issues from a more insider's perspective. This is because at the end of the day, an ERP system is supposed to make the work of an individual in an organization more efficient yet on the broader scale, this does not appear to be the case. There are many strategies for the whole company to implement, yet individually the issues might be somewhere else entirely.

The theoretical part will examine the broader impacts and define where the ERP implementation is currently and the introspection will take a more in-depth look into the matter from a new perspective. The discussion focuses on the employees, how their part in an ERP is and why and how it could be improved for the future. The

study leaves out a critical component and is worth taking note of, that being the software programmers who make the systems. Their part is critical and should be understood as well.

### 1.1 Aim of the study

Software programmes are an integral part of our modern society and the companies and industries that keep it alive. However the transition from the old patterns of work into this new digital age has been difficult and there is vast potential yet to be unlocked by companies. Even moderately sized companies have powerful software tools in their hands that provide a lot of data of the companies. This is a good development but without the employees and employers alike being able to utilize this data and the tools, the benefits turn easily to liabilities and increased costs. To resolve this, there has to be a way to improve the usage of these software tools and data without the staff necessarily being highly trained IT experts.

As will be seen, a great deal of studies have been conducted on the issues of ERP already and even more on their benefits. Kimberling (2015, 2-5) The numbers on the failure side are far too large to be put on the currently identified issues. Amid *et al.* (2011, 4-5) And some of the issues might be only symptoms of the true problem that lies in the current way of the implementation and usage of ERP systems. This core issue is the role of the employee which will be examined thoroughly and researched to understand if there is a gap in the understanding of the tasks and operations of the employees of a company and the creators of the ERP software that sell their systems to be used in the daily operations of these people.

This thesis focuses on the industrial sector as their practices are more tangible and the theoretical can be turned to practical examples with greatest ease. The industrial companies used as examples in the theoretical frame are from around the world as the same issues plague companies no matter where they are and how they run their business. More specifically, the role of the employee and their part in the usage of the ERP system will be examined with the co-operation of an expert in the field. This way opens possibilities for a new perspective from which to see and understand the major issues this field of software is facing.

## 2 Research methods

### 2.1 Qualitative versus quantitative approach

According to Newman (1998, 3), the qualitative and quantitative methods of research can be defined as such: “The qualitative, naturalistic approach is used when observing and interpreting reality with the aim of developing a theory that will explain what was experienced. The quantitative approach is used when one begins with a theory (or hypothesis) and tests for confirmation or disconfirmation of that hypothesis.” With this definition, it is important to note that the author Newman dispels the dichotomy between these two approaches and argues they are intertwined in all research to more or lesser degree. The combined use specifically is called an interactive continuum.

With that said, the qualitative method is used more here as there is a specific theory, that of the gap between the employees of a company and the software designers of an ERP, which will be examined with a thorough inspection of the field in its current form. The qualitative side also comes into play in the theoretical parts where other industrial companies are observed and in the discussion at the end where the phenomenon is reasoned from intangible to tangible with the aid of the introspection of the experts. The nature of the subject dictates the use of qualitative approach in the sense that opinions of people will be measured and their relations to other people in a specific context, the use of an ERP. This makes sense in the broader context as the qualitative method stems from the fields of anthropology and sociology Newman (1998, 9). The quantified answers from various other studies will then be used to assess the initial hypothesis.

Mahoney (2006, 230) defines the qualitative approach as to identify the causes of outcomes that are known for all of the cases that are inside the area or the scope of the theory that is being studied. Mahoney clarifies further that: “By starting with cases and their outcomes and then moving backward toward the causes, qualitative analysts adopt a ‘causes-of-effects’ approach to explanation.” This further categorizes this study as a qualitative one as it is a well-known and well documented fact that too many ERP implementations fail and have failed ever since their first adaptation



into companies. The quantitative approach is seen by Mahoney as more of a way to examine a controlled experiment.

## 2.2 Methodology of the data collection

The primary data is a collection of studies conducted throughout the world with an emphasis on industry to limit the variations between companies. There is still great variety there but the function of the software in this environment follows similar functionality from company to company Jacobs, Weston (2007, 361). This primary data serves as a canvas that draws the broader picture of the issue being defined. As these help to solidify the issue, a host of questions arise that help defining the problem further. The primary data is gathered from around the world and from industrial companies. This way the social aspects come into play without being interfered by other variances in the general corporate strategy. As these companies are examined, key patterns are noticed that warrant further examination from the point of view of the individual employee and to understand what is happening on that level when the systems fail to work as intended.

The industrial experts assist with the more in depth analysis of the situation with an insight into how the role of the employee is seen. As the employees are often left out of the loop, their point of view is critical to understand. Also, their relation to the developers of the software need to be understood and if any connection exists in the first place.

## 2.3 Research questions

The main issue to be solved is the following: Is there a gap in understanding between the people who make the ERP programs and the employees who use them? The follow up to this is: What are the effects of this if this can be observed? The approach will be from the bottom up; to understand the employees' point of view and part in the process of taking up and using an ERP program. This is critical to understand yet many of the studies done in this field focus on the other factors and analyze them to a great extent while seemingly marginalizing the employees role Munir (2013, 106-107). Often an emphasis in the other studies is put on employee training as it is seen

as the third most important factor in implementation failure factors but there appears to be very little focus put on the programs being made in a way that encourages intuition and natural human learning and development Dorobat (2012, 622).

The other major area to be explored is how to mend this if this can be shown to be the case. If a connection cannot be found, the issues might lie deeper within the developers of the software or a broader examination might be required. There are major fields that have risen recently that delve deep into the human/software interaction. The biggest field to explore the possibilities in this is the video gaming industry. They have the terminology and decades of experience in this specific area that help define and prove the issues ERP is facing Sepehr, Head (2013, 2-4). To add to the legitimacy of this field, SAP, the largest ERP company in the world, has its own entire R&D department dedicated to this explore the possibilities this field has to offer to its product line of software Lusher (2013, 2-3).

## 2.4 Limitations

The biggest limitation of the study is that the other side of the topic, the programmers, will be limited. Instead, the focus will be on the employees using the programmes within companies. The broad implications will be carefully evaluated and have been studied extensively, but the programmers appear to be often left out of the matter in terms of training the end users to their respective tasks. The software is just made operational and sold in that state. There is quality control just as in any software area, but there are too many issues specifically in the area of ERP in regards to the end users for it all to be just a coincidence.

Another important limitation is that the companies evaluated are all contained within the industrial sector. This way the variables are kept in control. The service sector has a great deal of variety within it as an example and its operations vary a lot as well. In the industrial sector the ERP systems handle roughly the same functions and the employees' roles are relatively similar, again keeping the variables limited. This might warrant a more extensive study on a broader scale in the future but as it stands, this limitation will serve well as it does not limit the results significantly. The

focus will not be in the actions per se but rather in the learning and general understanding of the system.

### **3 Literature review**

The ERP software is infamous with its issues in implementation throughout the world and time. There are many examples of these and a great host of meta data from previous studies. That said, the studies often only mention overall numbers of the companies and they tend to focus on how the company improves, or in fact fails to improve, after its implementation of a new ERP system.

In the literature review, a focus is put on specific studies from around the globe that put more emphasis on the employees of the company and how they have felt throughout the process. These give insight into an underlying issue, which will be further opened up that a great deal more focus and attention should be put on the actual people working with the software than is currently the norm.

#### **3.1 Enterprise resource planning (ERP) software**

Enterprise resource planning or ERP software is at the core of modern companies regardless of the field of business. This is also true mostly regardless of the size, as very quickly a company would lose in competition to other companies that are able to reap the benefits from an ERP system in their daily operations. Beheshti (2010, 446-447) describes ERP as a system that is “designed to improve productivity by upgrading an organization’s ability to generate timely and accurate information throughout the enterprise and its supply chain.” Implementing it successfully can yield many benefits such as lower inventories, lower development cycles, better customer service and improved coordination of global operations. There have been studies done on the effects of ERP when it is successful and there has been found a link between the performance of a firm and its productivity according to Poston (2000, 487).

Fundamentally, it is a software that enables a firm to operate more efficiently in every level of the organization when it has been adapted correctly. In this program, one is able to create pages for products that contain information about the product, cre-

ate bill of materials or BOMs, handle procurement and sales and human resources to name the most critical operations. In addition, an ERP system may be modified, and indeed usually is to the detriment of many companies, to fit into the operations of a company. This operation creates often trouble and is one of the results of the mismatch that happens between the people creating these programs and the actual users. There are a host of other features pictured below which touch virtually on all the aspects of a modern company's processes and departments. These can all be tailored, and usually are, to fit to any field a company might be specifying on which is why the emphasis has been limited here to include only the industrial sector.

|   |   |  |  |
|---|---|--|--|
| <b>Business intelligence</b><br><br>Analyze data and convert to information   | <b>E-commerce</b><br><br>Focus on external strategies   | <b>Enterprise asset management</b><br><br>Efficiently and sustainably manage the entire asset lifecycle, improve asset usage and cut costs with powerful analytics | <b>Others</b>  |
| <b>Customer services (CRM)</b><br><br>Capture and maintain customer relationships, facilitate the use of customer experiences and evaluate the knowledge management | <b>Procurement (SRM)</b><br><br>Maximise cost savings with support for the end-to-end procurement and logistics processes                     | <b>Corporate performance and governance</b><br><br>Aims to streamline and gain greater control of the corporate services   | <b>Accounting</b><br><br>Automate any financial operations while ensuring regulatory compliance and gaining real-time insight into overall performance               |
| <b>Sales</b><br><br>Implements functions of order placement, order scheduling, shipping and invoicing   | <b>Production (PLM)</b><br><br>Helps in planning and optimizing the manufacturing capacity and material resources. It is evolved from the MRP | <b>Human resources</b><br><br>Maintain a complete employee database and to optimally utilize all employees   | <b>Distribution (SCM)</b><br><br>Control warehouse processes and manage movements in the warehouse and respond faster to challenges and changes in supply and demand |

Figure 1 ERP modules.

Adapted from the works of Shing Hin Yeung.

### 3.2 History of ERP

To get a holistic picture of the ERP software and why companies use so much effort in acquiring one, its initial rise into use and the functions it was built to fulfill must be

understood. The term was coined in the early 90's; however, it was derived from another system that has its origins in the mid-60's called material requirements planning or MRP.

MRP is a system built to handle processes in the manufacturing such as scheduling, inventory controlling and production planning. These systems were mainly software based and they proved essential in the management of the manufacturing of goods. The main objectives for this type of system are the planning of the manufacturing, which includes the delivering and procurement of parts, keeping lowest possible inventory levels and making sure that materials are available for the production line. In the 60's and 70's the need for a more integrated systems approach pushed the designers to develop better and better software. The company structures activities changed along towards more optimal solutions. As the communication and data streams improved, cost reductions, reduced errors and reduced throughput times gave the companies that adapted these practices an edge.

These functions were further expanded by the manufacturing resource planning (MRP II) method. This combination of methods and software widened the use of the MRP. The enhancements of this system include many things considered vital for any modern company such as the bill of materials (BOM), a product structure, purchasing management or item master data. All these innovations centralized data handling and eased the increasing amounts of data that was gathered from all the parts of the organization's structure for manufacturing.

The actual use of the term ERP evolved from these as the software and the organizational structures evolved beyond manufacturing into governments and service oriented companies. The early days saw ERP enhancing and replacing some of the positions in the back offices of companies; that is, handling the procurement and sales departments as well as the logistics, accounting and research and development. The critical benefits from this system are that the data is all in a single system, accessible by everyone who has the allowance, near to real time information and homogeneous layout and modularity. Historically, these factors have eased and expanded the work that an employee is able to do inside a company's software system Jacobs, Weston (2007, 358-361).

### 3.3 Modern use of ERP

The software has developed into a system where information sharing is in a key position. All the transactions of a company should be clear in the system and all these should be traceable. Although there are issues with this when implementing in real life, the benefits are too great, and often impossible, to ignore. The cost reductions arise from the time saved and improved operations management. On top of uniting a company's information into one single place, multiple benefits are possible mainly due to a system such as this being integrated into the processes of a company.

Order tracking or following an order through the system as it is being fulfilled, was possible in the earlier days but it would demand workforce to be constantly tracking manually the individual case. This might have been reserved for the most critical and bigger projects. Now all the orders, even the minute ones, leave a trace, which can be followed even later on enabling reactionary corrections.

Sales forecasting, or the ability to predict and anticipate how the future sales might go, is another major benefit from a system like this. This leads to the current forefronts of the development, which is the inventory optimization. This optimization is the careful balance between having stock for orders versus saving capital costs by not having it be bound in inventory sitting on the shelves. Any company can buy and make a two year stock of their goods for sale and not have to worry about the stock lasting but the capital costs of this amount of inventory is far too great a burden for the company. Liquid assets are what make a company capable of strategic maneuvers in the market and reducing inventory is critical in enabling this. This also reduces the risk of having outdated parts, expiries, warehousing and other wasteful activities Wu *et al.* (2009, 409-411).

Several issues arise from a system like this. A successful implementation is in a key role in preventing and mitigating these effects. However, this area is where a lot of issues emerge.

Customization is one of the difficulties. There are only a few companies that share the majority of the market share. These companies offer a certain initial package, which can be customized to fit the customer. The way this is handled often is that

the organizational structure and the staff are molded to fit better into the ERP system. The more the software is changed to fit the company, the more possible issues emerge later on if the programme is used in a different way than intended or when the software is upgraded.

The staff adaptation into a new system is not a given factor. Often there is resistance to these changes inside the company, which can go all the way to the top management. Some employees might feel threatened, as they are now required to share their information that they might feel personal to themselves. Another issue is that there might not be a position in a new ERP for some staff members, causing difficulties in organizational structures. Staff training helps in this but the costs are often very high and take time away from working hours within the company.

As the costs of integrating a system as big as this, the relationship between the companies and the ERP vendors can cause issues. The companies become dependent to a more or lesser degree on the software providers. If the system is not satisfactory, switching to another system is often very expensive and time consuming. If the initial ERP is causing many issues, switching to a better system might be impossible Doro-bat, Nastase, (2012, 622-624).

### 3.4 Defining the issues with the software

It is imperative to recognize the issue fully and to try and make it tangible. This same idea runs through the entire thesis, making intangible and theoretical things tangible and more intuitively manageable. The focus will be first on the popular software programmes that many companies are using in the industrial sector. This will be followed up with examples of things to come and some examples of software that are more tangible. Finally the focus will be put on example companies where these issues can be seen in effect.

To start with, the companies examined are from around the world and they all appear to have common and similar issues in their organization when using an ERP system. When dealing with a work environment, cultural differences in the work ethics and power distances and work ethics might explain some of the problems. However the similarities are too broad and too homogenous to be put merely on

these factors. To add to this, some of the examples used are from the same countries, USA and Germany, as where the majority of ERP systems are developed.

The initial implementation of an ERP is known to be a key problem in many cases where the software has caused issues. Ngai *et al* (2008) argues that the Critical Success Factors (CSF) are imperative to solving the initial implementation. According to their study, 18 CSFs can be gathered from a host of other previous studies on the subject and be identified as a path to a better chance at having a successful implementation. Out of these factors, top management support and training and education were the most prevalent ones. Among the rest, two major topics can be noticed: Organizational willingness for change and co-operation.

Included in the willingness for change are factors such as: business process reengineering, change management culture and programme, organizational characteristics and project champion. Business process reengineering mandates changes in the structures of an organization as an ERP is implemented because the software does not fit perfectly to any company out-of-the-box as it were. Instead, the company needs to be willing to change to a certain point. The change management culture and programme means simply the training of the staff to the new ways of working in the new system and adapting to new positions. This point in particular comes up in a study after study as a CSF. The characteristics of an organization means how much it has experience in software and its use. In many cases when an ERP has been implemented out of peer pressure, issues have crept up more. The organization should thus be more tech savvy even before the implementation. The project champion is a person higher up in an organization who oversees the implementation throughout the entire company and all its branches. Having a dedicated person handling the case ensures it will be more likely finished at some point and it helps the morale as there is a person dedicated in assisting during the harder over-time hours of learning to work in the new system. These factors require willingness from the organization as a whole to be adaptable and from the mind set of the employees and employers to be receiving change as a positive force.

Among the co-operation there were the following factors: communication, ERP teamwork and composition and national culture. Communication should happen in all levels and before as well as during the ERP implementation. When done correctly,



good communication also eases the acceptance of the employees of the new system as they better understood the cause and effect of the actions taken. ERP teamwork and composition considers the core team that takes on the task of implementing a new system. This team should have both the technical know-how of the software use and business knowledge. The structure of the team should be flexible as they need to be able to make quick and effective decisions. The members of this team should also be readily available to the rest of the organization to ensure better success. National culture is an important one to understand for the ERP vendors. The organization should also understand the cultural background from which the software is coming from as its structures are built quite deep into the software. The work ethics, organizational structures and communication between the employees are all affected by this and the software should be moldable to these as well as vice versa, to a certain extent. All these factors share in common the average employee and the importance of their co-operation and dedication to the process of implementing a new software system.

### 3.5 Ludic interface

Ludic interfaces are a branch from the video games industry that focuses on the human-machine interaction. They are simply interfaces that are physical and through which one can interact with software. The core question that is asked here is how this interaction can be enhanced and made more enjoyable for the end user. As Matthias Fuchs of Game Journal explains: "Ludic interfaces demonstrate how playfulness is about to intrude systems, devices and relationships that were once governed by determinism, control, and straightforward teleological thinking." Fuchs (2012 6-8). One of the common themes in the software industry now is to breach the gap between the user and the software and video gaming industry is on the verge of something new in this field. Many of the desired benefits from ludic interfaces overlap with the issues that the companies are facing in their operations: ease of use, intuitive, visual feedback and tangible data.

### 3.6 Gamification

Gamification is a trending feature in many software programs. In essence, it means taking a task or an objective and putting elements of gaming into it to increase engagement. The biggest ERP company currently, SAP, has an R&D department dedicated for this already and its effects are yet to be seen in the field of ERP. Herzig *et al.* (2012, 9-11).

The term itself might cause confusion, as it does not derive from game theory but rather from the video gaming industry. In essence, it is the application of game-design to achieve desired outcomes outside of traditional gaming contexts. Gamification allows the improvement of user engagement, learning, productivity in an organizational context, employee recruitment and evaluation and ease of use. Hamari (2013, 238-241). It is important to take notice here that the user is at the centre of attention here. The entire video gaming industry, which has been perfecting these aspects for the better part of thirty years, focuses, out absolute necessity, to the users comfort and attempts to make it as good as it can.

There are many genres of games out there but the few noteworthy to be considered here are strategy, real time strategy or RTS, and simulation video games. In these type of video games the goal of a gamer, or simply as a user which can be said of an employee managing an ERP system, is to visualize, plan and execute often very complex procedures which require careful calculations and risk estimations. There are many failure states, as a game requires failure states to be considered one, which the user will try and avoid in pursue of a goal. This goal can be growth, maximizing benefits, minimizing risks and conquering opponents, which can be either other adversaries or a hostile environment. By only switching a couple of words, these goals could be defined to be the same that a company on an open and competing market would define for itself. The greatest difference between the two is that the gamification aspect approaches from the point of view of the end user to solve these issues, from the bottom up. Hamari *et al.* (2014, 3025-3027).

There are many benefits that come from this field of designing a software programme. One such major benefit is the user engagement. In the video gaming market those products that engage the users the most are usually the market winners.

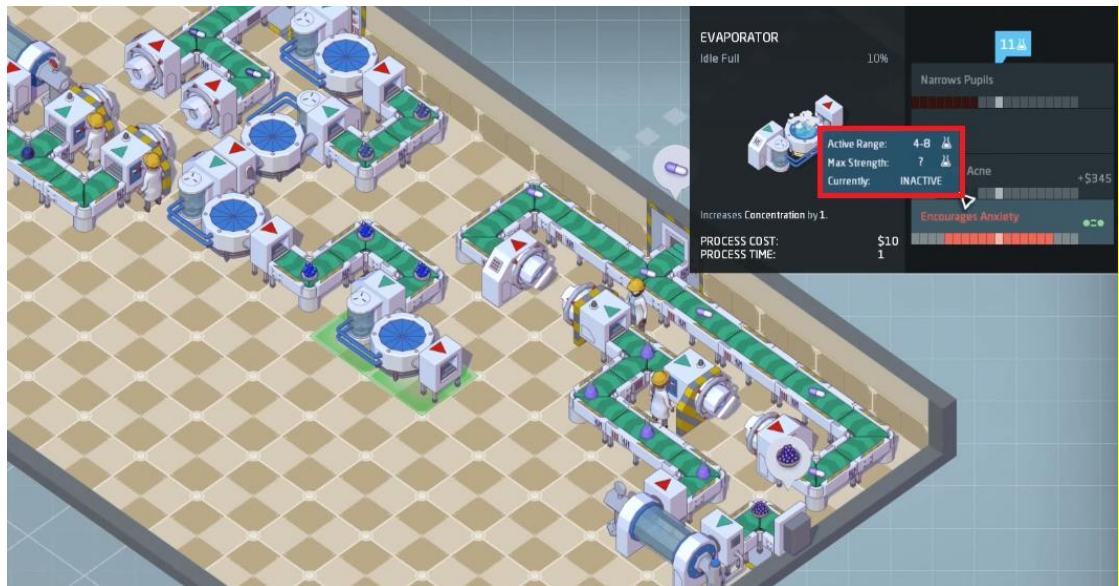
This has caused the companies to develop software solutions that engage its user and keep them engaged for long periods of time, as well as short as is the case with mobile phone games.

### 3.6.1 A practical example of functionality

The following two examples are taken from their respective fields of software. The goal is to offer a practical example in the form of functionality of the software used in the video gaming industry, which stems from its natural competitive market habitat, and point out the deficiencies in the ERP software, which has not been under as much pressure in its market to perform functionally. The importance of this added functionality to the learning curve of a software is also evaluated.

In accordance to the industrial companies, the example used here is of a pharmaceutical factory and its operations. The video game in question is called Big Pharma. The player in this game is a manager of a pharmaceutical company. The goal is to set up a factory and its operations and to manage raw materials inputs and transform them into finished medicinal products. The game simulates many of the real aspects which pharmaceutical companies face in the real market world. There are multiple factors to consider which apply to real companies as well such as delivery times, production times, delays, economies of scale, lead time, backlog, time management, scheduling, factory floor planning, budgeting, hiring staff, procurement of raw materials, procurement of industrial machinery, sales, sales forecasting, staff training, competing in the market and drug designing. The goal initially is to try and manage growth but there are also companies managed by an artificial intelligence, which competes in a realistic manner within the game's marketplace. The game even goes as far in its simulation as to mimic the adverse effects of drugs. As pictured below, if a drug is created with too little research invested on it, which is one of the key goals in the game to keep in check, then a drug can have too strong adverse effects when consumed and the general population might suffer from it, giving a competing company an advantage in the market. A minor detail to take notice is also the pop-up screen that appears when the mouse pointer is on top of the desired effect, which is highlighted with a red box. The information is attached to that particular part of the screen and is not visible until the mouse pointer is put on top of it. This reduces clutter.

ter and undesired numbers on the screen and keeps the layout simple yet effective. The gameplay is not broken and the user's experience is kept at an engaged level when they do not need to seek the information elsewhere yet they will still have everything they need at a slight move of the mouse pointer on the screen.

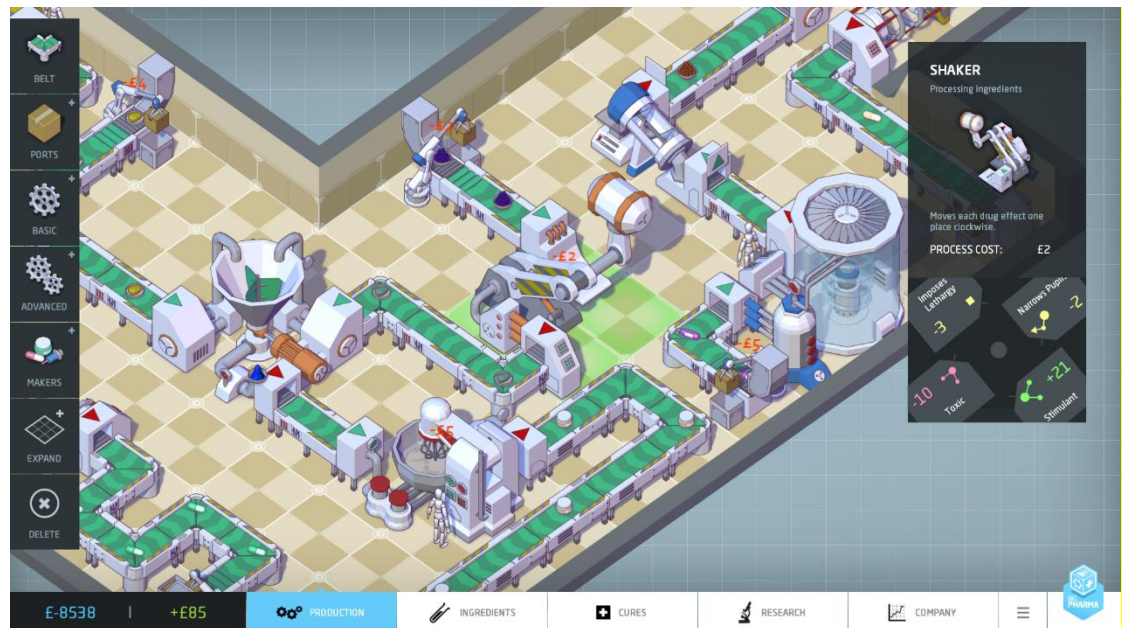


Picture 1 Big Pharma's main screen.

Captured within programme.

Another important factor in the field of video games is the learning aspect. Video games have gotten complex over time and yet there is always a strong incentive within the market to, again, enhance the user experience. Such terms as learning curve and teaching the mechanics are used to define how a video game allows a beginner to progress through the game and learn its functions in order to achieve a sensation and satisfaction of mastery. The learning curve describes the climb from first introduction to the game's rules and mechanics to the mastery of them. A learning curve is called steep if the user is introduced all the mechanics at once without any tutorials. As can be seen from the picture below, the layout of the different options in Big Pharma is designed in a way, which does not overload the user. There are clear visual cues for everything on the screen as well as colour assistance. In game there are also audio cues letting the user know of important matters and issues in a split second. The learning curve is eased with the aid of all these as well as a comprehensive tutorial. After a few hours of engaged operations, a user is expected to be

able to manage more complex operations, which can be seen on to background as the layout of the factory.



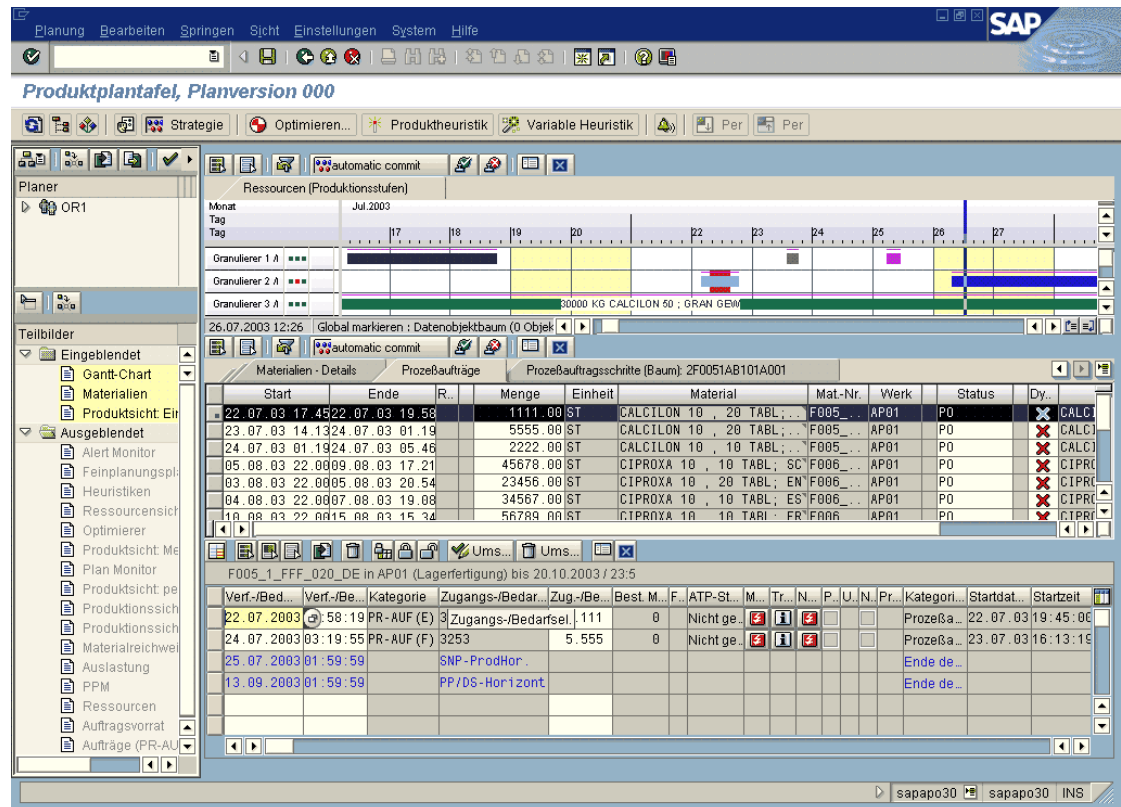
Picture 2 Big Pharma's entire screen and main hub of operations.

Captured within programme.

In the case of ERP systems this should not apply as the users are often required training of the ERP system beforehand. However, there can be argued to be a learning curve since ERP customization is prevalent and every company uses it to a more or lesser extent. Also every company's structure and methods of operation differ, requiring a user to learn the new company's ways of operation. Were the programmes designed to cope with this initial learning with built-in mechanics to introduce a new user, the staff training times could be possibly shortened.

Pictured below is a screen capture of one of the pages of the SAP ERP. The way the information is laid out in SAP, as in most other ERP software, is that there are pages which can be accessed with a drop-down menu on the side of the screen. In some programmes there can be upwards to tens of thousands of pages in these programmes. Each of these pages contain boxes of numbers and text which can then be filled out in order to execute certain functions and e.g. automate a procurement. The initial amount of information that a user faces in a programme such as this is gargantuan. It should not be underestimated how much information and delicate number

handling companies' fluent operations require. That makes a working and intuitive interface that much more critical to get right and to be designed user friendly.



Picture 3 SAP interface of a pharmaceutical company.

Captured within programme.

A comparison between the two examples presented here show that there is potential for cross-pollination between the two industries and their respective software. In ERP typically there is very little usage of the three dimensions available for programmes to aid with visual feedback. In video games this is almost mandatory to ensure engagement and effective learning of the mechanics. The ERP must be understood to have to be able to manage extremely complex operations with quick reactionary operations. This does not have to come with the expense of the user suffering from information overload, fatigue, company structure issues, disengagement or other issues currently affecting ERP users.

The learning curve can be visualised graphically as well. With physical products in a production line or any job that is repetitive, a period of learning takes place where a task is repeated until it is performed at its most optimal level in terms of quality and speed. The formula for this is  $K_n = K_1 * n^b$  where:

$K_n$  = time required to produce a unit when n pieces have been produced.

$K_1$  = original production time

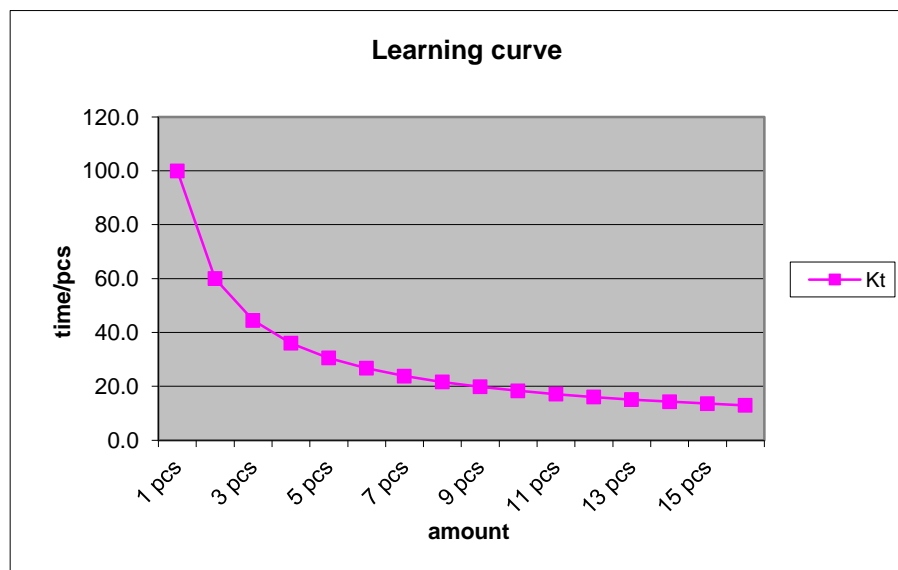
$n$  = cumulative amount of goods produced

$r$  = learning factor, E.g. 80%.

$b = \log r / \log 2$

In order to be able to give a quantifiable example of the learning curve, another term can be taken from the industry of gaming: actions per minute or APM. This term simply means how many keystrokes a person presses on an average of a minute. This number fluctuates heavily throughout longer time periods and is not expected to be maintained for 30 minutes at a time. This term is used in the professional scene of a number of video games as it is a useful metric in determining whether a user has a certain amount of skill to operate the programmes in their most efficient way. A typical average for a high intensity session of use is about 150 APM on average with the highest points being from 300 up to 600 APM, which in turn is 5-10 keystrokes every second. This is not typing the keyboard as with writing. This is the speed at which these professional players manage complicated tasks and manage multiple variables all while competing against other people and maintaining constant control and focus Wong (2014 3-4).

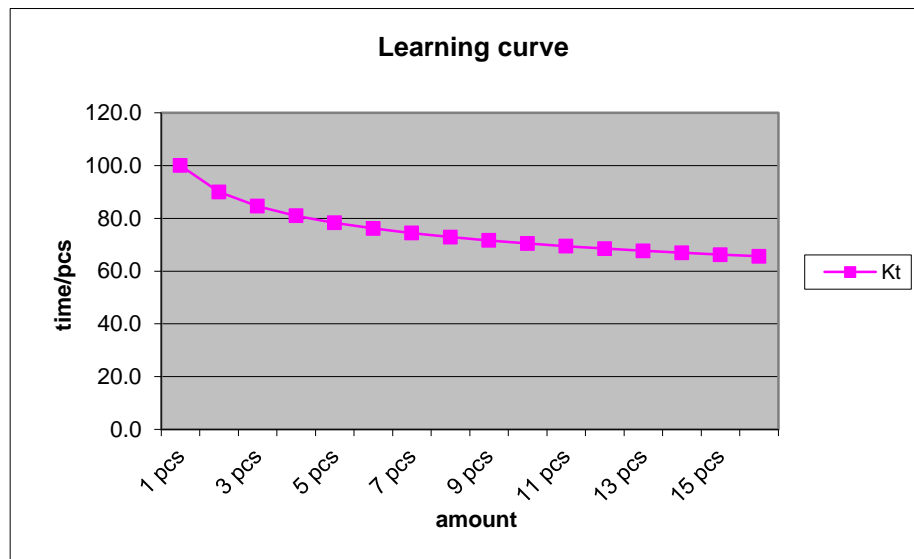
With a higher rate of APM, a supply chain manager can be quantified in his or her operations and the speed of the operations as well. In the graph below, the amount of pieces could be certain lines of goods or operations in a production line handled. when the learning curve is set to 60% and efficient, the curve looks as below.



Graph 1 The learning curve optimized.

Adapted from Teollisuustalous 2003, 318.

When the operations are not as efficient and the learning curve is set to 90%, the situation looks more stagnant as shown below. This visualises the difference when the software is optimized for learning. The potential to increase the APM of an employee and thus increase the productivity by improving the learning curve is observable in numbers yet these have not been capitalized in the ERP industry at the current time.



Graph 2 The learning curve unoptimized.

Adapted from Teollisuustalous 2003, 318.

## 4 Examining ERP integration in SME sized industrial companies

The CSFs and the CFFs are key part in identifying and understanding which factors exactly are resulting in success or failure in the implementations exemplified and examined in the following chapter. These factors vary in nuances from study to study but the overarching themes remain the same. These will be thoroughly analyzed in the questionnaire's results. Defining the factors in this manner is important, as it allows deeper analysis into the correlations and interactions between them as defined by Belassi (1996, 142-143).

To understand the issues with in the current paradigm of people working with an ERP system, it is important to inspect companies from a wide cast of varied countries and



cultures. This excludes the matter that the issues might lay in a singular cultural way of working and are exist instead within the current ERP systems themselves. The current countries that are producing the majority of the world's ERP systems and which are market leaders are western. This is reflected in the structure of the software that is produced and causes issues on its own. However, there are still underlying issues that are not apparent at first sight. This is why the following examples are from around the globe and from each respective country's industrial sectors.

#### 4.1 Iranian industries

As the focus of the issue with ERP has been on the actual users in companies, a comprehensive study, Amid (2011, 228-233), done to the Iranian industries as a whole serves as a canvas where the practical issues can be observed on a wider scale. As the study mentions, one of the core issues to the failure of ERP implementation, up to 70% failure to meet requirements and 25% complete failure, is that programmers in the west where they failed to understand the employees in Iran and other developing countries made the programmes. The success or failure was measure in a myriad of ways, from financial and timesavings to better decision-making.

To study the history of the implementations in the country, interviews from project managers were taken and literacy reviews were used. Through the interviews, up to 16 different causes of issues could be defined for the failed implementations. Some of the more notable ones were employees' high age, high system complexity, key users' replacement after training and poor key users. It is also important to note some of the factors that were not playing a key role such as unrealistic expectations and absence of an ERP readiness assessment before project implementation. These mean that the ERP was ready to be implemented and that the expectations were manageable for the most part.

The conclusions are that the issues stem from the fact that the organizations failed to realize what critical business goals the ERP system would address. Another key find was that there was a lack of clear IT strategies and the alignment of these with the business strategy and goals. Found in both the interviews and in the literature were multiple cases of issues in the project management. This was found to be an issue

repeatedly over the industry. The management team for the ERP implementation was often not full time and not fully staffed. The final critical note is the lack of human resources in the Iranian industries. There was little feedback from the employees back to the top management. The lack of communication from the employees was deemed a critical CSF.

## 4.2 Chinese industry

The Chinese industry provides an interesting glimpse to a neutral ground when considering the ERP software being used as they source these from around the globe. The language and culture are defined as major obstacles and these make the successful implementations that much interesting and important to understand why they were successful in the first place. As mentioned by Xue (2005, 280-281), amongst the key issues is a failure in communication with the vendor companies of the ERPs. The success rate of implementations in China is around 10%, which warrants a thorough inspection into the CFFs that the companies ran into.

One of the key points raised with the research is that the cultural differences in the social context vary greatly between the east and the west. In China, the society is structured around networks where people have personalism, paternalism and a high context in communication. The western culture on the other hand is more individualistic, impersonal and the communication is formal. This leaves its marks in the software when it is brought from the west to the east where the employees as well as the managers fail to realize the full utility of the software. These issues range from homonyms in the language to organizational structures that are incompatible with the software.

The examples used vary in the CFFs. The first example of a cosmetic company failed due to poor translation of the software from English to Chinese. This meant more than just wording as the order of many of the functions and the layout was off and slowed down the reporting significantly. The second example is a pharmacist, which had its employees protest after there, had been a misunderstanding that the whole company required business process reengineering. The employees did not want to restructure but for the program to adapt to their hierarchy and communications

web. A third example is a company specialized in exporting stone. Their issues were with the letter-of-credit payment reports. The exporting companies in China are required to follow a strict set of rules for the papers for exporting to be valid. The reports produced by their new ERP could not be adapted to according to these regulations. The cost calculations could neither be adapted to count their complex billing system.

### 4.3 Japanese automotive industry

The example from the Japanese automotive industry is from a larger company that has global reach on their products. The interest in this case is in their co-operation tightly with the ERP vendor and how they still had major issues and failure to implement their new system. They were also willing to make radical changes to their corporate structure from the beginning. The leading issue, as described by Motwani (2005, 539-541), was if the company's main force for the change and implementation of an ERP solely came from the top management and was being properly supported by the rest of the company.

The issues of this company began from the traditional case of growth. As they expanded their operations, changed and adapted their structure, they outgrew the mold to which the old ERP system had been built for by their parent company. This meant that tailoring was very difficult after a certain point had been reached. The coding was also outdated meaning it was difficult to find programmers who could code a new version for them. To raise themselves from this, the company went through a restructuring as well as a phase of adaptation and learning-by-doing in which the company was in a survival state to adapt to the new ERP system. What proved to be a helping matter was that the realization that a new system was needed came not only from the top of the company, but from the bottom as well. This aided greatly in the understanding and accepting of the system into the company's new operations.

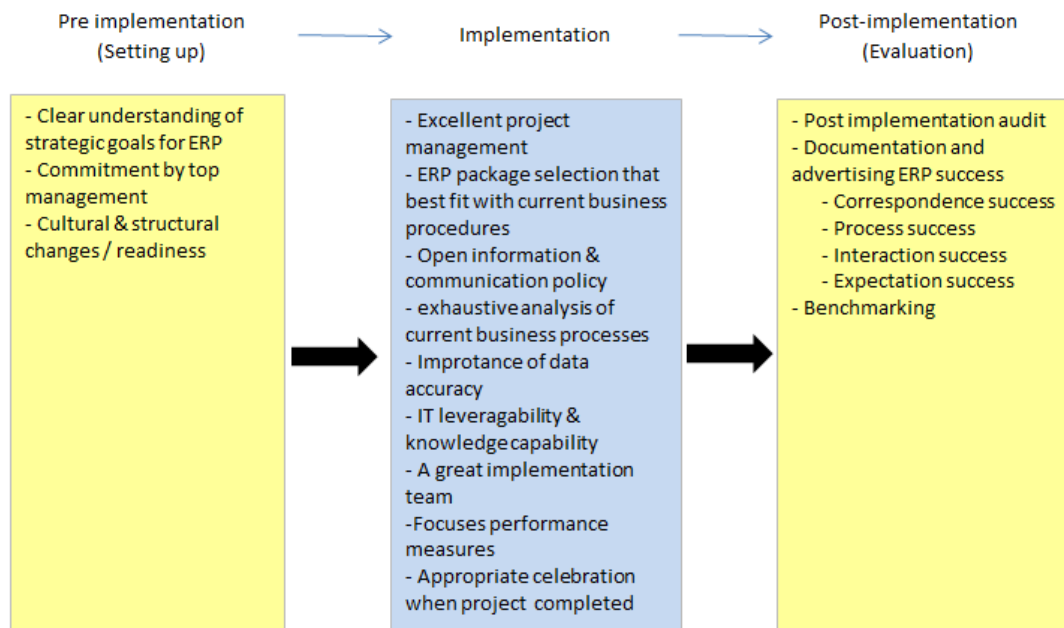


Figure 2 ERP implementation stages.

Adapted from Critical factors for successful ERP implementation: Exploratory findings from four case studies (2005)

#### 4.4 German industry

Germany is a critical country in understanding the usage and development of ERP programmes, as SAP and other major companies originate from there as well as consisting of 25% of the entire European ERP software market. The traditional German company’s hierarchy differs from other countries’ in that the structure is “lean” and very short compared to UK’s or France’s, as depicted below. This has the demonstrable effect on the ERP systems being on the market that they are structured and built to better suit a Germanic than Anglo culture. Regardless of this SAP still holds a dominant role on the market as leading software. The German companies, outside industrial ones as well, have also experienced higher rates of success in the implementation of ERP systems to their companies and less resistance from the work force. Skok, Döringer (2001, 2-5).

|                                 | Low | Medium | High |
|---------------------------------|-----|--------|------|
| Tallness of hierarchy           | D   | UK     | F    |
| Functional differentiation      | D   | UK     | F    |
| Share of white-collar employees | D   | UK     | F    |

|   |    |    |   |
|---|----|----|---|
| Supervisory span of control                     | D  | UK | F |
| Administrative and commercial personnel/workers | D  | UK | F |
| Authority positions/workers                     | UK | D  | F |
| Authority positions/white-collar workers        | UK | F  | D |

Figure 3 Administrative structures. Germany (D), United Kingdom (UK) and France (F)

Adapted from: Potential impact of cultural differences on enterprise resource planning (ERP) projects.

There are issues as well. A study conducted by a consulting company Detecon in 2012 revealed that 20% of the CIOs they interviewed told they were operating with 50 different systems. 80% of the CIOs expressed strong desire to reduce the number of programmes in use and to establish some standardization. The reduced number were below 10, with 36% insisting on only using a single system while 41% said a workable amount would be from two up to five. To solve this, 80-90% of the CIOs expressed that global standards for ERPs should be established from the existing software as mergers and company growth, regardless of field, inevitably creates issues in the current paradigm. Bongard (2012 34).

A comprehensive study done by the Germany Trade & Invest (GTAI) on the state of ERP in Germany in the upcoming years found that even though the expenditure for ERP software was estimated to be €2.5B in 2016 alone, the companies procuring these still reported major issues not being met. The demand for highly customized software solutions still remains high. Another noteworthy factor is that the emerging smart factories drive up the demand for more integrated ERP programmes across the industrial sector. As the backbone of the whole ERP industry in Germany are the many SMEs throughout the country, their drive for innovation and competition is estimated to bring resolutions to many current issues. Much of this focus is on the software side such as the upcoming era of the big data handling. These matters are critical but the issues with the employees using the programmes other than that the current graduate numbers from the fields of engineering and mathematics are very high, thus breaching the gap at least from one side. Troillet, Silva (2016 2-7).

## 4.5 UK industry

The British market area faces some of the toughest markets today. This means for the businesses higher customer expectations, increasing competition and expanding markets. Since the companies there are well established, the focus has in ERP implementation has shifted from “hard” elements such as company structure to “soft” elements i.e. human related issues which takes a deeper look into how humans find satisfaction in work and what engages them, not merely allows them to manipulate numbers in software.

The top management was found to be important in ERP implementations. The process requires strong leadership and management skills from the employers. They need to handle the budgeting, training and implementation all the way through. In successful cases, the employees were involved from the start and the programme was tailored with the people, the end users, in mind. To overcome resistance from the employees the management need to explain the process as well as the benefits and the training has to be thorough. Another important factor for the success is the organisational side of the company. Those who take into account early on the restructuring of the employee positions are more inclined to have a better success with their new way of working with an ERP.

The employee involvement is at the heart of the successful factors that determine better outcomes of the companies’ ERP implementations. When the end users are taken into account from the beginning and managed well throughout the integration period, the chances improve a lot for improved operations and increased growth Ibrahim (2008 6-7).

## 5 The Study

### 5.1 Comparing the countries

The studies examined before represent the current zeitgeist in each respective country and reveal a stagnated industry in terms of its software development. In many of the example companies the industry “standard” software was used; namely the in-

dustry leaders' software and their established standards for them. This offers a relatively good base to examine this software industry as these companies and their way of conducting business is the market winner's way at the current time. With that in mind here are the studies exemplified before and presented in the context of usability in the context of software in mind.

|  | Iran | China | Japan | Germany | UK    |
|--|------|-------|-------|---------|-------|
| Top management involvement important         | Yes  | Yes   | Yes   | Yes     | Yes   |
| Employees taken sufficiently into account    | No   | No    | No    | Mixed   | Mixed |
| Company structure changed heavily            | Yes  | Yes   | Yes   | Mixed   | Yes   |
| IT Knowledge by the employees                | No   | No    | Yes   | Yes     | Yes   |
| ERP vendor closely attached in operations    | No   | No    | Mixed | Yes     | Yes   |
| Cultural differences between company and ERP | Yes  | Yes   | Yes   | No      | No    |
| ERP implementation successful overall        | No   | No    | Mixed | Yes     | Yes   |

Top management is critical throughout all the implementations all over the globe. In all the studies the management was arguably the most important factor in terms of success or failure. If the management does not take care of the implementation, the whole process will suffer greatly. In many cases the employees were left out of the process for the most part. After the initial training the employees are expected to handle their part of the ERP system. In part this is due to legal issues as everyone is given permission to their respective parts of the software only. This way if any issues rise in these specific pages and operations of the company, it is fast and easy to trace which employee is at fault. This however is an outdated way of thinking as more efficient ways of managing user inputs exist.

In most cases the company structure changes heavily out of necessity. This is a telling sign of the issues the software has as the companies need to change to fit into its functions instead of the system adapting more to the company. There might exist a correlation here as well to the fact that many companies operate multiple different ERPs at the same time for different operations within the same company. This causes its own issues as these systems are rarely that compatible with each other and updates become very difficult as well as any customization.

IT expertise by the employees could be a reason as to why some of the ERPs fail to be implemented in an optimal way but as in the case of Germany and Japan, the knowledge is there but the implementations still face issues. The same countries that lack IT expertise also face issues with close support of the ERP vendor. This helps a long way and is integral if a company wants the most optimal usage out of their system but there is always a certain detachment from the company once the system put in place. This can cause issues when an employee is not certain how to operate the system in its intended way and might be a cause for some of the issues that plague this field of software. Cultural differences also play a role in these issues. The main culture where the ERPs come currently are western. However even the new systems developed in China for the Chinese still have similar issues as before. This also fails to explain why the west has so many issues as well with their implementations.

To say the ERP implementations are successful overall is difficult. What is meant by this is that the system is operated as it is meant by the vendor. In many examples this is not the case as there are too many issues that limit the potential. In Germany and in UK the implementations work overall as these countries have fewer issues in communication and are culturally similar to the ERP vendors. To say the software solves the issues it is desired to is another case. They work to a certain extent but still limit the potential in many areas.

## 5.2 The industry experts' introspection

To get a deeper insight into the issues with the companies using the ERPs, a few experts and key users in this field were questioned with a questionnaire shown in appendix 1. One of these key users work at a Finnish company Airbus and another ex-



pert is a professor at the University of Huddersfield, UK and a long time expert of the ERP software field. A big issue recognized across the board was that there were many different ERPs used in every company. This has a crippling effect on the companies as they grind to a halt in terms of software upgrades because the updates become virtually impossible. Another cause perpetuating this is that the longer the software is in use the more information is fed into the system. The more a system is fed with this data, the less there is desire for change as the system is just fine “as is”. That is, working as a “data dump”.

The common consensus is that there are grave issues within this field of software and company business. The common opinion as a solution is that the software is simply not used as intended by the employees of the companies although this was acknowledged to aid only to a certain extent as many of the issues are profound within the company structure or the software entanglement of several different ERPs. All in all the ERP software was seen as being in a tough place and the companies implementing these being at an even tougher spot as there are issues ahead regardless of the vendor they choose.

## **6 Results**

The issues with the implementations of ERPs to companies appear to be disproportionately high to the known CFFs. The employees’ position in previous studies has not been studied in depth nor has the software that is being sold in these cases been under more tight scrutiny in terms of their usability. Since the employees are in such a central position, it is important to limit other factors that might contribute to the issues they are having. This is why the example industrial companies were selected from across the world and from very different cultures.

Cultural differences, IT knowledge by the employees and good top management go a long way if they are handled correctly. These factors still cannot count for the major issues within this field of software. The number of failing implementations and dissatisfaction among the procuring companies is too high to be simply put on this or on the fact that the training of the staff was not sufficient. There are other

underlying issues and the solutions could potentially lie within the understudied software side.

A gap does appear to exist between the companies selling the ERP software and the companies procuring it at least within the industrial sector although these issues do appear to be the same in other sectors of business as well. These issues do not seem to come only from the previously determined CFFs and CSFs as there are too many failures even after considering these.

## **7 Conclusions**

The software development appears to have fallen behind in development as even the leader in the market, SAP, has had similar issues with its implementation as well as a host of lawsuits over the last years. There also appears to be complacency in the marketplace when it comes to ERP software. Add to this the many misunderstandings that companies from varied sectors, industrial in these cases, approach a software company and purchase a software to their use without full understanding of what they are getting themselves into. This, however, could be argued to be more on the software developers' side to resolve as they could implement better and leaner software that has more intuitive learning curves, as a starting point.

For the employees learning to use a new system is an issue that has limited amount of literature available at the current time. There are some meta studies done in this regard but these studies only reveal the overall atmosphere without going into specifics of why there is often such a strong resentment to these software implementations. Part of this can be put on the CSFs which the metadata has shown to be the more meaningful factors such as strong management or company culture adaptation to new structure changes. Given these there are still many companies where these factors are taken into account yet there is still only a limited growth gain from the software implementation.

## 8 Discussion

The potential is there and it has been in general knowledge: A company using an ERP is simply more competitive on the market as opposed to one that does not have the benefits of one. This reality of the situation more often than not has driven companies to acquire ERPs. Yet this also might cause a perverted demand onto the market which in turn has made the software companies complacent in their position. Were there to be a surge onto gamification to improve the intuitiveness and make easy and fast tutorials for the processes within the ERP software, there might be a restructuring within the current zeitgeist in this particular market.

Throughout the field of ERP software companies there appears a certain level of complacency and stagnation. There is little motivation for these companies to shock the status quo as they are making profits and growing steadily. This has caused the markets to merely accept the current way as there are few alternatives outside the current way of operating an ERP system.

Another common theme on this field is that direct quotations from the actual employees of these programmes are difficult to find. There is a lot of metadata out there from general overviews on the situation but direct user based interviews and opinions are difficult to find. This might be because companies don't want to publish that their employees are not working in ideal conditions or that their ERP investment hasn't exactly given them the expected benefits. Another reason for this could be argued to be, as mentioned before, that the field currently is stagnated and the way things work now are just how software is meant to be. In reality the software used in ERP systems is lacking in many areas when compared to many programmes used within the video gaming industry. These fields share common ground in terms of user interfaces or learning curves. These terms exist within the current ERP programmes but they are underutilized and underdeveloped when but side-by-side by any modern video gaming software. The end goals of both of these softwares is also very similar; the goals in business type video games are taken directly from the business world. The difference is that in the real world there are multiple layers of depth that needs to be taken into account e.g. shipment weight, warehouse space costs, hidden costs etc. when considering shipping a product. There is still no reason why these

deeper layers could not be managed in a more gamified version of an ERP system which would be more streamlined by its user friendliness.

The next step in studying this dichotomy between the software companies and their customer companies might be to study the actual employees using different softwares. There needs to be more factors taken into account in the future when measuring the effectiveness of an ERP software such as the average APM of the user, intuitive learning and level of engagement. Measuring these elements would weed out the bad practices that have crept up into the software all the way to the market leading software, which some of the companies studied here have been using as well.

Another aspect requiring a deeper study would be the software developers' side on these matters. How is it that the video gaming industry has advanced in leaps and bounds since the 90's in terms of user friendliness and the ERP software, while certainly different in terms of goals, has remained largely similar to those years? There are large money incentives on both fields yet one of them is advancing and one of them is not. The developers on one field are pushing and competing to be the best in innovativeness in their own area of software, and the developers of the other field are largely stagnant and offer few major innovations in their software. These fields cross paths in many areas in terms of their user interface yet the ERP programmes remain lacking and the developers for some reason do not push the technology to its limit.

The next years are going to be critical for ERPs to evolve as the developing countries of today will be developing their own softwares when they have caught up in technology. Already in China there is big resentment for the ERP offered by the west because it is not moldable to their organizational structures. A more intuitive software programme might assist in helping to cross between these two cultures. China also has a living and thriving video gaming industry of its own. In time there might be some cross pollination between these fields and the west might not be where this innovation comes from. What is more likely is that when these fields do merge, it will change the ERP industry profoundly.

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## Appendix

### Attachement 1. The questionnaire for the key users and experts

1) What ERP software is the company using and for how long?

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2) Is it easy is it to learn new aspects (new processes, new shortcuts etc.) about an ERP without contacting the vendors of the software?

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3) Is the ERP of the company customized and how much training does it take for a user to get used to it?

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4) How many people in the company are using the ERP?

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5) What areas of the company is it used for? Procurement, sales, H&R?

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6) How big part of the software is being utilized on a daily basis? E.g. in terms of pages within the software accessed.

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7) Is the programme easily customizable to your or other's use? If yes, is this done a lot? If not, do you think this might be a useful tool?

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8) What do you see as the biggest benefit the programme is giving to the company?

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9) What do you see as the biggest issue the programme is causing to the company? Do you see any solution to this?

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10) Is the company from whom the ERP was bought from easy to contact and do they offer support for the software use?