Budapest Corvinus University

Means of interpretive flexibility:

User workarounds next to information systems

Ph.D. thesis

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LIST OF TABLES AND ILLUSTRATIONS

1. INTRODUCTION

The implementation and the reliable operation of the information systems are core questions keeping busy both practitioners and researchers. Attempts in several directions and many fields aimed to formulate statements, theories and models to make this risky and expensive process (Carr 2003, Mahaney and Leder 2003, Pan 2005, Lyytinen and Robey 1999) successful, and the system operative. Researchers developed success models (DeLone and McLean 1992, 2003, Ives et al. 1980, Lyytinen 1987, Ein-Dor and Segev, 1978), described and analysed failures (Mitev 1996, Sauer 1997, Drummond 1996, Wilson and Howcroft 2005, Pan 2005), discussed system fit and match with different subsystems of the organization (Leifer 1988, Sabherwal et al. 2001, Dhillon 2004), numerous questions and aspects of users (Argyris, 1971, Ventakesh and Davis 2000, 2003, Chen 2005) and several other factors as well, but we have not yet experienced a real breakthrough (Fortune and Peters 2005, Sauer 1997).

Is it possible that it is worth looking for different approach? Was the social dynamism following the system introduction discovered deeply enough by academics? In my thesis I use constructionist approach to reveal the social dynamics of the process where, following the implementation of the information system, users and the IT system mutually shape each other to become an information system.

In my empirical research I examine two globally embedded information systems: namely enterprise resource planning (ERP) systems, where the users after the introduction have very small freedom in using the system as they want or to shape the system to their needs. As a result of my research I show that in this case the users realize the flexibility outside of the system developing and using routines complementing, substituting or bypassing the system.

My thesis focuses on this changing and malleable period following the system introduction. I aim to understand why these routines exist next to the system, how are they developed and I seek to understand how they can be useful.

Although the existence of these routines is a generally accepted fact for practitioners, the academic world has rarely dealt with them (Ferneley and Sobreperez 2006, Pollock 2005). I trust that through my research we can learn more about them. On a more general level, I hope that my conclusions add to the knowledge gathered until now about the way information systems really work.

It was a long journey to find my research question and then to find the exact focus. First, I approached it from the direction of failures of information systems, stating that workarounds are making the system more useable and they serve to avoid failure. This approach, during the viva of my thesis proposal and the following inspiring discussions (for which I am very much indebted to Dr. Nathalie Mitev and Dr. György Drótos) has changed and arrived to the insight that the question of success and failure are different from what I am currently looking for. Workarounds are rather necessities which are enabling the execution of tasks and the efficient working of users in a strictly regulated IS environment.

Here I would like to use the opportunity to thank once more to Dr. Nathalie Mitev and Dr. György Drótos who steadfastly supported me through my whole PhD research: accepting and polishing my ideas and believing in me.

2. THE FOCUS OF MY RESEARCH AND THE OVERVIEW OF THE LITERATURE

The current chapter, introducing the focus of my research and reviewing the existing literature, consists of three main parts. In the first part I overview the publications discussing the situation after system introduction.

This is followed by the introduction of the existing literature on workarounds[1]. I point out dominantly publications discuss workarounds as issues or smart solutions at user level. My research shows however, that workarounds are known by both the middle and top management; they regulate, in some cases even initiate or develop them.

In the third part of this chapter I review how my own concept changed and developed throughout the research, and as a result, what is my current approach to the phenomenon of workarounds.

Before I embark on reviewing the literature, it is useful to briefly outline the links of my research to some related areas.

As information systems are complex social and technical phenomena, there is a close relationship with *change management*, as the implementation of large scale new hardware, or software naturally brings change with itself (Dobák 1996, Fortune and Peters 2005, Mumford 1993). Similarly, *project management* is also a closely related area, as both system development and system implementation are managed in the form of projects (Markus 2004, Fortune and Peters 2005).

[1] It was a challenge to find a suitable Hungarian translation for the English expression „workaround". The English expression emphasizes that these rountines work *around* the system. However, as a result of this research I identify substituting and supplementing routines built up according to a different logic. Accordingly, following this typology I shall introduce the term „co-system routines" which includes all the three types.

The focus of my research is not the system implementation as a project or as a process but the ***interaction*** of system and organization ***following implementation***. Therefore, I am not dealing with the following – undoubtedly very interesting – questions:

1. The process and quality of the decision on system implementation;
2. The management of the project implementing the system;
3. The role of managers, software engineers (or software vendors), or consultants;
4. The specifications and / or evaluation of the system.

All these issues relate to the phase before the system introduction – that is, ***before the end of the project phase***. In my research I examine the user behaviour, more specifically, the user routines existing next to the systems ***after the end of the project phase***.

2.1 The starting point of my thesis: the social dynamics following system introduction

In my thesis I regard information systems as complex socio-technical systems (Drótos 1999). Information systems include human and technical sub-systems, are able to collect, store, retrieve and process data (Drótos 2011). The technical infrastructure I label information technology (Drótos et al. 2006). Information systems are complex phenomena themselves, as well as their organizational environment, but the two are of very different nature. As Berg (1999: p88) formulates it: the organisation, and the processes and tasks in the organisation are “messy” and ad-hoc, while the domain of computing is structured, rational and predictable. This way the optimal use of the

system resides in the extent to which the system can adjust to the everyday practice of the trained users reacting to the changes in the environment.

In the existing literature we can discover two basic approaches of the situation following system implementation. Firstly, there are theories looking at a (single) **static factor or characteristic**. Good examples are concepts aiming the *evaluation of the system*, or considering *user satisfaction*, or *system use* as a single factor. [(These are very widely accepted factors amongst success factors (DeLone and McLean 1992 and 2003)].

The works discussing *user resistance* or the theories about the *acceptance of technologies* are already dealing with system and user relationship – but still looking at it from a static approach.

The other approach in the literature acknowledges the **dynamism** of the situation. This research inquires about the actual use of the system and looks at how the information system is *constructed* (by users and the system) following the system implementation.

2.1.1 Works with a static approach to the situation following system implementation

Many scholars seek to understand certain aspects of the system implementation itself, or the situation after system implementation. Such approaches are the evaluation of the system, or attempts to identify success factors or reasons for failure. Similarly, the system use and user satisfaction can be also considered as static factors. Below, I briefly summarize the related literature.

The system evaluation itself is a broadly discussed area. The newest direction emphasises and acknowledges that the evaluation is a highly subjective process (e.g. Smithson and Hirschheim 1998 or Wilson and Howcroft 2005). One main reason behind is that the evaluation of the project introducing the system is closely linked to the arena of organizational politics and power games in the organization. Smithson and Hirschheim (1998: pp158) „highlight organizational and political questions which make evaluation more difficult". Wilson and Howcroft (2005) consider evaluations rather as means for enrolling users and consolidate their opinions (pp18). Since information systems themselves are complex phenomena, and their direct environment, organisations are complex systems, the evaluation of information systems is very often ambivalent: very much dependent on when we inquire, which questions we pose and also, whose aspect we take into consideration.

Similarly, significant research focuses on success factors, or conceptualise system failures or anomalies. For this thesis, the ones are relevant which discuss aspects following system implementation: they consider system use or user satisfaction as indicators of success or failure.

System use seems to be a very obvious and easy-to-measure indicator of success or failure. By definition, use is the consumption of the output of the information system (Ein-Dor and Segev 1978). This aspect is the most frequently used success measure: very obvious and easy to measure (Ein-Dor and Segev 1978, DeLone and McLean 1992). That is a reason why it is often used in itself to measure the success of the information system.

Ein-Door and Segev (1978: pp1065) explain why *use* is the ultimate measure of success: „We claim that a manager will use a system intensively only if it meets at least some of the [numerous suggested success-] criteria and that use is highly correlated with them. Thus we choose *use* as a prime criterion of IS success".

This simplistic view can be criticized arguing that "use" itself is a very complex factor and far from unambiguous:

- We can observe the *de facto* usage (with observing the usage of different hardware tools, e.g. following the mouse movements) versus the *reported* usage;
- An important matter is also whether only the basic or also complex system functionalities are in use (Lassila and Brancheau, 1999).
- An important question is the system usage *of whom* is considered (DeLone and McLean, 1992);
- Also, according DeLone and McLean (1992), it is important to differentiate between the compulsory and voluntary usage, as only voluntary use can serve as an indicator of system success.

These above examples prove that the measurement of even such a seemingly simple factor raises several questions. Along with these dilemmas DeLone and McLean (1992) state that based on their comprehensive research, system use is still an objective and easily measurable indicator.

There can be several reasons behind users *not* using the system (DeLone and McLean 2003; Markus 1983): next to individual level issues – lack of proper training, negative

attitude – the system functionality or the lack of user friendliness can cause significant problems.

An other commonly considered factor is **user satisfaction** which can be defined as the reaction of users to the use of the output of the information system. This other, earlier very popular aspect is "probably the most widely used single measure of IS success" (DeLone and McLean, 1992: pp69). According to the authors, there are three reasons behind that: (1) a high degree of validity (2) statistical reliability and (3) other measures are conceptually weak. Questions emerge also regarding the measurement of user satisfaction:

- Whose satisfaction do we measure?
- To what extent is user satisfaction associated with user's general attitudes towards information technology?

The above works are above all doubts very useful, but for our case they simplify the reality too much. There are researchers who consider the *change* aspect of the system introduction. As the implementation of a company-level information system brings changes in the status quo (e.g. Dobák 1996, Markus 1983, Markus and Pfeffer 1983), the elements of organizational politics are interwoven in the process and overcoming the *resistance* is a key to successful implementation. Franz and Robey (1984) emphasize that this phenomenon is ubiquitous and state that the resistance against the system is a natural reaction of users. Similarly, Collinson (1994) states that resistance is a key characteristic of contemporary organizations, and can be regarded as kind of a reaction to the existing power asymmetry.

Several scholars focused on user resistance against the implemented new technology (e.g. Braverman 1974, Foucault 1977, Markus 1983, Webb and Palmer 1998). According to Joshi (1991, 1989) users will consider equity when deciding about their attitude towards changes. The author identifies three aspects which are considered by individuals when assessing change: (1) individual gain or loss in equity status, (2) their status outcome relative to the organisation and (3) their status outcome relative to their peers. Joshi argues that in case users perceive inequity at any of these levels, they respond with resistance.

Resistance can be negative, like boycott or sabotage (Carnall 1986, Coetsee 1999). The majority of the literature assumes that workers are not co-operative, cheat, break the rules without their supervisors knowing it (LaNuez and Jermier 1994).

Based on the negative approaches of resistance, several researchers have concluded that user resistance is an obstacle for implementing information systems successfully. Some, however, have recognized that resistance is not necessarily a negative phenomenon (Markus 1983, Lapointe and Rivard 2005, Hirschheim and Klein 1994, Marakas and Hornik 2004).

According to this aspect, deviating from the planned or prescribed use should not necessarily be evaluated as negative or stubbornness of users. We can also consider it as a sign of support of the users: this way they try to find solutions for the flaws or imperfections of technology and fulfil the regular work tasks (Ferneley and Sobreperez 2006).

For the present thesis, **positive user resistance** is more relevant. The motivation behind this type of resistance is generally supportive; it aims to find the optimal workplace practices to be able to fulfil tasks (Bain and Taylor 2000). Actually in these cases workarounds can be viewed as necessities, for if users do not have the possibility to

execute their daily jobs as prescribed, they will try to find other ways to do so (Sobreperez 2007).

The approach of Sobreperez (2007), as well as Ferneley and Sobreperez (2006) introduce an excellent and valuable approach about workarounds and user behaviours. However, the authors focus on user attitudes, while in the current thesis I focus on the process of social construction how users and the information system *mutually shape each other* after the introduction of information technology.

Both the emphasis and the focus are on this dynamic process and neither on the rather static value which the users attribute to the system and to the process of system implementation nor the power relations linked to these. The developed theoretical research starting point was supported by evidence from both research sites.

An other, slightly different approach regards workarounds as fruits of user creativity. Ciborra (2002, 1996) introduces the French word *"bricolage"* in connection with discussing the long term strategic advantage of information systems. Bricolage in French means tinkering, some kind of do-it-yourself, hinting that users develop, or rather, tinker creative solutions to perform their tasks. According to Ciborra, "the capacity to integrate unique ideas and practical design solutions at the end-user level turns out to be more important [to acquire sustainable competitive advantage] than the adoption of structured approaches to systems development or industry analysis" (Ciborra, 2002: pp32).

Accordingly, the author claims *bricolage,* improvisation and hacking undoubtedly positive, suggesting that these activities, ignoring normal processes, are to be supported by the top management (ibid. Pp47). But can this approach be widely used? In my

opinion this is rather an interesting argument, which can be applied by top managers rather selectively but not in general.

Looking from the other side, we can inquire about how much users accept technology. Technology Acceptance Models (TAM) attempt to predict the impact of external variables on the internal beliefs, attitudes and behaviour of people in new technology situations (Sobreperez 2007).

Ginzberg (1981) was first researching how user expectations towards the system influence their attitudes – which will influence their behaviour. Later Weick (1990) pointed out how the individual level cognitive processes influence technology in organizations.

One of the best established TAM by Ventakesh and Davis (2000) identify two main factors which define the acceptance of the technology:

- **Usefulness:** „the degree to which an individual believes that using a particular system would enhance his or her job performance." (Davis, 1993: p477);
- **Ease of use**: "the degree to which an individual believes that a particular system would be free from physical and mental effort." (Davis, 1993: p477).

Ventakesh and Davis conclude that these two factors influence user acceptance to a larger extent than the mandatory organisational rules or policies. Further research by the same authors (Ventakesh and Davis, 2000), confirm that other factors like experience, gender, age and work environment are also influencing user acceptance.

TAM has been criticized from several aspects. Firstly, the models were developed based on research results where the respondents were university students or office clerks.

These samples are obviously not representative and exclude the significant majority of the society (Cushman and Klecun 2005). Secondly, Lamb and King (2003) criticize the model simplifying the reality with regarding users as passive and isolated individuals, and not part of the social environment and processes which surround the users (who are active "actors") .

The TAM can not be used for the current thesis either as its focus being the user, it disregards the changes in technology, the process how the technology itself gets shaped and modified during use. (This aspect as a further shortcoming is mentioned by Cushman and Klecun (2005) as well.)

Below I introduce approaches which focus on the mutual influence the two sub-systems of information systems have on each other.

2.1.2 Works with a dynamic approach to the situation following system implementation

Works discussing the dynamics of the human and technical sub-systems use structuration theory (Jones 1995, Giddens, 1979) as a starting point. According to modern structuration theories, planners and designers *inscribe structures* in technologies based on their expectations regarding how users will use the given technology (Hirschheim and Klein 1989, DeSanctis and Poole 1994). These structures influence the way technologies are used: enabling certain ways of use while inhibiting others (Orlikowski and Gash, 1994).

While using technology, users will interpret and use the technology in a more or less different way from what was foreseen by its designers – this way *appropriating* it. Through this, the users also *enact* structures in the artefact. Through this process the

interpretations of technology and the institutional factors together define how users will use the technology – which process in return also shapes and modifies technology (Orlikowski et al. 1995, Orlikowski and Gash 1994, Orlikowski 2000). The followers of structuration theory bring up the internet as one key example: Tim Berners-Lee, the developer of the HTML protocol (serving as the basis for the World Wide Web) admits that he would have never thought that human kind would use the technology he developed in this magnitude and in so many areas (Orlikowski 2000).

Orlikowski et al (1995), as well as Woolgar (1996) discuss the factors in details which influence the actual use.

The extent to how flexibly technologies can be interpreted and shaped is very different: there are artefacts with more and with less *interpretive flexibility* (Orlikowski 2000, Orlikowski and Gash 1994, Pinch and Bijker 1987): its embeddedness as well as the physical features can largely limit the ways of use. Tyre and Orlikowski (1994) highlight that the initial interpretive flexibility following system implementation decreases fast as the users' cognitive frames of the technology and therefore the modes of use congeal fast.

While the static approaches reviewed in the first part of the chapter simplify reality way too much, they are able to answer too few questions regarding the routines developing and existing next to the information technologies. An important result of the dynamic approaches is that they acknowledge the mutual effects technology and humans have on each other. According to structuration theory the actual system use develops through continuous interaction – and *interpretive flexibility* plays a key role in this process. This

flexibility enables that users deviate from the originally intended way of use and use the technology according to their own cognitive schemes.

But what happens if the strict rules of technology use do not let enough room for users to shape the technology and use it the way it is suitable or convenient for them?
Orlikowski (1992 and 2000) examines the Lotus Notes e-mail program, Orlikowski et al. (1995) the communication channel of a Japanese research laboratory, while Orlikowski and Gash (1994) groupware software. What is common in all these software that they have a significantly larger interpretive flexibility as for example an enterprise resource planning (ERP) system? Orlikowski (2000 pp: 409) emphasizes that globally standardized, interconnected and interdependent complex technologies [*as for example ERPs – E.B.*], leave less room for individual interpretations of users.

As far as the interpretive flexibility of a given technology is large enough, the structuration theory can indeed lead to valuable insights highlighting the social process where users and technology mutually shape and develop the information system. But what kind of process develops in the case of a technology where the use is strictly defined by rules and interdependent processes? In case of ERPs, the regular standard reports and the pre-defined data transfer between separate functional areas are limiting very much the freedom of users. Not only the originally developed system features, but also the strict and numerous corporate rules of use leave very small room for flexibility for the users.
Based on my experiences I must highlight that the significance of user workarounds grows considerably in such situations. Practically these “solutions” around the system represent the interpretive flexibility what, in the case of more open and flexible systems,

can be discovered *within* the system (Figure 1.) In the case of less flexible systems, these type of solutions will be developed outside of the system.

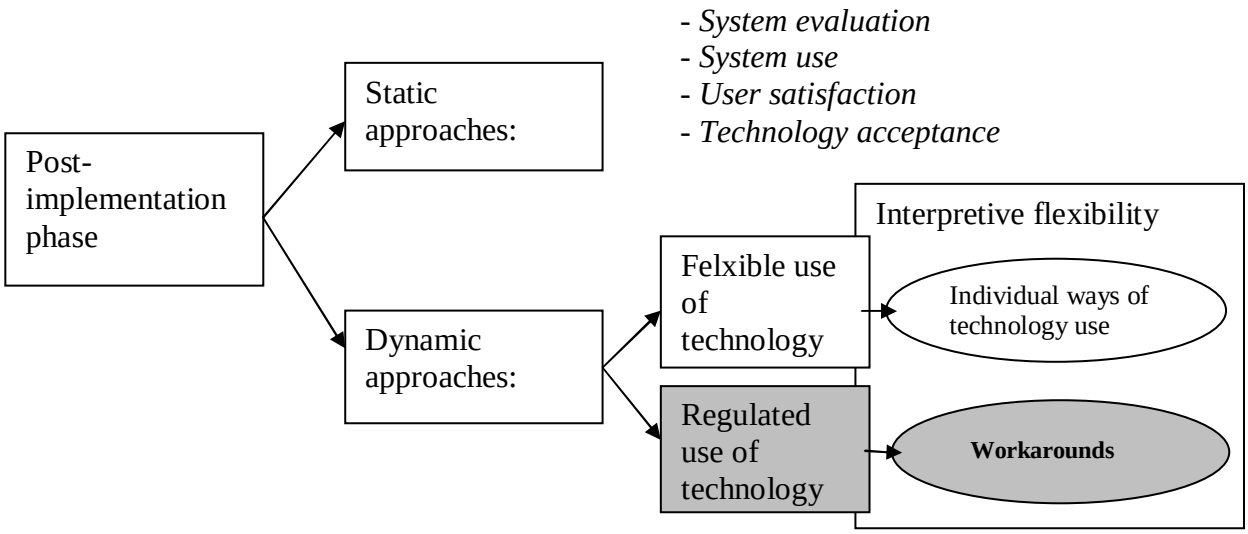

Figure 1: Placement of the research in the literature

In this case the time factor is of higher importance: right after system introduction users solve many, even key steps outside of the system: they might return to former tools or, if possible, to the previous system. Following this early period, gradually – but not so soon as Tyre and Orlikowski (1994) describe – quasi-equilibrium develops: the users will more and more use the system for executing the key data transformations, however, where it is worth more to use routines outside of the system, the workarounds prevail.

According to my research therefore, the appearance of interpretive flexibility is different in the case of freely used technologies or technologies with regulated use. As a response I am seeking to understand and evaluate the workarounds on a very pragmatic level. My goal is to reveal and describe the process developing involving the factors of organizational environment, the inherent characteristics of technology and the user behaviour.

In the following chapter I review the literature discussing the workarounds developed next to information systems and introduce the current research questions in detail.

2.2 Literature of workarounds

The existence and prevalence of workarounds is obvious, practitioners and IT professionals in organizations take them for granted as part of everyday life (Pollock 2005; Petrides et al. 2004). Despite of this ubiquity, the area is still under-researched: Kobayashi et al. (2005) as well as Pollock (2005) emphasize that little research has attempted to characterize workarounds, theories and classifications are still missing. With my research I aim to contribute to the knowledge about this phenomenon.

What are workarounds exactly? In the following sections firstly I discuss the presently available relevant literature on workarounds. Secondly, I develop the approach and definition of workarounds used in the present research and thirdly, I introduce the objectives and questions I seek to answer through the current research.

As Pollock (2005) emphasizes, little scientific work focuses on the description of workarounds. Here I review the existing research and their main results which discuss this very phenomenon.

Gasser (1986) wrote the first and for a long time only piece of work about workarounds. He investigates how information systems fit into the everyday work life, fulfilling their routine tasks. In this context he describes the phenomenon of workarounds for the first time.

The unique strength of Gasser's work is that he collects data from 10 organizations, revealing and classifying the user routines developed by users working with computers during their everyday work. The researcher takes for granted that the automatized and / or computerized systems do not match perfectly the daily tasks of the members of the organizations (Gasser 1986: p207). As a result, individuals – or groups, co-operating – develop strategies in order to be able their daily tasks. „...These basic processes which we term *Fitting*, *Augmenting* and *Working Around computing*, serve to take up the slip between static or slowly changing, fairly rigid work procedures associated with computing, and the fluid, rapidly evolving contingent demands of daily work which computing supports." (Gasser 1986: p207.)

In Gasser's view these user strategies at micro level ensure that computerized systems can exist in the organizations and, from a pragmatic perspective, he emphasizes the importance of 'unearthing' and understanding of this phenomenon. Gasser argues that studying this dynamics "allows us to better integrate computing by giving us theoretical bases for when and how to freeze work routines (perhaps in a new technology), and when to allow for the flexible adaptation of ad-hoc, perhaps manual, operations." (Gasser 1986: p207).

Gasser lists 'Working around' as the third type of micro level user strategy and gives the following definition: "Working around means intentionally using computing in ways for which it was not designed or avoiding its use and relying on an alternative means of accomplishing work." (Gasser 1986: p216).

The researcher highlights that the system developers participating in his research did not like workarounds which are typically ad-hoc strategies to solve immediate and pressing problems as they often conflict with the formal principles of the system use.

In his research Gasser identifies three types of work around routines (ibid. p:216.):

- **Data adjustment**: In several cases participants "game" their computer systems by entering data that they knew were "inaccurate" or that did not reflect the spirit of the input data expected by the programs. They did this in order to get desired, usable, and in an important sense, "accurate" results.
- **Procedural adjustment**: The users often reverse organizational procedures for getting service or making changes. The ability to work around established procedures depends upon having the power to create and exploit flexibility in work routines, a close working knowledge of the procedures and the particular division of labour in the organization (one must know whom to trust and whom to ask for favours and speedups) and having the access to key actors who can do the work one needs in the way one needs it done. This type of workaround, as Gasser observes, needs substantial knowledge and experience with the organization of work and the system itself.
- **Backup systems**: The identified backup systems can be automatized or manual. Manual systems in many cases result in the duplication of data or notes, calculations on computer-based reports, which would have been more difficult or impossible to execute within the computerized system. The automatized backup systems are relevant not at individual level but when more individuals or functions have to co-operate.

In summary, Gasser states that for both practitioners and system engineers (and software developers) it is important to understand the essence of workarounds. He emphasizes that further research is required to identify the distribution and patterns of workarounds on the level of everyday user routines.

The undoubted value of Gasser's work is to be the first to describe and classify user routines existing next to the computerized systems. We have to note that in Gasser's research workarounds are only one of the possible complementary user strategies – this interpretation is a narrower definition than what other researchers, as well as this research, uses. Here we consider workarounds a label involving all user routines bypassing or complementing the computerized system.

Stephan Poelmans (1999) focuses explicitly on the better understanding of workarounds. The starting point of the Belgian researcher is that the way users use the system and their perception of the system reflects how well the system fits to fulfil the tasks. Poelmans considers workarounds as *coping strategies* through which, deviating from the defined process, users can reach their goals (Poelmans 1999, p11). The objective of these coping strategies is to save time and effort, or to bypass the limitations of the system.

As a significant additional value, Poelmans introduces the term '*viscosity*' which is defined as "the perception of extra efforts that do not contribute to the end-user's goal that are brought about by the […] system." (Poelmans 1999: p11). The researcher emphasizes that the essence of viscosity is that individuals, through to the processes coded into the system, have to exert extra-efforts for the benefit of an other individual or a group. He concludes: "…therefore, viscosity is supposed to be distributed." (Poelmans 1999: p11).

Practically Poelmans explains the development of workarounds on the basis of economical principles, through individual profit maximalization and opportunism. The researcher draws the conclusion that individuals have a decisive role in the process: in certain roles or in connecting jobs users perceive a larger amount of extra work and they replace it with workarounds.

Similarly, Kobayashi, Fussel, Xiao and Seagull (2005) consider individual roles to be the decisive factor for workarounds next to computerized systems. The American author quartet applies a wider definition for the term workaround: not only the computer system but the complete process supported by the information system stands in the focus. The authors consider any and all informal steps diverging from the normal process as workarounds. In this approach the workarounds are "informal temporary practices for handling exceptions to normal workflow" (Kobayashi et al. 2005 p:1561).

Kobayashi and her colleagues are seeking to understand which factors influence the efficiency of the workaround practices. They consider workarounds ***successful*** if they provide an answer or solution to certain recurring organizational problems and they reduce the cognitive efforts required in these situations. ***Unsuccessful*** workarounds, on the contrary, are not reliable and lead to instability in organizations (ibid. p: 1561).

An important shortcoming of the conclusions drawn by Kobayashi and her colleagues is that they are strongly influenced by the research site and settings (the coordination of medical work in a hospital) and more difficult to apply to general organizational settings. However, a very valuable contribution is that they differentiate between

organizationally successful and unsuccessful workarounds, although there is only little information on how they evaluate the single workarounds.

Also Petrides, McClelland and Nodine (2004) aim to analyse the usefulness of workarounds at organizational level. The Californian researchers investigated the use of an information system linking together multiple universities. They observed users' behaviour under circumstances when the users can not access sufficient information (data) for executing their daily tasks. During their research, the researchers identified several workarounds.

According to Petrides et al. "workarounds can be seen as inventive and short-term solutions to pressing organizational needs" (Pertides et al. 2004 p:101). The authors differentiate between two types of workarounds: (1) essential and (2) ancillary.

The first category, ***essential workarounds*** were resulting in data which already existed in the IT system, but for various reasons users acquire them through non-formal channels. The reasons behind them were the lack of accuracy or the reliability of the data available in the central system, or the non-adequacy of the data structure.

The second category, ***ancillary workarounds*** are describing routines which were not fulfilling basic needs, but were comprised of efforts to collect data that were secondary or non-vital to the everyday processes required for state and other agency reporting. For example data and results of student surveys, or non-compulsory reports or summaries from single departments are listed in this category.

The researchers found that users put more efforts to execute essential routines where also the developed informal routines and procedures are more complex.

Costs of workarounds	Benefits of workarounds
Enhances the fragmentation of information /data (personal / local databases)	Flexible and cost efficient solutions to satisfy local and ad-hoc user requirements
If the use of ancillary software is accidental, the user has no routine, can make errors without the possibility of control	Proofs of positive user attitude: the responsible want to and are able to solve the emerging difficulties
Weak quality, non-reliable data (Data had not been collected uniformly throughout the years)	An innovative solution developed on individual level can be useful on a larger (organizational) level
Question of knowledge transfer, if the developer of the workaround leaves the organization	Innovative atmosphere and a "do-it-yourself" attitude in the organization
Checking of data from non-formal processes entered manually takes very long time	Can direct the attention to the issues and problems with the existing IT system
If users do not use the system, it can not be developed either: the falling out of the benefit of system improvements	

Table 1:The costs and benefits of workarounds: summary based on Petrides et al. (2004)

An important added value of the works of Petrides et al. is to identify the costs and benefits of workarounds on organizational level. In the above table (Table 1.) I summarize the costs and benefits listed in the article.

Petrides et al. (2004) in their article explain that workarounds do not provide long term solutions as if the developed workarounds congeal, the costs will in any case supersede the benefits (considering users' extra time and efforts, lost opportunities and other issues – ibid. p107). According to the authors, the workarounds serve best as showing

directions for necessary system developments and the management has to pay attention to these.

Next to the obvious strengths of the article, it is questionable that the authors do not identify workarounds (or do not acknowledge them) which make the process easier. They do not discuss examples where the given step could not be solved within the system or this solution would be very expensive. Petrides et al. practically suggest that the developed solutions are temporary and the final solutions have to be developed within the system. The authors do not acknowledge that in certain cases the workarounds can offer the optimal solution for the organization.

Finally I briefly introduce Nail Pollock's 2005 article, the uniqueness of which is the discussion of a case where users and system developers have co-operated during the system implementation and customization. This is an important aspect, as from the middle of the nineties most information systems are designed and programmed in modular structure – in a way that it is customizable for the company buying the system (Pollock 2005: p3).

Accordingly, Pollock (2005) defines workarounds as tools used by the system actors to shape the system for their own needs. One of Pollock's main statements is that between the developers and the users there is constant tension as the existing roles and responsibilities are unclear. Pollock observes that when users develop a workaround, that is they work around the system in some ways, they in fact exert some form of resistance.

In her comprehensive dissertation Polly Sobreperez (2007) thoroughly discusses workarounds as manifestations of positive user resistance. Although the focus of my dissertation is similar, my approach is different. I am not discussing the individual level acceptance of the system, but take the functional or process misfit of the system as a starting point.

In the Hungarian literature there are even less scientific discussions about workarounds. In fact I have not found any scientific publication discussing this very phenomenon.

Research connecting to the current research area was conducted by Péter Dobay (1993). Dobay examines the motivation of decision makers at the dawn of office IT applications, the preparation (or, to be more exact the lack of preparations) before introducing the software applications, as well as the reactions of users and the extent they are using the system. Next to the motivated and enthusiastic minority of users, Dobay mentions the user resistance he revealed: “Any type of constraints to use the system are mostly without results (…): the worker “proves” that the system is absolutely unusable in ‘our office’, or they quit.” (ibid. p22). Regrettably, the article does not discuss further details about user attitude, even though it would be very interesting. Dobay, in his article, rather embraces more research questions instead of diving deep in one.

One other, very interesting article connecting to the current thesis is written by András Nemeslaki and his fellows (Nemeslaki et al. 1997). The authors present evidence that in Hungary and the Central-Eastern European region the implementation of systems are

rather cumbersome and less efficient. The researchers collected data at 13 Hungarian companies and identify four characteristic hindering factors (Nemeslaki et al. 1997: p2):

Obstacle 1: fit between IT and the management;

Obstacle 2: fit between the organization and the other institutions of the environment;

Obstacle 3: fit between the local management and the employees;

Obstacle 4: fit between the international management and the local management.

According to the authors the first and the fourth obstacle is mostly characteristic to the post-socialist companies, while the second and third factor can be experienced at Hungarian affiliates of multinational companies. These obstacles build true difficulties for efficiently introducing and using information systems – next to the obvious issues with the less developed information infrastructure.

The research approaches and publications of András Nemeslaki (1996) and György Drótos (2001) played essential role in importing the sociological and interpretive approaches in information systems research in Hungary which stream has been followed by several Hungarian scholars.

Rather from the field of sociology, the works of Csaba Makó can be mentioned as well, where the users, workers are in focus. The publications of Makó from before the political transition (Héthy and Makó 1980, 1972 and 1970) analyse and describe workers attitudes and behaviour in non-market economy. Later Makó extends his research and discusses in several (country) studies how technology changes the circumstances, the daily work and the opportunities of workers (Makó et al. 2009)

Greenan et al. 2009). The level of inquiry in Makó's works is generally at macro level, discussing trends of the labour market.

2.3 Chapter summary and the research question

Through the below table I overview the articles about workarounds introduced in the previous chapter. The table summarizes the types of IT systems researched, how the author(s) look at workarounds, what types of workarounds the author(s) revealed and in the last column I highlight the significance of the publication.

Author(s)	IT Systems	Workaround as…	Workarounds revealed	Significance
Gasser (1986)	MRP systems of 10 organizations	Harmonizing the technical and human systems of different logic; Non-intended use or passing by of the system is conscious	Data-adjustment, data-manipulation; Entering fictive data into the system; Manually prepared attachments; Personal favours; Informally bypassing the system; Supplementary systems (manual or automatic);	The first scientific publication describing workarounds; identifying types
Poelmans (1999)	Workflow system of a Belgian bank	Avoiding strategies to save time and efforts, or to bypass the system	Entering data ex post; Skipping single steps of processes; Informal relationships;	Viscosity: the reason behind workarounds is the extra-efforts
Kobayashi et al. (2005)	Information system and supply chain of a hospital	Informal and temporary practices which handle the exceptions of normal processes	Magnet board; Post-it; Personal contact; Asking favours; Re-allocating inventory (data manipulation); Entering data ex-post into the system;	Workarounds are inevitable based on informal relationships
Pollock (2005)	Modular university information system	Adjusting technology to individual needs or goals	Legitimizing individual development; Re-coding; E-mail;	Workarounds are individual initiatives
Petrides et al. (2004)	Multi-campus administration information system	Creative, short-term solutions parallel to the IT system to fulfil organizational needs	Data-manipulation; Personal observation; Excel; Manual / paper based data collection; Taking notes; Hiring consultants; Double / Triple administration; Data exchange through e-mail;	Costs and benefits of workarounds for the organization; describing workarounds
Sobrepere z (2006)	Clothing company / English Fire station	User uses the system to execute the task, but not according to prescribed rules	Data-adjustment, data-manipulation; Supplementary systems (manual or automatic Entering ex-post data;	Positive user resistance in the background of workarounds

Table 2: Overview of the more significant publications on workarounds

The table indicates well that on the one hand indeed only limited research aimed to reveal more about workarounds and they hardly correspond to each-other. We can state that independently from the sector or area of use, the workarounds are present where an information system is implemented – as well as individual creativity is unquestionably present in tools and forms of workarounds.

With reviewing the above table, we gain an overview of the key terms and added values introduced by the articles discussed. In the next chapter I introduce my research definition which builds on the above research and I will use in the empiric research I conduct.

2.3.1 The definition of workarounds used in the present research

Considering the discussed literature together with my acquired knowledge of the field, I developed the following pillars to build the starting point of my definition:

(1) The term workaround is used exclusively for work done including computer systems. We can use Gasser's approach: "computer use [is] the employment of computer based information in the accomplishment of other primary work" (Gasser 1986: p213).

(2) I do not only regard workarounds as handling exceptions but rather as activities connecting to the computer system to fulfil everyday work – complementing, supplementing or bypassing the computer system.

(3) I only focus on the use of the system already introduced and not the process of customizing or introducing the computer system.

Based on the discussed literature and the above constraints I developed the following definition which I use for my thesis:

Workarounds are routines existing next to the computer system: complementing, supplementing or bypassing activities which are not planned, and which users exert in order to fulfil their work tasks.

2.3.2 Research questions

In my research I wish to investigate the following aspects:

In which cases and with what motivations do users develop workarounds? In the approach of some scholars in previous studies, as for example Kobayashi et al. (2005) workarounds are developed by users as a response to pressure, for example time pressure, or to handle unexpected situations. According to Gasser (1986) the reasons behind workarounds are the planning difficulties, the bounded rationality, while Sobreperez (2007) emphasizes the struggle of the users to fulfil daily tasks against all difficulties.

What tools are users using for workarounds? What tools are used: electronic and non-electronic; how complex are these tools and what is the cost of their use?

Individual or team workarounds, furthermore is the necessity subjective or objective? This inquires about whether the given workaround is an individual response

to the system logics and function or in what cases are they results of co-operation of groups; in which cases are workarounds individual (therefore subjective) solutions or objective necessities?

Evaluating workarounds according to their productivity – at organizational versus individual level. At individual level in many cases it is easier to execute the tasks by avoiding using the system. However, at organizational level the use of the system is unavoidable as for example by skipping a step within the system results in void data which can not be used for the further process steps or in other functional areas. At the same time, there might be cases when workarounds bring the optimal solution at organizational level.

Through this research question I compare optimal solutions at organizational level and benefits at individual level. Under which circumstances is an individual willing to optimalize according to organizational aspects and when (s)he becomes opportunistic? How can these contradictions get resolved in practice?

The above research aspects are summarized in the below table:

Research question	Explanation	Earlier research
DEVELOPMENT		
Motivation and necessity behind workarounds;	What root causes are behind workarounds? Objective or subjective necessity?	Kobayashi et al. (2005); Gasser (1986); Sobreperez (2007); Petrides et al. (2005);
REALIZATION		
(A) Used techniques and tools (B) Group level or individual workarounds	What ex-system tools are used by users? What factors define whether it is a group or individual level routine?	Indirectly Gasser's 1986 research, other research had not dealt with these questions;
USEFULNESS		
(A) Productivity at individual level (B) Productivity at organizational level	Does the workaround improve individual or organizational benefits? Opportunism versus obedience;	Petrides et al. (2005) discuss costs and benefits of workarounds at organizational level, however, they do not evaluate;

Table 3: Summary of research questions

In the below diagram (Figure 2), I illustrate the above research questions and their logical relation.

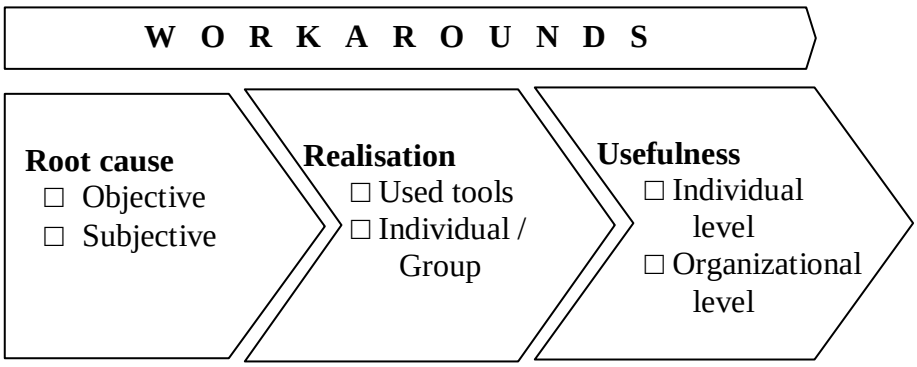

Figure 2: The basic logic of the research questions

2.2.3 Pre-assumptions of the researcher before the field work

Following the literature review I realized that I have developed pre-assumptions about the researched phenomenon. Part of these was proven true as a result of the collected empirical data and became part of the concepts I have developed, while other part of the pre-assumptions were refuted during the field work. I will reflect on them when discussing the conclusions and concepts.

There are a few pre-assumptions which are worth to mention:

- Workarounds are results of users' creativity; they are witty and smart solutions.
- Workarounds are essential, without them it is impossible to use the system to execute daily work
- There are informal "IT gurus" amongst the organizational members who regularly and readily help other users. Their solutions and system interpretations largely influence the system use in the given organization.
- The routines bypassing the system are sort of secretive (under-the-counter) solutions which are hidden from the top management and are not discussed openly on official forums (like departmental meetings);
- The majority of workarounds are developed and used at individual level.

3. THEORETICAL BACKGROUND

The main research streams appear in the domain of information systems research as well. Due to the interdisciplinary nature of the field all paradigms and accordingly, more research methodology have their raison d'être. Notwithstanding the research field have changed a lot since its existence: in the early years dominant engineering (and therefore natural sciences) characteristics were diversified through the involvement of alternative paradigms and research methods of social sciences.

Accordingly, first I discuss the most commonly used paradigms in the research of information systems and then review the research tradition. This is followed by the introduction of my chosen research paradigm, discussing which research method serves best the answering of the research questions of this thesis.

In the third part of the chapter I introduce the interpretive paradigm and the chosen research method.

3.1 Research paradigms in information systems research

From the second half of the eighties the scholars of the field information systems have started discussions about the research field itself. One branch of this self-reflective discussion inquires about the justification of the research field, the limits and the subject of research (e.g. Avgerou 2000). At the same time research methodology and the research paradigms are brought in the focus.

In 1987, two influential scholars, Robert D. Galliers and Frank F. Land call the attention in their article to the vast differences in the proportion of paradigms represented in the

determining journals and they promote to publish more research using alternative paradigms.

Galliers and Land (1987) explain that the traditional research with laboratory-based characteristics suits better the natural sciences while the less conventional approaches should gain more publicity to be able to contribute to the further growth of scientific knowledge. Galliers and Land acknowledge that the field of information systems used to be completely under the influence of technology, however both the researchers and the practitioners realized that also organizational and behavioural considerations have to be involved (ibid. p:900).

According to the authors, methodologies researching connections described with classical, statistical parameters have an obvious disadvantage in such a complex field. In the research of information systems, if we insist on statistical variables, we are not able to assign right numerical values to variables with decisive influence; therefore they are eliminated from the calculations. Galliers and Land (1987: p901) to prove the lack of success, highlight that the positivist research had not been able to bring relevant cures and solutions for practical questions.

Galliers and Land suggest that the use of alternative approaches in the research, though "likely to be more complex and difficult as a consequence, but the results are likely to make the efforts worthwhile." (ibid. p:901).

Similarly, Orlikowski and Baroudi (1991) urge more opportunities for alternative paradigms. In their often cited assessment article the authors show that between 1983 and 1988 in the most relevant journals of information systems 96.8 per cent of the

articles are based on positivist paradigm while the remaining humble 3.2 per cent are divided between articles with alternative paradigms. In this period there was no publication in the North-American journals which would be based on the critical paradigm as classified by the authors.

For this disproportion Orlikowski and Baroudi largely blame the doctoral schools, the supervisors and the editorial boards of the journals (ibid. p: 24). The article is undoubtedly a milestone in the struggle to gain more opportunities for the publishing of alternative paradigms and research methods: this importance is also proven by the number of references: in September 2008 the Google Scholar website counted 910 scientific citations).

During the time has passed since the publication of this article, there is a gradual opening towards the so-called post-empirist (i. e. non-positivist) paradigms: this opening can be caught in the change of the editorial politics of the most influential journal of the field, the *Management Information Systems Quarterly* (MISQ) (Walsham 1995). According to a 1997 assessment, 16 per cent of the published articles are clearly based on interpretive paradigm (Nandhakumar and Jones 1997).

As a result of the editorial openness and diversification, by the previous decade we had arrived to a state where more research methods and approaches are accepted (Myers 1999) – according to Markus (1997: p14) it means the “the war between quantitative and qualitative is over”.

Certainly this variety in research has a reason for existence as the field of information systems – similarly to organizational theories or different fields of management sciences – are closely related to social sciences: next to the engineering and technical directions the sociology, linguistics, mathematics and psychology are all strongly linked in with this field (Mingers 2001). Accordingly, all the scientific results and research methods of these fields shall be used when studying information systems – and we, without any doubt, arrive to the plurality of paradigms (Mingers, 2001: p240).

The 1991 article of Orlikowski and Baroudi served as inspiration for many further research and inquiries. For example, Chen and Hirschheim (2004) aimed to study the proportion of paradigms in the articles published between 1991 and 2001, as an extension of Orlikowski and Baroudi's research. Chen and Hirschheim choose a wider basis for their research: they take into account articles not only published in North-American, but European journals as well. From other aspects they narrow down the inquiry to only interpretive and positivist paradigms, arguing that the critical paradigm is used in so few articles that only interpretivism means a true alternative for positivism: "the only relevant alternative for positivist research is interpretive research" (Chen and Hirschheim 2004: p201). This simplification is criticized by Richardson and Robinson (2007) who review the articles adopting critical paradigm published between 1991 and 2001 – also reviewing the developments of critical research. In their eye-opening critical article the authors arrive to the conclusion that critical paradigm is a key aspect for the pluralism present in the research field. Furthermore they provide evidence that critical IS research is continuously growing, but naturally, "critical research is likely to remain the preference of a minority of IS researchers for the foreseeable future" (Richardson and Robinson 2007: p265).

Chen and Hirschheim emphasize (ibid. p:199) that since the publishing of the Orlikowski and Baroudi article (1991) several new journals are published which do not necessarily follow the main stream but rather give opportunities to the alternative approaches and research methods. Most authors acknowledge – and it is also supported by evidence (e.g. Orlikowski and Baroudi 1991, Chen and Hirschheim 2004, Kaplan and Douchon 1988, Lee, Baroua and Whinston 1997) that European journals are more open towards publishing research adopting non-traditional (mainly therefore interpretive) approaches.

In the below table (Table Table 4) I summarize the findings of the above discussed surveys about proportions of paradigms in published information research. I aim to give an overview on the trends how the positivist paradigm's dominance has changed over time.

Period	Authors, year	Found proportions	Survey focus
1983 – 1988	Orlikowski and Baroudi (1991)	96,8 % positivist 3,2 % interpretive 0 % critical	Only North-American journals, 155 articles
1989 – 1995	Lee, Barua and Whinston (1997)	100 % positivist	Only North-American journal, 307 articles
1991 – 2001	Chen and Hirschheim (2004)	81% positivist 19 % interpretive	North-American and European articles: 1893 publications

Table 4: Proportion of paradigms in different research in the field of information systems

Two conclusions can be drawn from the above table: firstly, indeed, European journals allow more room for publishing alternative (in this case mainly interpretive) paradigms. Secondly, during the nineties the proportion of alternative paradigms published had

been growing. Reviewing the publications adopting critical paradigms, McGrath (2005) observes that in fact there is only very little empirical research which is rather published in conference proceedings or, as Richardson and Robinson (2007) highlight, in special issues focusing on critical research.

It is important to highlight that although there is an overlap in the periods reviewed by Lee, Baroua and Whinston (1997) and Chen and Hirschheim, as well as Richardson and Robinson (2007) still there is an obvious difference between the results as well as the conclusions drawn. Taking a closer look at the published surveys and analyses we can discover two reasons behind the differences: On the one hand the classification of articles are not identical. For example in the survey of Lee, Barua and Whinston (1997) the authors identify 24 research using case study methods and 90 further field research and these research are all strictly classified as positivist research. This fact could trigger a far-reaching discussion about classifications and the limitations it brings into answering research questions – however, this is not my goal in this thesis. As a matter of fact, Lee and his colleagues in their survey analysed causal models which apply positivist methods.

An other reason for differences can be that all three research teams emphasize that European journals are more prone to publish alternative paradigms.

A relevant personal experience of mine is from my school year at the London School of Economics, one of the leading workshops of Europe; in early 2006 Professor Ian Angell held a presentation about how to choose topics for our dissertation. He said nobody should even consider choosing a positivist research as this institute represents and supports research adopting alternative paradigms.

The above presented figure (Figure 3) from Mitev (2000) illustrates well how the research on information systems had developed in the past decades. The figure shows well that together with the change of the epistemology and the scientific fields involved, the focus of research had also expanded.

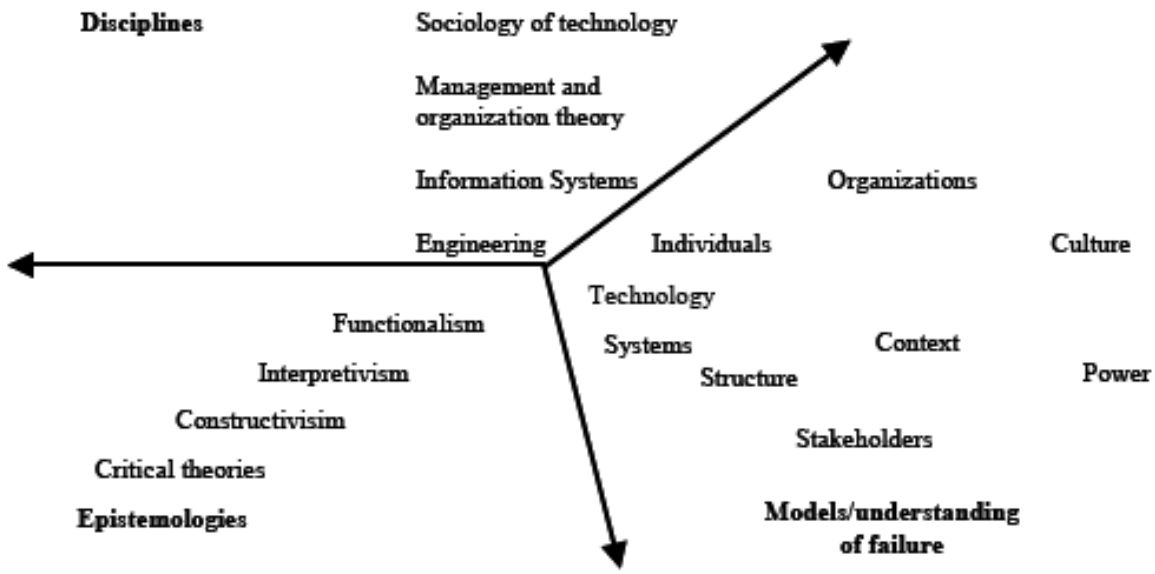

Figure 3: Evolution of Understandings of Failure (Mitev, 2000: p85)

The above figure, although Mitev presents it regarding the literature of information systems failures, is also very useful for our current review of paradigms. It is well visible that alternative approaches become more accepted and more factors and aspects are involved in the research. One main trigger for this expansion can be the gradual modification of the image of the field of information systems: the technical-engineering characteristics became less central and the organizational studies and sociological aspects explained more and more generally experienced phenomena.

In the following section I briefly discuss the main research paradigms in the field of information systems. Instead of the classical four paradigms of Burell and Morgan (1979) I use the research findings of Orlikowski and Baroudi (1991) and next to the positivist and the interpretive paradigms, as a third paradigm I introduce the critical approach. A main reason for this choice is that the radical humanist paradigm, the fourth paradigm of the Burell-Morgan classification (considered as standard), is not present in the research tradition of information systems (Orlikowski and Baroudi 1991, Hirschheim and Klein 1992, 2003, Richardson and Robinson 2007, Chen and Hirschheim 2004).

3.1.1 Chosen paradigm for the current research: the interpretive paradigm in information systems research

In the first part of this chapter I give a detailed explanation of my choice for the interpretive paradigm which I found most suitable to answer my research questions. In the second half of the chapter I review the interpretive research tradition in the field of information systems and its main trends and directions. This latter part is important to me as in Hungary; this research tradition is lack of strong foundations yet.

Both Johnson and Duberley (2000) and Mumford (1985) emphasize the importance that the researcher, mainly for a doctoral thesis should chose a research paradigm which

- Can easily be matched with personal beliefs;
- Can easily matched with the of the research itself; and
- Enables to answer the posed research questions.

The chosen approach has to be related to one of the existing research traditions in the field of information systems, hereby supporting the credibility of the research in the eyes of the audience (Trauth and O'Connor 1990).

As Drótos (2001) emphasizes, the chosen paradigm defines not only the process of research but also influences the selected topic of research. Drótos adds, agreeing with Lee (1999), that the more intriguing research topics can not be approached according to the strict and rigorous expectations of the positivist research. Choosing the suitable paradigm therefore has to support the answering of the developed research questions. In this current thesis, two characteristics of the research questions have to be considered in order to choose the suitable paradigm:

(1) I am studying the social dynamics following the introduction of two separate information systems that is the **process of social construction of information systems**. My objective is to study the necessarily developing mechanisms in the given socio-technical sub-system which are **situative and informal**. At the same time the single correction mechanisms (workarounds) are useful from one perspective, from an other perspective they can be non-wanted.

(2) The research is of **explorative type**, as it wishes to reveal the informative routines, solutions which the users develop individually or at group level to complement or to bypass the system.

Accordingly, the current research adopts interpretive paradigm as this paradigm serves best

- The revealing of social processes and the development and shaping of social interpretations;

- The studying of perceptions and sense making of certain actors (which therefore defines their actions);
- To compare the perceptions of different stakeholders of the same system and to study the resulting situation;.

The objective of the dissertation is to observe and analyse the developed behaviour in the given situation and this objective can be best reached in the domain of the interpretive paradigm.

I can identify my approach with Hacking's (1999) and highlight that I can not agree with the extremely interpretive stance where artifacts which are not part of the social construction, do not even exist. This standpoint can be refuted through several facts from the history of science. I can rather agree with the approach which acknowledges the existence of reality independently from individuals; however it can be displayed or projected through subjective discourses, social interactions or causal routes (Hacking 1999: p48).

The interpretive approach suits very well to take into account the organization, the individuals and the system as a whole, as this paradigm considers the environmental effects and organizational processes which interplay with the system during the process of social shaping (Walsham, 1993).

A justifiable suggestion would be to take a look at the interesting relationships and aspects what the critical approach would reveal where the focus could be the conflict of the dominant managerial coalition (the decision makers of the system introduction and

operation) and the users without power and influence. This direction would be very useful if I would approach the use of information systems as a compulsion (and this assumption would not be completely mistaken), or I would like to reveal the different forms and process of resistance. The critical paradigm would be the right choice if my starting point would be that the implemented information systems are prohibiting the users from exercising their regular activities – therefore their individual freedom got limited – and the workarounds would be considered as actions against the status quo.

We have to note however that the critical and interpretive paradigms can be conciliated (Mitev 2003, McGrath 2005, Sobreperez 2007). At the end the current research takes an interpretive stance, but also the regulations of system use have strong coercive power, the critical approach is also present.

At the same time the research does not stand on critical basis as the general objective is neither to handle workarounds as tools or manifestations of emancipation, nor to evaluate them as limitations to individual freedom. My objective is instead to identify, describe and evaluate different types of workarounds.

In the followings I will discuss the constrictivist approach, rooted in the interpretive paradigm, within field of information systems research. According to the interpretive paradigm "the external world is constructed through a social process as result of the participants' subjective experiences" (Burell and Morgan 1979: p28). The constructionist approach focuses on the interactive characteristics of this social process (Gelei 2002). In the next section I briefly overview the trends of social constructionism within the field of information systems research.

3.2 Constructionism and social research tradition within the field of information systems

In the past two decades in the research of information systems the interaction of humans and technical factors received more attention. The scholars of behavioural sciences and sociology largely contributed to the growth of knowledge about this multi-faceted phenomenon of information systems.

Wilson and Howcroft (2005) explain this change with the following argument: "A social shaping approach is attractive because, in taking a stance against technologically determinist bias, it emphasises a view of technological development as a social process thereby enabling an understanding of how social factors shape technologies as well as providing a framework for understanding the context in which technologies are displaced." (Wilson and Howcroft, 2005: p18).

In the next chapter I introduce the interpretive directions developed within the field of social and technical studies (STS).

3.2.1 Introduction of social constructionism and the main approaches

Social constructionism developed as an answer to the dominance of technological determinism. Opposing technological determinism, which suggests that technology has its own logic determining usage and development, the socio-technological approach became prevalent during the second half of the twentieth century. Some scholars even argue it has become orthodoxy in research traditions of the information systems field (MacKenzie and Wajcman, 1999). Sociological research tradition in general criticizes

the over-representation of objective, quantitative research in journals (e.g. Orlikowski and Baroudi 1991, Lee 1999 or Wilson and Howcroft 2005).

During the last decades of the twentieth century, many different approaches and frameworks emerged within social constructionism (Monteiro, 2000) and they yielded different insights on the interplay between informational technology and the organisation. Bijker and Law (2000) identify three main branches of productive traditions. As they note, these are different in scientific background as well as in theoretical approaches (p12).

- **Systems thinking** – developed by Thomas Hughes, originally describing the growth of large technical systems (e.g. the first book discussed the dynamics of the development of electronic infrastructure: Hughes, 1987). It aims to go beyond both technological determinism and social constructivism. Hughes suggests that the relationship between technology and society is dynamically changing during the stages of technology. In the early stages of the development of any technological system, that system will be shaped by society. Hughes introduces the term 'momentum': when the technological system, as it grows and develops, will have more influence on society - it will begin to shape society (Dwyer 2001);

  Actor-network theory, ANT: with the aim to develop a neutral vocabulary (Akrich and Latour, 2000) to describe the interactions of networked technical, social and economic elements. In ANT, the social and technical are regarded as inseparable. The most important, revolutionary approach of ANT is that the original differences between human and non-human elements of the network are disregarded. The consequently *heterogeneous actor-network* contains people, objects and organizations which get aligned in a *negotiation process*. Many

scholars label ANT as extremely constructivist (see for example the overview of Mitev on this (Mitev 2005). ANT, which became a very popular stream amongst European researchers in the nineties, has been criticized because of the radical (and innovative) move to grant artefacts the same explanatory status as human actors. First main contributors are the French Michel Callon and Bruno Latour, and the English John Law;

- **Social construction of technology (SCOT)** – emphasizes the interpretative flexibility which is attributed to technological artefacts by different relevant social groups (RSGs). Initial concept was developed by W. E. Bijker and T. J. Pinch, their starting point being the most developed research of sociology of that time. As this approach had a large influence on my thinking, in Appendix 1 of this thesis I give a more detailed overview of this direction. SCOT puts less emphasis on the process of social construction as ANT does.

Much of the above is also closely connected to a fourth approach, the **sociology of scientific knowledge** (SSK) "which is devoted to unravelling the infights and manoeuvring that go into the establishment of a scientific fact" (Monteiro, 2000, p74). SSK, therefore, focuses on social influences on science: how scientific facts (which are considered highly rational and objective) are developed. Collins and Pinch (1993 and 1998) discuss this topic in two very interesting volumes challenging several experiments leading to justification of scientific facts.

SCOT and ANT transferred this focus on unravelling the construction of scientific facts to the opening of the black box of technological artefacts. Although these approaches differ both theoretically and empirically, it is important to note that they are complementing each other (Bijker and Law, 2000). They together give a hint about the intertwined development of technology and society.

These interpretive research traditions suppose that the society influences, in some stronger constructivist directions even defines the technology. This argument arrives to the conclusion that technologies are fully determined by the interpretation of the individuals. This extreme is called interpretive determinism – to follow the logic of the term technological determinism (Orlikowski 1996, 2000). As I stated earlier, my standpoint is different of this extremely interpretive direction.

Having reviewed the theoretical background and the chosen paradigm, the next chapter reviews the research design developed accordingly.

4. RESEARCH METHODOLOGY AND DESIGN

In general, we differentiate between two main types of research methods which represent two distinctive ways of acquiring knowledge. The first type, the quantitative methodology roots in the natural sciences and it used to be considered as "the only" scientific methodology for a long time. The other type is the qualitative methodology which gained appreciation in the scientific world from the second half of the eighties.

4.1 Research tradition in information systems research

According to the survey of Chen and Hirschheim (1991: p202) the most popular qualitative methods in the field of information systems are the surveys (41%), followed by the case studies (36%) and the laboratory experiments (18%). In their earlier survey Orlikowski and Baroudi (1991) found that 49.1% of researchers used surveys to collect data. The case studies took only 13.5% of all research and at that time 27.1% was identified as laboratory experiments. Thus the trend shows that the surveys continue to be the most common tools to collect data, case studies got more in the foreground with laboratory experiments loosing from their popularity.

In the below table (Table 5) I summarize and briefly overview the single quantitative technologies based on the articles of Galliers (1991), Mumford, (1985), and Chen and Hirschheim (2004).

Quantitative technology	Brief description
Experiments (laboratory /field)	The measurement of the precise relationship between key variables in a designed, controlled environment and the results are analysed with qualitative techniques. Field experiments are the extension of laboratory experiments into the "real world" (Galliers 1991: p333), aiming to conduct the experiment in a more realistic environment. Their strength is that a few variables can be measured deeply and thoroughly; the disadvantage is that the disregarded variables almost never take zero value in reality. (Orlikowski and Baroudi 1991).
Survey	Essentially "snapshots" of practices, situations or views at a particular point of time. Quantitative techniques are used to analyse their data. It's strength is that large number of variables can be analysed and provides a reasonably accurate description of real world situations, generalization is less of a concern; however reasons behind the results are not revealed and respondents subjectivity brings bias in the results (Mumford 1985, Galliers 1991)
Models and simulation	A given system is studies by generating random variables – this allows modelling and analysing complex situations. Strength is the possibility to reveal alternative scenarios, disadvantages, similarly to the experiments, are the extent to how accurately the simulated world reflects real world situations.
Case study method	Good way of describing real world situations and interdependencies usually in one single organization Both positivist and interpretive case study method is acknowledged (Lee 1991, Walsham 1995). Strength is to provide great amount of details about the organization and the interdependencies – weakness is the uniqueness: comparability and replicability are an issue (to gain data from a statistically meaningful number of similar organizations as Galliers (1991) formulates).
Forecasting and Futures research	This technique is based on analysing regression and time-series, therefore identifying future trends based on past data. In the field of information technology it yielded useful insights about the societal impacts of IT (Galliers 1991). Its accuracy however depends largely on the reliability of past data. An other issue can be that it is not possible to calculate with unknown factors and self-fulfilling prophesies.

Table 5: Short introduction of quantitative research techniques (Based on Galliers 1991, Mumford 1985 and Chen and Hirschheim 2004)

For the methods reviewed above it is essentially necessary to identify, define and quantify the right variables; in many cases control groups are required which are not impacted; as well as the random samples and the hypothesis testing.

Without any doubt, if we only use quantitative methods we have to disregard the social and cultural effects and therefore we assume that the reality is neutral and objective. Already in 1967 Glaser and Strauss point out that although hypothesis testing is very important, if we insist on the logic dictated by statistical methods, our hypotheses can become irrelevant and will not promote theorizing based on our data (Glaser and Strauss 1967).

Mumford in her excellent article (Mumford 1985) emphasizes that laboratory experiments are not suitable for researching human attitudes and behaviour for it is much more complex and more difficult to control the factors.

The fact that there are fields, relationships and general questions the answering of which the quantitative methods can not serve, gave room for the use of qualitative techniques which suit better the studying of complex variables and human behaviour.

Quantitative research using mathematical and statistical methods give the impression of 'scientific' characteristics. It is important however, that we promote the acceptance of qualitative research as similarly "scientific" by the scholars. The promoters and representatives of qualitative research made several efforts to reach this acceptance and they choose the terms "*Relevance and Rigour*" to label the road (Galliers 1994).

As Kuhn (1970), as well as Guba and Lincoln (1994) highlight, the paradigms include not only the harmony of epistemologies and ontologies but also the harmony of the methodology. Accordingly, for my interpretive research I choose qualitative research methodology.

In the following sections I present the most commonly used research techniques and I will introduce my research design.

4.2 Qualitative research techniques in the current research

Since field of information systems was enriched with new scientific approaches, involving social processes and human behaviour into research next to the engineering aspects, also the research methodology got richer. As a result of this opening also the qualitative techniques got more accepted which I briefly review in this chapter.

I will review the qualitative research techniques applied in the current research as the following: I will discuss the case study method and the ethnographic research considering their advantages, as well as the disadvantages and risks involved.

4.2.1 Case study method

The case study method is one of the most wide spread interpretive research technique with considerable traditions (Lee 1989, Chen and Hirshheim 2004).

The case study method is a research strategy which focuses on understanding the dynamics present within single settings (Eisenhardt 1989: p534). Case study method

typically combines more data collection methods such as interviews, questionnaires, observation and archives. The collected data can be therefore quantitative or qualitative – or even both.

In the current thesis I review the case study method both amongst quantitative and qualitative techniques as this research technology has roots in both (Benbasat et al.1987, Walsham 1995). Positivist and interpretive case studies have, of course, many similarities and differences at the same time. The founding paradigm brings the main difference determining the data collection methods.

The case study method fits several objectives (based on Eisenhardt 1989):

- description, exploration of phenomena;
- theory testing;
- theory generation,

depending on what phase is the research field at that moment.

An obvious advantage of the case study method is that it allows a detailed exploration of the researched phenomenon and therefore provides opportunity to identify more influencing factors (variables) (Galliers 1991). This is a very important aspect in the field of information systems as this scientific field changes fast and is very pragmatic – consequently the researchers have to build a close relationship with the research field to be able to understand the complex and dynamically changing notions (Benbasat et al. 1987).

Two further recommendations consider the appropriate answering of the posed research questions. Yin (1994) highlights that the case study method is the right research method if the researcher has less previous knowledge of the key variables, the decisive factors and the appropriate observation techniques. Benbasat and his colleagues (Benbasat et al. 1987: p369) mention that case study method is the best choice for a sensitive, very pragmatic research focus where "the experiences of the actors are important and the context of action is critical".

These both criteria stand for the current research questions: on the one hand we have scarce previous knowledge, on the other hand these informally existing "out-of-the-system" solutions can only be solved through the close relationship with the everyday practices of the actors in the research field.

4.2.2 Criticism of the case study method

In many cases the existence of the variety of case study methods: both qualitative and quantitative case study methods, as well as case studies with both inductive and deductive logic cause confusion (Cavaye 1996).

An undoubted weakness of the case study method is that in most cases it considers only one organization over only a certain time span. An other difficulty is to collect comparable data from different organizations (Galliers 1991) – therefore the question of generalization emerges.

Furthermore a necessary disadvantage is the lack of ability to identify the individual effects of the single variables: any observation can only be the result of all influencing factors (Cavaye 1996).

The above criticism shows directions for my research to pay attention to and consider the limitations of the chosen technique. In a later section I will discuss how I have handled these during the data collection and analysis.

4.2.3 Ethnography

Ethnography seeks to understand the meaning of phenomena that participants at a site assign to the phenomenon (van Maanen 1979). In ethnographic research the researcher can not enter the site with preconceptions and previous assumptions and this focus on facts have to be maintained through the phases of data collection and recording. The task is to interpret the data in the context of the observed phenomena and not through the researcher's own or some theoretical viewpoint (Cavaye 1996: p 230).

Therefore ethnography is distinguished by these characteristics not throughout the data collection period but also the analysis, which two can not be separated in the case of ethnographics. This method has a very strong root in constructionism – which delayed it's acceptance in the research of administrative organizations (Rosen 1991).

Ethnography is rooted in social and cultural anthropology, however it has it's reasons for existence in the field of organizational studies as the formal organizations have very characteristic social networks (Rosen 1991).

The fundamental difference between case study methodology and ethnography is the extent to which the researcher immerses himself or herself in the life of the social group under study (Myers 1999: p4). The ethnographer can be characterised by his (her) fully written notebook (Rosen 1991) which contains every phenomenon and interaction

observed or revealed. Case study method rather aims the understanding of relationships, the exploration of influencing factors.

The biggest advantage of ethnographic research is the in-depth and intense data collection and the gained thorough understanding (Myers 1999).

4.2.4 Criticism of ethnography

The largest difficulty of the ethnographic research is the long time spent with collecting the data and analysing the large amount data collected (Myers 1999). Naturally this lot of time and effort spent can also yield a lot – for example one of the best known and most basic books in information systems research is the one titled „*In the Age of the Smart Machine*" from Shoushanna Zuboff (1988) which is a fruit of longitudinal ethnographic study with several new insights and interdependencies revealed.

The other essential problem of ethnography is its narrow focus: critics argue that after studying one single organization, one single culture, no general conclusions can be made as the insights are relevant only for the given environment (Myers 1999).

A further interesting challenge is how long the researcher can stay truly objective, focusing on sole facts while spending a long time in the given (organizational) culture. This question – the personality of the researcher – naturally emerges regarding any interpretive research technique and we have to accept the impossibility of being truly objective.

Discussing my own empirical research and data analysis I will touch this issue considering how my own position and interpretations as a researcher could influence the observations, the interpretations and the conclusions made.

I also have to mention the multi-methodological or pluralist research. Mingers (2001), or earlier Lee (1991) or Kaplan and Douchon (1988) discuss this type of research emphasizing that combining more research techniques, they can complement each other and therefore balance out the shortcomings. In my current research I have not seen the necessity for applying pluralist research as the case study method offered a good fit with my research objectives – to answer the research questions.

4.3 The chosen research method

In this section I give a detailed introduction of the case study method, the research method I have chosen to help answering my research questions.

Yin suggests the choice of case-study method in case if we are "posing 'how' and 'why' questions concerning present event where the researcher has limited possibility to control" (Yin, 1994). In my research I collected data in two different organizations. Based on Yin (1984) and Benbasat et al. (1987) it is only suggested to draw conclusions from a single case study if the researched field is very new, or the situation is extreme or unique. In any other cases it is suggested to study more cases and relate, cross-analyse the observations gained in the separate cases. The conclusions drawn from research involving more case studies are more reliable and generalizable. This way,

through the time I have spent in the two organizations I developed such an understanding of the workarounds which helped to identify and evaluate them.

To build the case studies I collected the data with qualitative techniques (Walsham, 1995, Benbasat et al., 1987, Star 1999). Based on Benbasat et al (1987: p370) the chosen qualitative techniques are suitable to yield data which supports the answering of the research questions:

- they enable to study the information system in it's own, natural setting, learn about the state of art therefore develop a close, detailed picture of the real situation;
- allow the researcher to answer 'how' and 'why' questions – that is to understand the nature and complexity of the processes, which is critical for researchers;
- is an appropriate way to research an area which is under-researched and therefore it is less known for the scientific public.

Why do not I use survey methods like for example in one of the most valuable research of workarounds, Petrides et. el (2005)? I am convinced that this phenomenon can be best understood through getting very close to the practice. As Schultze (2000: p4) explains, in the case of such research decisive is if we focus on what people say about what they do, or we focus on what they actually do.

Summarizing the above, I will answer the research questions through two case studies built from data collected with qualitative techniques.

According to the logics of qualitative research, it is not necessary to formulate hypotheses as we are conducting an exploratory research. However, it is possible to

identify pre-assumptions which can be supported by empirical data or refuted. These pre-assumptions were discussed in chapter 2.2.3, page 35.

In the next section I will briefly introduce the two companies and the respective information systems implemented. For the sake of transparency firstly I will summarize the similarities and secondly, I will detail the differences between the two cases.

4.4 Research sites

Choosing the research site for the qualitative research, my aim was to identify sites which will result in being able to answer the research questions. Generally, qualitative samples can be described as follows (Miles and Huberman, 1994; Bokor, 1999; Gelei, 2002):

- Small sample and embeddedness in the context (versus large sample and the disregard of the context);
- Intentionally and consciously chosen sample (versus random sampling);
- Theoretically oriented sample (versus representativity);
- Continuously, step-by-step evolving sample (versus previously defined sample).

Taking into account the above, I conducted the research at two different companies. When selecting the companies I considered the below highly important aspects:

- Excellent access to data and good relationship with the members of the organization;
- Possibility to spend longer time in the organization;
- Operative ERP system implemented.

Based on these aspects I selected two companies where I was placed (independently from the research) for organizational development projects as an on-site consultant. This position ensured the possibility to learn about the systems, the processes and the users – consequently, I had excellent access to data. The possibility to spend longer time in the organization was also given – as local consultant working on the organizational development project. Also both companies had an operative ERP system implemented. Although the organizational development project did hardly overlap with the current research questions, the users knew that my main task concerns their daily work. This fact probably influenced their behaviour and the information shared with me. This reservation I attempted to dissolve with the data collection techniques discussed later in more details (observation and focus group interviews).

Both companies can be described as:

- Hungarian affiliates of multinational companies – and as such, the local management is to report monthly certain financial indicators. The local strategies can be defined locally as long as it fits the general global strategic directions;
- Were founded as green field investments;
- Are in the middle of the supply chain: both companies are suppliers of industrial manufacturers (business-to-business);
- Internationally uniform ERP systems were introduced to support the operations based on centrally made decisions;

In the below table I summarize the main differences between the two companies. To respect the confidentiality of the data to be accessed and analysed and to protect the

companies' identity, the data are somewhat distorted. This is however not influencing the purpose and the credibility of the research as there are no relevant differences in the data and the data regarding the information systems will not be distorted.

ALFA Company	Aspect	GAMMA Company
Jász-Nagykun-Szolnok county	**Hungarian location**	Budapest
2003	**Year of foundation in Hungary**	2006
Sweden	**Company headquarters**	United States of America
Car component assembly	**Profile**	Supply chain services and inventory management
Hungarian	**Local top management**	American
11 million EUR	**Revenue (2007)**	19 million USD
210 heads	**Number of local employees**	40 heads
AXAPTA	**ERP**	ORACLE
60 users	**Local users of the ERP**	39 users
Sweden	**IT Support team**	India

Table 6: Overview of main characteristics of the research sites

Other companies which I contacted in this period of time, or beforehand, were not meeting all the criteria I listed. This way I had two companies where the management was open to let me conduct my research. According to Klein and Meyers (1999) the research conducted at two research sites can also serve reliable data.

4.5 Systems investigated: integrated ERP systems

At the companies I introduced above I examined the implemented ERP systems. Beta had Axapta, while Gamma had Oracle systems introduced. Such integrated enterprise resource planning (ERP) systems are characterised by the followings (based on Drótos, 2011 – **emphasis added,** E.B.):

- They serve the comprehensive **tracking and storage of single transactions** of organizations and the production of **regular reports**;
- They have **modular structure** and modules cover the majority of standard operative areas (e.g. financial, controlling, purchasing, production planning, sales, quality assurance, etc. modules);
- They are **integrated**, meaning that data is entered only once in the system, ideally at the location and time of its formation;
- **Real time data processing**: integrated automatisms help the tracking of sequential events;
- **Sold as pre-configured software** and **industry specific parameters** can be set up and programmed.

In summary, an important advantage of enterprise resource systems is their integrated characteristic what enables the co-ordination of cross-functional activities and the efficient information sharing throughout the whole organization. (Stair and Reynolds 2008: p232).

5. DATA COLLECTION

In the first part of the current chapter I introduce the process of data collection executed at the above research sites. This is followed by the data collection techniques in general, and lastly, I give a detailed overview of the details of the research conducted at the specific research sites.

5.1 Research design and data collection techniques

On the figure of the next page I illustrate the process of data collection and the timeline of the research at both companies.

My main sources of data were observation and semi-structured interviews which I discuss in more detail in this chapter.

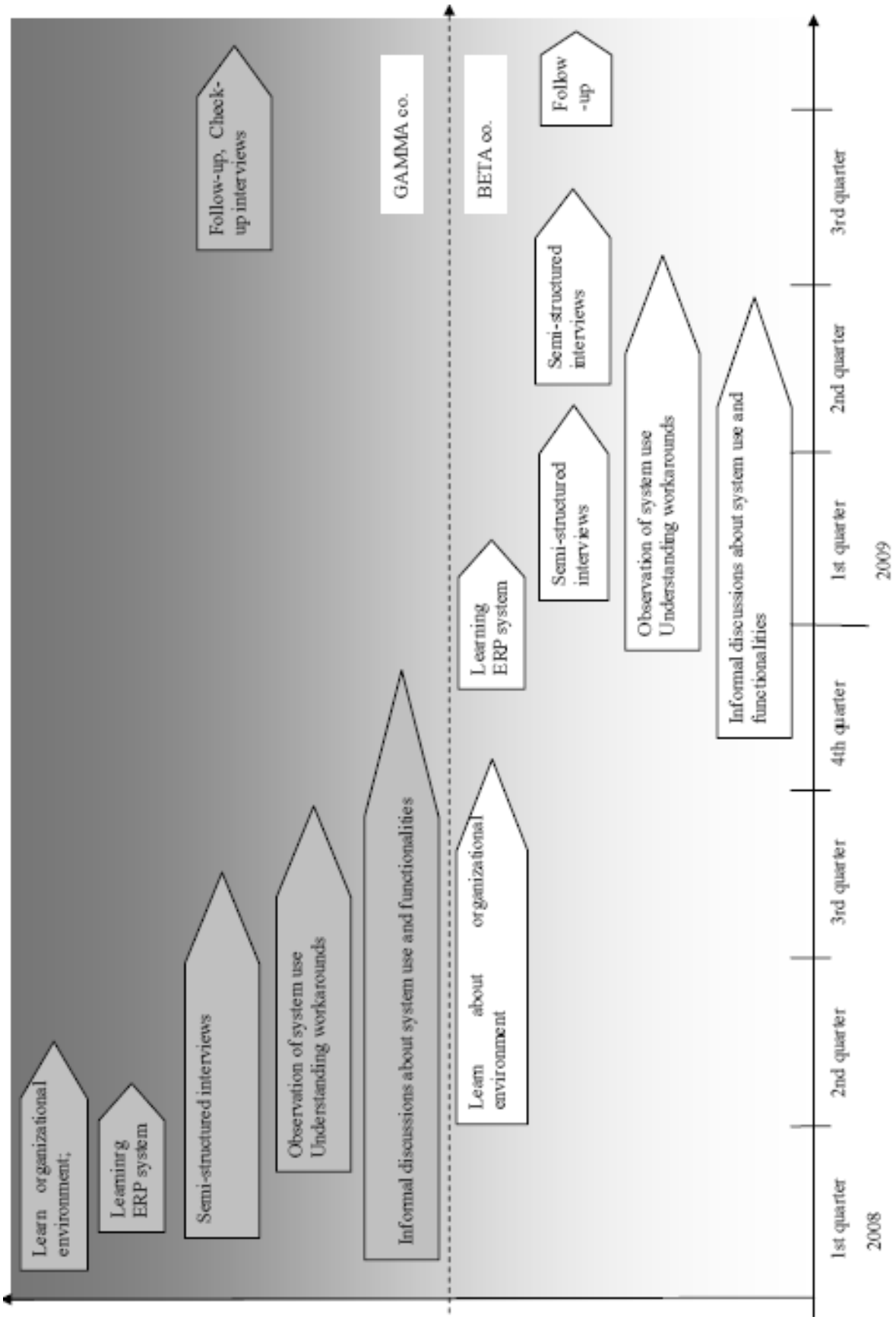

Figure 4: Overview of research timeline

Qualitative interviews are, as Kvale defines them "attempts to understand the world from the subjects' point of view, to unfold the meaning of peoples' experiences, to uncover their lived world prior to scientific explanations"(Kvale 1996: p1). Differently from everyday discussions, during a qualitative interviews are not exchanging experiences between equal partners but the interviewer and the interviewee have different roles where the interviewee might have to reply unprepared to unforeseen questions (Sobreperez 2006).

The advantage of interviews is that the participants can use their own words and decide about content and meaning – what is important and what is not told. Prescribed categories and terms are not limiting, therefore the answers as outcome are more credible and valid. Nevertheless, the interviewer is able to ask further questions about interesting areas or newly emerged issues or ask for deeper explanation for unclarities or inaccuracies. That is why the research instrument of interview is very appropriate for areas which are less researched and less theorized.

Patton (1990) identifies three basic types of qualitative interviews: the informal conversational interview, the interview guide approach (or as better known: the semi-structured interview), and the standardized open-ended interview. The first type interviews develop from spontaneous questions, informal discussions during field work. Typically, questions are not pre-defined and the discussion is fully dependent on the context, thus provides the opportunity to discover un-anticipated information. According to their role, informal discussions should promote the interpretation and the amendment of the collected interview data – I also hoped to find new correlations or phenomena.

The interview guide approach requires interview outline with prepared questions but in this case there is opportunity to deviate from the interview outline to discuss ad-hoc questions. In case of the standardized, open ended interview the interviewer adheres to the prepared interview script and has limited flexibility to deviate from the standard list of questions. Advantage is that the resulting data are standard and easy to compare.

A popular data collection technique is the **focus group interview** which has its roots in market research. One participant is the facilitator who guides the discussion and aims to bring attitudes, perceptions and emotions to the surface, which are resident in the focus group participants (Vaughan et al. 1996). Certainly, the group characteristics have to be preserved: it is not about asking more people in turns but to facilitate connections and ideally there is interaction between the members of the focus group.

Fern emphasizes that the task of the facilitator is more to define the topic and the scope of the focus group session, instead of providing too strict or non-productive methodological prescriptions (Fern, 2001: p3). This attitude helps to preserve the uniqueness of each discussion.

Fern (2001) explicitly suggests the use of focus group discussions for exploratory research, as, according to him, this technique is very appropriate for collecting expectations and problems, for exploring the innovative use of the system [the existing product], or for learning about creative routines developed to fulfil missing functions.

When setting up focus group discussions for data collection, I paid attention to invite participants according to the process sequence or the cross-sections of identical process steps.

For the current research I experienced focus group discussions to be very fruitful, as colleagues working sequentially according to process steps were listening to each other and could always add complementing information or aspects to the story heard. It was interesting to observe how the participants had been filling the beforehand rather vague term "*workaround*" with meaning and sense during the moderated discussion.

At both companies I conducted two focus group discussions. Consciously I selected colleagues from the same hierarchical level into the separate groups: at both companies I had one group with the managerial colleagues (second layer of the organizational hierarchy) and the second group had members from the third organizational layer, reporting to them.

Following the suggestion of Calder (1977), I scheduled the focus group interviews to the second part of the empirical research to avoid the valid trap where opinions of the single group members of the focus group influence each other (Gibbs 1997). This way in the first part of the data collection period I gained knowledge about the most common workarounds and with the help of focus groups I revealed their judgement and the co-operation between users.

The technique of **observation** enables to learn systematically and directly about individual actions and behaviour and therefore discover hidden phenomena. An

undoubted advantage is that it does not build on personal discourses or perceptions (as for example interviews or questionnaires) but we can collect data in their actual forms.

There are two basic forms of observation: the *participant* and the *non-participant observation*. The non-participant observer spends time amongst the organizational members to collect data about their actions and behaviour – and it is obvious for all participants of the research. In this case neither the observant researcher, nor the observed participants behave naturally during the research which fact has to be considered when analysing the data.

The participant observer, although not doing the same work as the observed ones – takes a (non-researcher) role in the situation (Atkinson and Hammersley 1994) which can be for example a part-time job. Throughout this, the researcher has opportunity to learn and record environmental, discover activities and attitudes of the research subjects and hereby develop a rich and detailed understanding of the situation.

At the same time we have to take into account that the researcher through getting involved in the context, connecting to the people and friendship circles also decreases the amount of information through becoming part of the formal and informal organization (Berry 1979). This dynamics definitely leads to the loss of objectivity and the ability of perceiving details with the internalisation of the group norms.

In the current research observation proved to be a very useful data collection technique at Beta company, where – being a manufacturing company – physical processes and the connecting routines are easier to observe. In the case of Gamma company, being rather

a service providing company – I in fact had to sit next to the clerks to ask them about what are they doing and why (with the exception of the routines in the Gamma warehouse where it was somewhat easier to observe routines). In summary, at both companies observation proved to be a helpful technique through helping to understand the daily work of users and the process steps, the logics of the system (through the participant's eyes) and the developed routines.

5.2 Data collection at the research sites

Below I discuss the details of the data collection at both Beta and Gamma companies.

5.2.1 Data collection at Beta Company

At Beta company data collection took six months between the December of 2008 and the July of 2009. During this time 18 semi-structure interviews were conducted (initials and job titles are listed in Appendix 3), two out of which were check-up (repetition) interviews to clarify, check or refresh certain information which I gained from other interviewees or from observation. Every interview discussion lasted minimally one and a half, maximally three hours and I made manual notes. The manual notes enabled drawing together, illustrating processes and linking certain thoughts.

I arrived to every interview discussion with a list of prepared interview questions (Appendix 2.)

Next to the semi-structured, formally organized interviews I gained significant amount of knowledge from discussions during lunch, coffee breaks, factory tours and talks

during the travel to the countryside site. As part of the observation I could ask questions from operators (blue collar workers of the assembly lines) concerning interesting signs, processes, methods and habits which I observed on the spot. The answers of the helpful operators I treated as data as they were honest, informative and very pragmatic.

Field research was conducted during the re-implementation of the company ERP system therefore during all interview discussions we systematically discussed the use of the old system and the new system as well.

5.2.2 Data collection at Gamma Company

Field work at Gamma Company took eight months from January 2008 until September 2008 during which time I conducted 19 semi-structured interviews (initials and job titles are listed in Appendix 3). The data collection and the organizational development project were running practically parallel. Interviewees were openly discussing and explaining the system use participating in the discussions of the job descriptions. The organizational development project aimed the enrichment of jobs along the process steps and affected the ERP system as well. At the beginning of the research (project) a typical user had access to one or two ERP modules. After introducing the new, richer jobs, most users started using 4 or 5 ERP modules. This enrichment was undoubtedly welcome claiming that their jobs became more interesting the additional responsibility granted more overview and the feeling of more control.

At this period of time 30-33 users used the ERP system. Observation had an important role: I spent 2-3 hours next to the selected ERP users observing their system use. During the time spent together the interviewees answered the emerging questions. Most

inquiries aimed at the objective and logic of certain steps and their role in the process, as well as difficulties and shortcomings of the system. Similarly to Beta, I prepared hand written notes illustrating process steps as well as describing opinions and attitudes of users.

5.3 Case studies

In this chapter I discuss the two case studies: first Beta and then Gamma company: the company profiles, their ERP systems and the results of the empirical research.

I describe and summarize the data resulting from interview discussions, observations and other data sources. When analysing the data collected in the next chapter, I will add further details in a structured way.

The individual, or group level routines revealed during the interviews can not be all labelled as true workarounds. In some cases, the small solutions supported the organization of the individual's daily work, in several cases the coordination, standardization or monitoring of group work. In my research, I consider routines as workarounds only if they are directly connected to the ERP system: if they complement, substitute or bypass it.

The names of the companies and all data which is not relevant for this present research, is distorted, the interviewees are anonym (with real initials to preserve traceability) to keep confidentiality.

5.3.1 Beta Company

Beta is a manufacturing company, branch of an international group, founded as a green field investment. Beta's main profile is manufacturing and assembling vehicle parts for the order of different vehicle manufacturers.

The investor sought the return of investment from the cheap and still well developed workforce, as well as the lower price level of the local supplier base. At the moment they should not be disappointed as even during the currently challenging economic circumstances the company is making profits (2010).

As more than 60 per cent of Beta's costs are represented by inventory costs, the key to success is excellent inventory management which lies in the organization of efficient (regional) supply chain.

At the time of data collection, 5 separate assembly lines were in operation at Beta: all of them assembly similar product families for the few customers. Beta had a revenue close to 20 million USD in 2008, 142 employees in Hungary. The ERP system has 60 users.

5.3.1.1 Beta's ERP system

Beta introduced the ERP system at the launch of the company, being the second site to use the system within the international group.

During the time of data collection the system had been used for 2 and half years. The basic objective of the system is integrated process management and the availability of systematic reports – although the reason for system implementation was a group level decision to use the chosen system at all locations internationally.

Being the second site in the world-wide group implementing the new system, the main parameters and settings of Beta's ERP system reflected those of the pilot company. The headquarters expected the regular monthly reporting, mainly financial and sales data, already from the very beginning.

Theoretically the system is used by the procurement, manufacturing, planning, logistics teams, the program managers (managing customer requirements), the quality control and finance groups. Only white collar colleagues have access to the system.

5.3.1.2 System implementation and history

The first implementation of the system happened at the foundation of the company. At this time only one other site used the ERP system, testing as a pilot project. This also meant that there was no company-specific know-how available about the use, settings, advantages and challenges, risks of the system.

The international group choose the ERP system called Axapta (today called Microsoft Dynamics AX). At the first introduction everybody had small or no experience with the system, even on group level all specifications were rather raw.

As Beta operates in the car manufacturing industry, the standards are very established and rigid. Nevertheless, any of the Hungarian consultancy companies working with Axapta had no experience within the car manufacturing industry.

As a result of all the above, the first settings and parameters were not satisfactory: in the case of cross functional transactions within the system, data created in one functional area could not be matched to data created (or worked with) in other functional area. In short, transactions were not cross-functional, not flowing and not alive.

The managing director and the IT manager summarized the reasons behind it as follows:

- Missing functions (surprisingly in a case of a manufacturing company, the material management module and the capacity planning module were not purchased, so all related processes were missing);
- Lack of professionalism and experience with the system (IT professionals both from the headquarters, local employees and consultants supporting the implementation);
- Lack of preparation, documentation and training (there were no descriptions, user guides available, first "test" transactions were immediately live on the system): "*The first test transactions were already logged as real transactions*

(S.T.[2] project engineer), or "*We have not received any [descriptions] on how to use the system*" (H.I. Head of project engineering);

— Lack of funding to purchase new modules, developments, system fine tuning;

— Lack of top management attention: at the beginning the local management did not devote any managerial time to improve the system or solve the issues.

Not surprisingly, the system implemented with such shortcomings was not really used at Beta: the data were not reliable and the processes not functional. At the same time, in the beginning working with small quantites most of the operations and calculations could be done on paper, on a spread sheet or even just in somebody's head:

> „In the early days S.T. [*project engineer, a key member of the pioneer team* – E.B.] had an MRP system in his head. He knew by heart which supplier which part, what are the costs and prices and where the container is." (Beta managing director).

The local public opinion was that the system is unusable, completely unnecessary and unimportant. It meant nothing else than an administrative burden from the headquarters.

Urgent purchase orders or the handling of other exceptions also required that the pioneer team makes decisions influencing the production of that very day. In this era they often had to use information not stored in the system, mostly owned by individuals:

> „We had to sort sales reports per production units as well as per product groups but such break of data were not available in the system. I knew all parts where and when they are assembled, I entered it into the system manually, filtered it and put together the monthly report like that." (H.I.)

> „In case of change in customer requirements the system re-calculated the whole production plan and the procurement orders. Running this took 3 or 4 hours. If we did not want production to be halted for all this time, we started to produce something we knew we needed anyway. Once the new production plan was calculated, we quickly adjusted the production lines.
> By now, we have learnt to run the re-calculation every evening as a part of the weekly routine." (S.T.)

In sum, the system was not able to support the material processes either in manufacturing, or in logistics, or finance. Accordingly, in the company culture the norm became that the use of the system in unnecessary, the data in the system is not relevant.

[2] In the main text I only use initials, in some cases job titles to keep anonomity. The initials of the managing directors are not used anywhere. The list with job titles according to initials are listed in Appendix 3.

Understandably, the problems in connection with the monthly financial close became soon obvious for the headquarters. The regular monthly financial close took every time several days, the company failed the scheduled internal audit, as well as the control audit. Based on the audit findings the solution was to completely re-implement the full ERP system, from scratch. This decision was made after more than two years of the first implementation.

An internal project team was selected to champion the system implementation: they had a thorough knowledge of the processes and local specifics and this knowledge enabled them to define well the required functions and set the optimal parameters. As the managing director suggested, the workarounds used after the first implementation were used when defining the parameters of the new system and the new processes.

> „I delegated the three guys into the project team, who were here from the very beginning and knew the system inside out." – Beta managing director

The decision was to rebuild the ERP system from scratch, followed by multi-loop testing with parallel operation of the old and the new system and then turn off the old system. The project was based on two pillars: (1) first, the setting of the right parameters of the system, as well as building up the right processes and (2) secondly, clean the data in the system.

In more details it all meant:

(1) In case of all transactions it had to be (re-)defined what data had to be entered: what type of data every process shall contain. The objective was to make every process unique, but only requiring data which makes sense in every functional area. In the system, these are called "dimensions": that means how many and what type of parameters describe incoming materials which are processed through the company processes.

(2) The base data needs to be accurate, unique (not redundant) an maintainable. For all these, all company processes had to be re-defined and their proper operation ensured. Best examples are the prices of raw materials, or the measurements of the single materials. The "Data cleaning" project took one and a half year (!) and involved all data stored in the system.

Defining the new system specifications, the project team used several solutions – workarounds – which were developed in the preceding almost three years. The company members of the project team said that in many cases these workarounds pointed at the real requirements, the optimal solutions. In practice it meant that they were readily translatable into specifications.

> „I do not think this messy start is a problem. When we re-implemented the Axapta system, we exactly knew what specifications we needed." (H.I.)

From February 2008, as a result of the re-implementation, the ERP system provides all data for all calculations. This also required a significant change in the company culture in the attitude towards the system and its use. This change was the result of the persistent and consequent decisions and actions of the managing director. These will be detailed in the chapter titled "Controlled use of the ERP system".

5.3.1.3 Workarounds at Beta Company

The bypassing and substituting routines and tricks preceding the re-implementation were well known through the whole local branch. The system was used only by a few key users. An interesting fact, that due to the non-satisfactory regulation of access rights and user profiles all users had system administrator level rights to all functions. An other example describing the situation well, that the internal audit revealed that five out of the six quality engineers did not have access to the system, and the only user from the quality team had logged in only once.

Following the re-implementation, the system use was regulated and monitored as required. However, still several routines developed next to the system were kept alive and even new ones were established.

In the following pages I describe the routines connecting to the ERP system revealed during the field research. I grouped the routines based on what the raison for existence is behind or, what is the essence of the given practices. The group limits are somewhat blurred, the workaround types are often mixed.

I. Using spreadsheets and database management software (EXCEL, ACCESS)

The most common and most obvious software used to complement, or substitute the system functions are the spreadsheet management programs. This software is in most cases the Excel from Microsoft.

One interviewee formulated it saying: "*Excel is a key tool*" (S.T. project engineer), or the managing director started off our interview joking:

> „Can you measure the success of the system implementation by counting how many Excel spreadsheets are used at a company?"

Most users mention using Excel when filtering or ordering data. Users with more knowledge of the software use pivot tables or cross tables for calculations.

In the times of Beta's first Axapta system version, almost all reports, calculations or analyses were prepared in MS Excel. Excel produced all sales reports, cost calculations, cost estimations, and in general, all calculations.

The order specialists, the customer representatives, and colleagues in logistics and manufacturing were all happy and open when telling about their small tricks, routines. They also mentioned Excel as a key resource used for multiple purposes.

As long as the produced quantities were low and only one production line was operating in the manufacturing hall, this was all possible. However, with growing production quantities, more types of products, product varieties, and assembly parts, the daily algorithms became more and more complex and less possible to fulfil the requirements with static Excel tables.

Inventory level, order management

As approximately 60 per cent of all company costs are represented by inventory costs, a key to success is a strict inventory management, together with a rather flat use of available capacities.

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> „Key is to keep the inventory levels very low as raw materials represent the main cost factor. Based on our experience, the incoming orders have an approximately 50

> per cent accuracy. This low accuracy would result in a very high inventory level which we can not afford." (Beta Managing Director)

This was, to optimalise the inventory levels, the fluctuations in the incoming orders have to be managed well. Sz. L. (program manager), using *six sigma* principles, developed an ITO (inventory turn optimalisation) table in Excel. Using a simple report filtered from the ERP system, the ITO table uses mathematical and statistical functions (norming, standard deviation) to flatten out the incoming orders and calculates more flat procurement orders based on them. In May 2009, this process and the behind lying calculations were presented in the quarterly Board Meeting in the Headquarters and ever since it was inaugurated as group-level best practice.

When asking about it, the IT manager makes a short remark about it:

> „They could have told me they needed something like this. I could have helped a lot with this table." (Sz.Z.)

Since a few months, a more complex data base management software, Access has also became an important tool in the area of warehousing.

<u>Incoming goods, material moving</u>

The warehouse supervisor explains:

> „Before using this new Access database, we had fixed slots in the warehouse. This means that the same parts are always stored at the same location. However, as we had to put away more and more types of parts, this resulted in very low efficiency." (T.G.)

The Logistics manager emphasizes that one important criterion in the ISO TS standard that all parts are individually marked and retrievable. This way all received items are labelled with a unique batch-tag.

The other principle to be regarded is the FIFO principle of cost calculation: the forklift handler always has to pick the item which came first and deliver it into the production. If the forklift handler makes a mistake, it brings complications at the month end financial close through the exchange rate residue.

> „The more complex warehousing module in Axapta would have been much more expensive. This way we had to approach the IT department to help us finding a solution to this issue. This Access data base brought the solution." (T.Sz.)

Currently the process flows in the following way:

(1) The incoming goods forklift worker enters the incoming items in the system and places it in the shelves. After this, he registers the goods put away in the Access data base: item number, amount and location stored.
(2) The picking forklift worker uses the list generated by Axapta to see what is required in manufacturing on a given day. Using the FIFO principles looks up the required materials in the Access data base and defines the warehouse locations. The picked goods are delivered into the production.
(3) If the full package was not used in production, the forklift worker has to put back the opened package into the original location and use an "OPENED" marker in the Access table (no exact amount is entered).

In a reply to my question I learnt that Axapta is still important in warehousing: it keeps track of the inventory level of all materials. The Access data base has the three main roles:

(1) Simplify the daily work of the warehouse workers ,
(2) Use and keep the FIFO principle,
(3) Efficient use of the available warehouse space.

In our separate interview, the IT manager explains to me that this function does exist in the Axapta and is in fact available for Beta. He adds that before the re-implementation, this function was even used:

> „For some reason this process in Axapta makes mess on the Finance side. The problem is on the side of the evaluation of the existing inventory: even if all inventory is used, the financial calculation brings up a residue. This is a bug in the system: changing warehouse locations should not have any effect on the finance side.
> They [at Beta] stopped using this process as it was always just causing problems." (Sz. Z.)

Setting up the production plan

Beta operates in weekly cycles, which means that the ordered products should be manufactured within the given week. To organize the production accordingly is fully up to the production planner.

> „Axapta is able to schedule the customer orders according to required production time, or promised delivery time. However, there are two main shortcomings, which make human factor necessary to set up an optimal production schedule:

— Axapta is not able to divide large batch production, which means, it handles a 5000 piece order the same way as a 10 or 20 piece order.
— Axapta does not know about raw material shortages…. " (Cs.L. production planner)

For these two reasons the production planners have to review the production schedule calculated by Axapta. They check available materials with a connecting MS-SQL based application called *Shortage report*. This report is run every day and highlights which materials are in shortage for the production scheduled for the day. During the 9 a.m. daily operation meeting all shortages are discussed and reviewed and the production schedule is modified accordingly.

Finally, a paper-based Excel table is given every day to the shift leaders showing the revised weekly production schedule.

II. Manual data modifications

Manually deleting orders

Sz.B. material specialist explains the situation:

> „Currently the larger customers submit their orders through an EDI system. This is a standard method in the car manufacturing industry. These data packages – according to industry standards – contain two types of data: firstly the current (in our case bi-weekly) fixed order amounts and secondly, a long term forecast of the orders. This data is directly stored in the system, they are, however, not reliable and we have to correct them." (Sz.B.)

The orders incoming through the EDI connection are connected to an experience based mechanism. Orders regarding three parts from the two largest European vehicle manufacturers had proven continuously unreliable. This caused serious issues in the inventory and order management areas. As the order quantities are usually not significantly large, the responsible program manager determined an optimal safety stock level based on historical data. The safety stock is large enough to satisfy the fixed bi-weekly orders.

Accordingly, the material specialist automatically manually deletes the order data arriving electronically from these two customers regarding these three part numbers.

Using registered manual order forms

Ordering materials outside of the Axapta system is processed through an other manual process.

Beta uses a manual system with built-in control in these cases:

> „These types of orders are entered in a commonly used Excel table which has pre-filled order ID numbers. This order ID number from the Excel table has to be filled-in in the Word document which is the standard order document used by everyone.
> The orders outside of Axapta can be tracked with these unique ID numbers.
> We do not only order indirect materials through this manual process, but also some direct materials like binding tape. We can not really foresee its usage." (T.G. warehouse supervisor).

The IT manager evaluates it:

> „The registered manual order forms are justifiable from the business aspect. It is not worth it to enter parts in the system which are rarely ordered or are not standard materials. The ordering of consumption control materials are managed the same way [a routine to be introduced below – B.E.], which is also justifiable." (Sz.Z.)

Co-operation between functional divisions – "adjusting data to reality"

> „A characteristic situation is when the quality controller finds a faulty item during incoming inspection. In this case, he has to put on hold the whole incoming batch and it has to be fully reviewed piece by piece. The full amount of this incoming item has to be put on hold also in Axapta and therefore, the system will not calculate with the amount on hold when planning the raw materials – and if the material is required for an upcoming production, Axapta generates a purchase order for the material. However, if part of the material on hold passes the tests, they will be put in the warehouse on stock, where the inventory will be unnecessary high with the newly ordered materials. I will be blamed for that…" (T.Sz. logistics manager)

Obviously, being responsible for the inventory levels, the interest of the Logistics Manager is that the review of the materials happens as soon as possible and the amount of useable materials becomes clear. However, it is not always a straightforward process: there might be an extensive debate with the supplier, or there is no available resource for doing the large amount of individual measuring or testing.

In such cases the upcoming request for orders are deleted manually for a while – as well as the production plan is modified to postpone the production of the given parts as long as it is possible.

The IT manager explains that it is not a unique situation:

> „Upon the introduction of Axapta, there was no common vision, no co-ordination: everybody was doing their own tasks and got somewhere independently from the others. This was of course not functional and such situations are the best triggers for developing workarounds." (Sz.Z.)

Preparing picking notes

J.I., customer representative explains:

> „We have to print a picking note to be able to release the delivery. It is available in Axapta, however, the generated document on the one hand contains too much information, on the other hand, the font size is way too small. The older fork lift workers are not able read this document well. B. [*the General Manager* – E.B.] said, to have it developed in Axapta, would be very expensive, so we collect all daily deliveries in a single Excel table and the fork lift drivers use this table to collect and prepare the shipping of the daily deliveries." (J.I.)

Sz.Z., IT manager hears this issue from me, and comments as follows:

> „Well, they really should have told me this – such small ergonomic questions are really easy to solve."

T.G., the supervisor of the warehouse has an other explanation:

> „When I had asked Z [*the IT manager* – E.B.], why can we not use font size 20, he told me leave him with such requests, saying that if we use huge fonts, the report will not fit on 5 pages." (T.G.)

Manual modification of invoices

The manual preparation or even just the modification of invoices is strictly regulated on the level of managing director. He explains that once an invoice is generated automatically by the system and we know that the base data are correct, we know that the invoice is accurate. This is guaranteed by the automatisms built in the system.

There are, however, two cases, when it is necessary, to be able to modify the invoice manually. One case is of course the handling of exceptions – which can occur in any real production process. The other case, when the problem can only be solved by manual modification, is the following of reverse transactions. Reverse transactions are most often required, when for example faulty raw materials are assembled in a part. In this case the product (which is registered in the books as "semi-finished goods") has to be dis-assembled and all parts and materials remaining have to be "booked back". The materials, which can not be re-used, have to be amortized or scrapped. For this real material flow process, there is no standard process in the Axapta system, so all these steps have to be entered manually and calculated for.

Modifying the date of receiving

An important entry in the supplier scorecard in the car manufacturing industry is the delivery-on-time. Consequently, the arrival date entered in the system for the incoming delivery is an important detail for measuring supplier performance.

T.Sz. logistics manager explains:

> „The fork lift worker, who is putting the received materials on the shelves, has to enter the date of the real arrival into the system. This is not necessarily the current day's date.
> In a few exceptional cases, when the delivery was late because of the fault of the logistics company, the Buyer overwrites the date of arrival. This way we can measure and evaluate the real performance of the supplier." (T.Sz.)

III. Entering fictional data, or modifying system data

Modifying system time

In the years of the earlier Axapta version in many cases even the most basic system settings had to be modified. The most common trick of this type was the modification of system time. This step had a key role in three situations: (1) consolidating orders, (2) pre-printing of documents and the (3) quarterly rolling cost planning.

> (1) „With the orders we had the problem that while most customers systematically send both their bi-weekly orders and their annual forecast, we had some customers who send a fixed order for two or three weeks and do not send a forecast.
> In these cases we had to add a fictional annual order batch into the system which was based on historical data and information of the international sales team. This method can ensure that if we order material from overseas with eight weeks lead time, we can manufacture the standard amount of finished material order well within time.
> However, the system is not able to put together and consolidate the forecast and the bi-weekly fixed orders, but the two amounts were added up, and in many cases we ordered the double amount of the real purchase requirements." (H.I.)

The manual calculation, although obvious, but involve high risk of human calculating mistakes. So the solution became the modification of the system time.

> „When running the calculation of purchase requirements, the material specialists changed the system time and set it to two weeks later. This way the system will not calculate with the fixed purchase orders (which theoretically were already calculated with 2 weeks ago, in case of continuous operations), only with the pending orders. This way we could ensure that all customer orders were taken into account only once.
> We introduced that the system time is set ahead every Wednesday after working hours, only for the time this report is ran. The table calculated is saved with the actual date and loaded in the system. According to the parameters of Axapta, it will

> use the data base saved with the given [current] date when calculating the purchase requirements." (H.I.)

(2) The second type of requirement is when some documents needed to be printed in advance. The classical example is when the products assembled in a weekend shift had to be delivered immediately on the same day. In this case – for convenience and cost saving – the office workers did not come in to work only to prepare the necessary documentation according to the strict process.

> „In these cases I changed the system time on Friday afternoon and I put in the system that the batch is assembled. This way I could print the shipping note and the invoice and the shift leader coud send the delivery on the weekend as necessary.
> If there was any difference, we could modify it manually on Monday – after we had checked if anything had been necessary to adjust in the system." (H.I.)

This is really occasional, a true exception handling. Since the second system implementation the managers strictly check the weekend deliveries – mainly for the several sources of mistakes.

(3) Similarly, the change of system time is required for the quarterly rolling cost planning.

> „The system can not handle the exchange rate differences at different times; it can handle only one exchange rate. This way, we found the solution for the consequent cost plans for the quarterly planning, that the finance team enters the corrected exchange rates for a future banking holiday (possibly not a weekend day, but a real banking holiday). The system time is set for this date when the cost calculations are run and the reports are calculated regarding production volume and unit costs." (V.K. finance team leader)

These reports are saved in Excel tables and then imported into the special finance software of the international group – this last step is actually the quarterly financial plan itself.

> „The system time has to be set back to current in any case after we are finished with the calculations." (V.K. finance team leader)

These tricks are always used only after 5 p.m., by those, who have access. At 5 p.m. the working hours end and most of the workers leave for home.

When I asked about the change of the system time, the IT manager gets surprised and says that he had never heard about it and does not even want to discuss it: "*Let's not*

even talk about it, this is unacceptable!". My slight persistence yields an answer from him though:

> „There are always exceptional situations, but if the exception becomes a rule and becomes a systematic routine, that is a serious issue. We have to consider that we have serious problems, and we urgently have to fix it.
> If there is an exceptional case, we have to use control mechanisms, consider consequences and have a well prepared action plan. We have to save key data – but not regularly!" (Sz.Z.)

Asking him whether the users could measure the risks of changing the system time, the IT manager replies: "*I am sure they could measure the risks, they knew the system very well…!*"

Ordering consumption control materials

One of the most interesting, at the same time officially accepted workarounds discovered is related to the ordering of the so called "consumption controlled" materials. These are amongst others: wrapping materials, lubricants, washers, standard screws or other bulk materials.

For the procurement of this type of materials there is a fully independent cycle developed, so the inventory data is not stored and maintained in the system. The managing director explains the starting points:

> „In Axapta there is a unit cost calculation, therefore we have to enter the amount and price for every material used for assembly. Based on usage, inventory levels and lead time, the system automatically calculates the purchase requirements and our material specialists systematically send order based on the generated purchase order requests. In the case the indirect materials we had enormous inventory piled up.
> What did we do? First we tried to solve this by enabling negative inventory level on these materials. But this did not help the material specialists to know when to release the next order. Once it happened that we had to stop all assembly lines because of the lack of lubricants, and at an other time we could not ship because we had no wrapping foil" (Beta managing director)

Finally, the solution was found: it started with a paper-based list consisting of all such type of materials. Now the inventory supervisor on duty checks every Monday the inventory level of the materials on the list, and if any material's inventory level is below the calculated safety stock level, he notifies the material specialists.

The safety stock level might vary per raw materials, but essentially we are talking about visual signs:

— In case of bulk materials (for example washers, simple screws) there is a red buoy built in the corner of the storage boxes. Once the buoy is visible, a new order is necessary.

— Similarly for the lubricants, there is a red line painted on the storage box's side. Logically, if the level of the material is below the red line, a new order becomes necessary.
— In the case of wrapping material, there is a measurement pole fixed next to the storage box. The height (or to be exact: the lack of height) of the pile of the wrapping material is the sign for a required new order.
— Some liquids are stored in barrels; in this case the number of remaining barrels will sign the time for a new delivery, same case with the roll of tapes.

> „We calculated the signal positions based on the lead time and the speed of usage. We were experimenting, but based on the experience of our material specialists, the first guesses were already quite good guesses." (Beta managing director)

In the case of these materials the material specialists manually delete the upcoming purchase order requests generated by the system. Purchase orders are only released upon the information of the warehouse supervisor. (The material specialists work with the same list as the warehouse supervisor.) These orders are not released through the Axapta system, but an Excel table is sent to the suppliers and they deliver based on this data.

> „The fundamental idea comes from the kanban system – the Managing Director explains. The basic difference is that for the cost calculations and the completeness of the BOM we have to have data in the system, while the operation of the kanban system can be harmonized with the ERP system." (Beta managing director)

IV. Operating a KANBAN system

> „The kanban system is an industrialized workaround" (Beta Managing Director)

The responsibles for the operation of kanban system are the production planners who (interestingly) report to the Logistics Manager.

> „The kanban system is better able to follow the reality as the ERP system: the discrepancies are smaller and last for a shorter period. The ERP system is accurate at a weekly level; this is then the "sensitivity scale" of the ERP. This means that all data is accurate at a weekly level only." (Beta Managing Director)

T.Sz. continues:

> „It is much easier to put together and follow a daily or even an hourly plan (for example a manufacturing sequence) in the kanban system."

It is important to note that the Axapta system is functionally able to schedule the manufacturing at daily or even at hourly level. However, for this accuracy much more

dimensions [parameters] would be necessary to enter for a single transaction. This, similarly to the first Axapta version, would make the identification much easier, but at the same time to run the processes cross-functionally would become more complicated. T.Sz. explains:

> „Based on B.'s [*the managing director* – E.B.] decision, the operation of the integrated processes is more important than the accurate planning. We can very well replace the planning with the kanban cards, where we can visualise the items and volumes to produce. Accordingly, we have put a programming table in front of each assembly line where the weekly production plan is visualized with kanban cards."

The production planners have to regularly synchronize the ERP system and the kanban cards. The company management appreciates very much and continuously improves the kanban system. At lower hierarchy levels however, other factors, mainly the work orders, are defining the daily tasks.

> „The kanban system is important only to me and B., the others deal with it only because we monitor it. Maybe if I would not pay attention for a week, I would find the last weeks' cards on the tables." (T.Sz. Logistics Manager)

V. Complementing software

As one of the key competitive factors of Hungary is the cheap workforce, it is a regular task to relocate assembly lines here and start up the production. H.I. project engineer explains that "external" software is necessary for this task:

> „The single entities of the international group are relatively independent. This makes co-operation quite difficult, additionally, the local Axapta versions have different parameters set up. We often experience difficulties when we need to take over and set up the data base connected to the actual assembly line back home. In the case of complex data bases we save the Axapta data base in a separate data base and we upload it into our system. In the case of less complex data, it is possible to use the central server for the movement of data." (H.I.)

Since Microsoft in 2002 bought the originally Danish Axapta (today the software is available as Microsoft Dynamics AX), several additional applications are available on the market. One of such applications is ATLAS XL, which grants access to the data base behind the ERP system and therefore enables the generation of ad-hoc reports, which then are exported into MS Excel.

> „ ATLAS, which is currently introduced at group level, is able to produce reports based on the Axapta system data, can generate cross tables and pivot tables directly from the Axapta system. This is a very important help for us." (Sz.Z. IT manager)

> „What else is important, that there is a software package for following the engineering changes. The Swedish engineering group is supervising the design drawings of the single parts and they can approve changes. If there is a change in the BOM, we have to immediately apply the changes in our purchase orders. The

> Swedish team sends an email and I run the change through the BOMs stored in ERP system" (H.I. lead project engineer)

The comments of the IT manager

Sz.Z. IT manager was hired just when the Axapta system was re-introduced. He later got promoted to the global responsible of the ERP system which granted him a very wide overview of the system and its international use. His comments and explanations – just as well as his naturally unique viewpoint – helped me in many cases to understand the interdependencies. In many cases he could not agree with the "easy way" how users used the system:

> „I never understood: Beta being a supplier in the car industry and the engineering changes are documented very accurately, but if anything is changed in the ERP system, nobody cared about its consequences."

He started our conversation with the following statement:

> „The main source of problems at Beta is that the first implementation of the system was done without professional support."

Sz.Z. explains that the evolution of workarounds next to ERP systems is a natural phenomenon and in many cases this is the rational state:

> „As a consequence of the first implementation, here nobody really trusted the system.
> It was important to convince the users about that the system is reliable. First time the system was launched without testing. The testing is an important tool for user enrolment."

In the case of ERP systems the templates are set up internationally, at group level, consisting of the standard processes, however, not the processes specific to the single countries.

> „The ERP systems work with standard processes and standard reports. It is normal, that the system is not able to fulfil all user requests. I can understand if everybody wants to see everything in individual set ups, but if somebody has a sudden idea, he or she should use Excel or a workaround."

Asking Sz. Z. how it is decided whether the workaround or the system adjustments are the optimal solutions, he answers the following:

> „If the given report or function is regularly necessary, it has to be developed within the system. The costs of such developments are also to be taken into account, and the return of the investment. There might be always intangible benefits, too."

Discussing how user's requirements and ideas can be built in the system, Sz.Z. tells the following story:

„There was a big resistance when I introduced the *change request forms*. Such forms had to be filled in for every request they had: the current state as well as the required state had to be described and a business reason detailed. This was very unpopular, because they were unable to give business reasons, in many case even unable to describe what they really wanted."

Here I had to ask if he knew the workarounds I had revealed.

„I did not know the most of them. I was not involved in these solutions, even though I asked them to do so. Although I was involved in the management meetings, there only the key indicators were discussed and not any change requirements. Process changes were discussed at other meetings and these never really reached me."

The IT manager summarizes the situation as follows:

„Generally those who have not worked with other systems before are satisfied. Those who know other system are not really happy. The speed is often problematic, which has several reasons. The Internet bandwidth used for data transfer is not enough, so the system is often very slow. An other reason is that due to a faulty development, often happened that the database gets locked and the system gets very slow – even seems to have frozen. The user interface is quite good; I would say the system is user friendly, although we had to have lot of new developments." (Sz. Z.)

Asking Sz.Z. to evaluate the system, he is rather positive.

„Part of the truth is that Beta uses an Axapta version from the Stone Age. Several functions are missing which had been developed and added. This version is not even supported by Microsoft anymore. The new version is much better." (Sz.Z.)

He also adds that the mother company have been planning to change the system since several years (they would like to change to SAP), but this investment is prolonged due to the economical crisis – and they also do not spend on the old system anymore.

„In many cases the user does not use the system even if the given functions would be available.
Worst is that the management oversees it. They usually accept it, because they do not know – but if the colleagues are claiming that they have too much work, it is worth to think about whether they use the system." (Sz.Z.)

In the below table I summarize the user workarounds existing next to the ERP system I have collected during the field research and introduced in the above chapter.

Type	Routine
Spreadsheet or data base management (MS Excel, or MS Access)	Inventory level, order-optimalization
	Putting together the production plan
	Putting away material, material movement
Manual data adjustments	Deleting orders manually
	Preparing registered manual order sheets
	Co-operation between functions – adjusting data to "reality"
	Preparing picking note
	Changing the date of arriving goods
Entering fictive data or modifying system data	Changing system time
	Ordering consumption control materials
Operating a KANBAN system	Kanban system
Complementing software	Complementing applications connected to the system

Table 7: Summary of user routines found at Beta Company

5.3.2 Gamma Company

Gamma was founded in 2004 as a Hungarian branch of a worldwide multinational company. Gamma's main profile is supply chain solutions provided for large OEM manufacturer companies. Gamma's net turnover and the number of employees have been steadily growing since 2004.

As a result of being a trading company (with some additional services), a large number of transactions are conducted every day, mainly on the side of procurement, but also on shipping to the few customers. The individual buyers have to execute minimally 250, sometimes more than 1000 transactions per week. The main focus of the colleagues is to process the transactions within the ERP system according to the prescribed process. The company also offers some additional services as kitting, packaging or quality inspection related services.

5.3.2.1 The ERP system of Gamma

Gamma introduced the mother company's ERP system, Oracle. The company level partner for system developments is an Indian company (part of an outsourcing deal), where a dedicated team of software developers work for Gamma. Gamma has also an IT team whose main task is to harmonize the development needs and to improve communication between the business side and the development team. The continuous and intense development activity results in annually approximately 35-40 smaller or larger solutions by the external development team.

With one exception (the HR), every employee uses Oracle for their daily work.

The below figure illustrates well that executing even the most basic transactions require the close co-operation of all company functions as well as frequent communication (Figure 5). The guaranteed and expected high level of service, the optimal timing and the continuous communication of up-to-date information towards the customers are of key importance.
The handling of exceptions (most often an urgent or an extraordinary delivery, or a case of a lost item) requires a very intense co-operation.

To satisfy the customer needs, a normal transaction follows the following path:

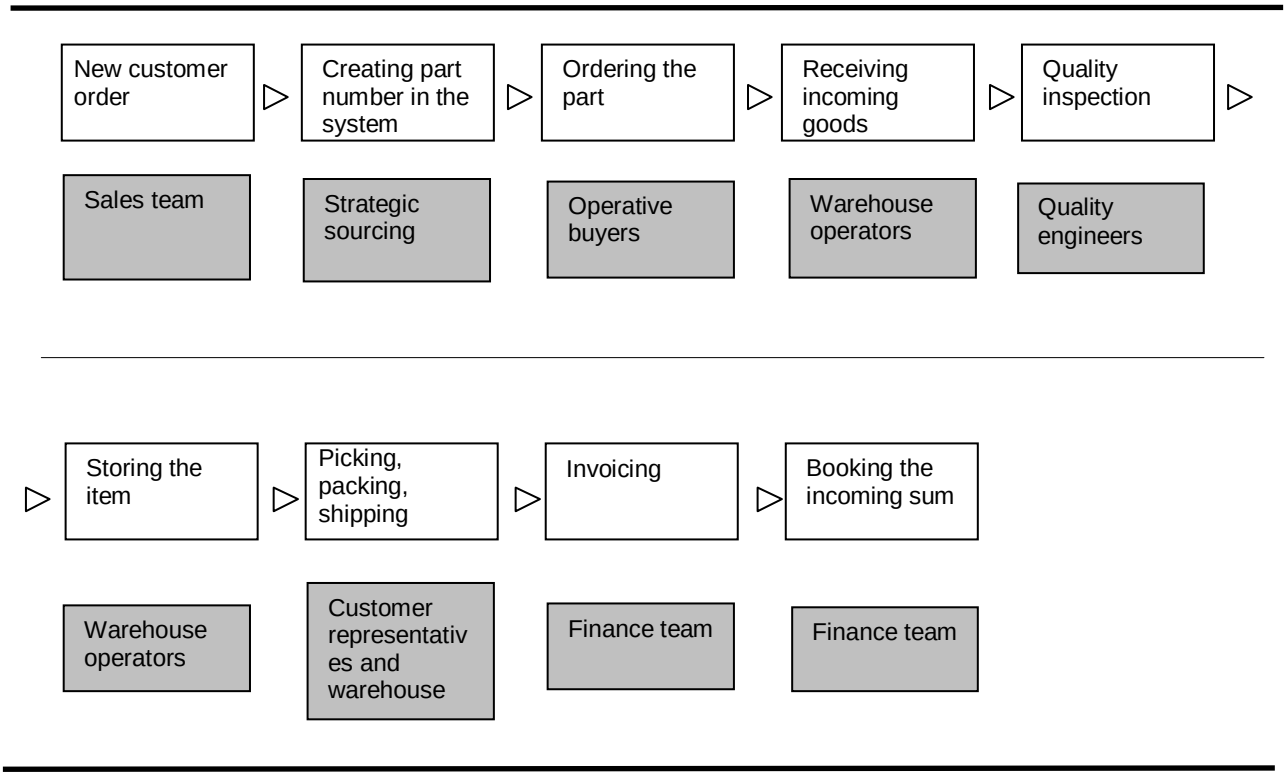


Figure 5: Basic process and the connected data flow at Gamma company

To ensure the co-operation, there is a weekly meeting for all the teams, as well as with all supporting departments where all the indicators are reviewed. In this so called Operations meeting all information related to urgent or exceptional cases is discussed and the status checked.

At Gamma the finance team is a culturally different user group. The harmony between material and finance processes is inevitable so the operation team has a very close co-operation with the finance team.

5.3.2.2 User routines existing next to the system at Gamma Company

The development and customization of the ERP system proceeds slowly, constantly priorities have to be chosen between requirements. Accordingly, there are numerous complementary and bypassing routines used regularly at Gamma Company.

As the IT manager explains:

> „On the one hand, our development team is slow, and they are not the best ones either. On the other hand, Oracle has also shortcomings. Some of our basic

> processes are missing. A system of this level should, in my opinion, contain much more processes by default. Instead, we have to pay really a lot of money for essential functions." (N.L.)

As an other reason, N.L. points out the following:

> „Oracle is not really good in reporting. Not only our development team is slow, but this function is not well designed. You have to enter manually the filtering options, which are on separate tabs."

Additionally, the type of the business Gamma is doing also requires an emphasis on exception handling – this is of key importance for the satisfaction of the clients. This company is a service and trading company, a delivery accuracy of 95-99 per cent is guaranteed for their customers. Gamma's managing director explains the speciality of the business:

> „You might have a service level 99 per cent, but the customer will not be satisfied if you are not helping them in the urgent cases. On the contrary, you might provide a service of 80 per cent accuracy, but always solve the special and urgent cases quickly, he will be very grateful and you get new business!" (Gamma managing director)

In the following sections I introduce the routines revealed at Gamma based on the explanations of the users. I have to note that the internal language at Gamma uses several English words – following the terms of Orcale, Excel or the company's performance indicators.

Workarounds at Gamma Company

At the local company the most common complementary tool is the Microsoft Excel spreadsheet software. There are some tables which are used by everyone, while there are pairs who work together, so they share the same table and of course, there are individual tables, too. In the following section I introduce the regularly used Excel tables.

Open order report

This report is one of the most important tools. The essence is summarized as follows:

> „Every Monday the buyers make a report reviewing the open orders which is then exported into an Excel table. This report is saved in a common directory, anybody

can access it. We use this table to follow up the open orders." (P.Á. customer representative)

K.A. buyer adds the following:

„The Open order report is open the whole day long, anything happens, I enter it or adjust the data." (K.A., showing the sizeable spreadsheet)

The report is gained from Oracle, and transformed into individually marked spreadsheets with big routine: for example with the help of functions, individual tags are ordered to every line of every order. After this, with the help of the VLOOKUP function, they enter the supplier of the part (from the later introduced Costbook).

A.E. customer representative shows the table:

„Any action, update is entered into this table: status arriving in email, or the number of the delivery dispatched, any delivery information, or quality related documentations, where they are stored – anyway, anything what might be necessary related to that very order is stored here."

B.R. customer representative admits:

„Oracle is accurate one time every week: Monday 3 p.m., [*this is the time when the line manager runs the report checking if the data is entered into the system* – E.B.] otherwise the whole week I am using my own Open order list." (B.R.)

A.E. of the same topic:

„If we would not have the Operations Meeting on Monday, I would not even load the data into the system. The Oracle is slow and I can not filter the data." (A. E.).

Also this table, managed by the Buyers, is opened by the Customer representatives if they need any information regarding the incoming goods:

„I am not using the Oracle, because I know that [A] enters all the information in the OOR and here is where I will find what I need if the Customer is asking." (A.E.)

All the tables can be filtered according to every aspect, so the Buyers have very quick answers they receive regarding the status of the items: let it be about the location, the supplier or the payment status of the invoices.

Individual users have developed further methods in the table to support their own work. The most commonly used is the colour coding.

„This is important, because in peak times, like the launch of a new program, you might have to deal with 1000 or even more open orders at the same time. It is

much more transparent if you use the colour codes. I can find very quickly what I am looking for." (K.A. buyer)

P.A., B.R., and A.E tell me what characteristics they usually code with the colours:

- Parts arriving on the current week
- Means of transportation (ship / train / truck / air / container)
- Per continents of origin
- „Received"
- Problematic orders – the red colour always means "problematic issues".

N.L. IT manager has a negative opinion about colour coding:

> „I think it is not smart to use colour coding because you can not filter the data per colours in our Excel version."

K. A. buyer explains further:

> „Open order report can also be used for the supplier communication. I filter the lines of the weekly open orders of the given supplier and I send the status to the representative. The nice ones just add the status to my table and send it back. The less nice ones I have to call the whole week to learn about the status of our orders."

The buyer can not check the "reuired date" in the system (the date when the customer needs the delivery), because this information is stored in a different module of the Oracle and buyers do not have access to that one. Earlier phone or Skype instant messages were used to get this information, but now the seating was re-arranged, so Buyers and Customer Representatives are sitting next to each other can easily discuss such questions.

POR list (Purchase Order Requisition)

In the Oracle system the customer representatives enter the customer orders. The system then generates so called Purchase Order Requisitions (POR), which are visible for the buyers. The rule of thumb is that from every POR a Purchase Order (PO) has to be generated within 24 hourd. This would mean that every day there is a different POR list. The reality is of course very different. The daily POR list consists of generally 120-150 lines and approximately half of these are not new.

At the time of this research F.Sz. buyer is responsible for preparing the POR table. He helps me understand the table and the process:

> „In Oracle every morning an inventory planning algorithm is ran which practically consolidates the customer orders with the open order lines, the existing inventory and the goods in transaction. Based on this calculation a POR list is generated and I, using this, have to prepare the POR table every morning by 10 a.m. in Excel. We need this Excel table because the POR list available in Oracle is not usable from many aspects." (F.Sz.)

K.A. explains:

> „I can not see in Oracle when the customer needs the items ordered. Maybe the supplier has them on stock and I can take those, if it is urgent. But Oracle automatically adds the lead time stored in the system and calculates the suggested promise date which we can communicate to the Customer. Oracle makes it much more complicated."

The Buyer responsible for the POR list puts together a single report containing all the PORs from the system and the raw data can be easily exported into Excel.

The Buyer in charge follows the following steps with the Excel table:

1. Inserts new columns necessary for the daily work:
    a. Further data is added: Unit price, Currency, Supplier; and
    b. Comments;
2. This is followed by a VLOOKUP function to fill-in these newly created columns from the Costbook of the previous day;
3. Also using VLOOKUP, from the previous day's POR table the Comments fields are transferred to the new table. The lines which are for some reason not found by VLOOKUP, have to be filled manually. There are more routines to make it faster.
4. Colour codes are added:
    a. GREEN: ordering for safety stock;
    b. YELLOW: the Buyer has pending action;
    c. RED: strategic souring team has pending action;
5. As a last step, the Buyers sit at F.Sz.'s computer and filter their order lines, where they add the status of the given items (amazingly they know them by heart).

The finished table is then sent to everyone via e-mail. Practically, for the procurement side this table defines the daily work.

In the beginning, to execute these steps took 45 minutes. By now, after nearly half a year, F. Sz. is proud to prepare the table in 20 minutes.

> „I learnt countless tricks and settings from (K.)A and (P.)Á., but this column [*proudly shows column F*] was my idea. This is an IF function related to column E and I managed to shorten the preparation time by 5 minutes!"

The IT manager adds to all the above:

> „Having this POR table might indicate that the system does not work well, but in fact, this is the question of the inventory planning method you choose. For what Gamma has chosen, this is how it works, can not be done differently." (N.L.)

Sales Order (SO)

The customers send their orders in Adobe Acrobat files, or via fax, or e-mails, which all have to be entered in the system.

> „We like it more if the orders arrive in Excel, because we can immediately edit them and we can use the uploading macro which loads all new orders very fast, even the very large orders." (A.E.)

Getting orders in Excel is however very rare. Generally (with small individual differences) the incoming orders are printed, the local Gamma data is written on it manually (order ID, value of order) and they are filed per customer in folders.

> „This way we can easily find the sales orders. The system is unbearably slow, and it is not efficient to search the attachments of email messages, or fax messages. It is also easier to enter the data in the system from the paper on the table." (A.E)

> „I have only one monitor, so it is easier to see the paper sheet in front of me while entering all data in Oracle. This way I can easily compare if I entered the correct numbers." (B.R.)

Costbook

Two young engineers are working as strategic sourcing engineers: T.B. and K.G. This is also a "fast" type of job, but the atmosphere is very good in their office. They also feel that this job is important: the prices they get from the suppliers define if the company can stay competitive or not…

The young men explain that they are responsible for one of the most commonly used solutions which are outside of the Oracle system. This is an Excel table containing all prices, nd key information on items as well as the basic data of the suppliers.

This database is strictly confidential. T.B. strategic sourcing engineer explains:

> „The Costbook contains everything we have. This is where we save the supplier, the price, the trade terms and all important technical and trading information what is related to every single part we are dealing with."

Not surprisingly the unit price is the key information.

> „The data in the Costbook is the valid data, you never use the Oracle." (K.G. strategic sourcing engineer)

Accordingly, only two employees (and the managing director) have editing rights to the Excel spreadsheet and read rights only those, whose daily work requires it. At the time of the interview, the spreadsheet contained 5460 lines and 18 columns. The file is to be found on the local common server, the data is continuously updated by the person in charge for it, and the current version is archived daily.

The prices have to be looked up in the Costbook for every single transaction and manually entered into Oracle. Oracle is currently not able to store the prices as required. The reasons behind it are numerous:

> „The prices are given in 6 or 7 different currencies and, of course, we also give our offers to our different customers in different currencies. Also many issues are caused by the difference of the unit of measurement – additionally the exchange between metric and imperial measurements is always an issue…" (J.R. Sales manager)

Consequently, the Costbook provides the basic data for every calculation where parts are matched with suppliers or prices. In these cases always the archived version of the

previous day's Costbook file is related with a VLOOKUP function to the given calculation.

The Costbook got infamous:

> „Last year [*Somebody*] was dismissed because of the negligent handling of the Costbook. The spreadsheet collapsed and for days we could not use the table and we could not tell the prices of the items. Of course back then we did not have regular archiving and we could only find a very old version. Even after months we had piles of problematic invoices sent back to the Finance Department. K.G. had to spend several weeks with setting up a working version again – and we introduced daily archiving." (S.R. Sourcing Manager)

The sourcing engineers use external software as well:

Storage of scanned documents

K.A. buyer explains the main points of the procurement side:

> „On the one hand there are the technical drawings; we use them when we procure the most parts. On the other hand, [Sz.]T. and his team use them for the incoming inspection."

A.E. customer service representative explains the customers' aspects:

> „Many customers require quality inspection documentations for certain parts. We have drawings which are prepared by our team, but we rather try to acquire them from the suppliers and attach it to the shipment."

N.L. IT manager was leading the project which linked the external software to Oracle.

> „In both cases it is important that the technical documentation is fast and easily retrievable. Oracle is not able to link a document to a single transaction so we had to find an external solution.
>
> The next challenge was to customize this external software. This was a rather expensive adventure and I had really a lot of hassle with the Indian team [the Oracle Support team – E.B.]. At the end, we added a new field to every data block where next to the part numbers the storage location ID of all related documents is stored." (N.L. IT manager)

Manual steps in the warehouse

In the warehouse I have revealed more steps which are executed manually by the warehouse operators. One warehouse clerk tells me about one of the oldest workaround:

„...this is how we have been doing it since a long time – and this is how it is best, otherwise we would really loose track." (P.J.)

If parts are received which require incoming quality inspection, a label should be printed. However, printing function is not available in the receiving modeule of Oracle. P.J. explains:

„For example there are parts which are new to our warehouse, or we have customers who require all deliveries to be inspected.
In these cases we put the parts to be inspected in a separate category in Oracle [he is showing on the screen a pull-down menu: "*SAMPLES*"] and they remain there as long as the inspection is not done. For these boxes the warehouse clerk on the receiving side has to write a label manually. The label contains the part number, the count of the items, the short name of the part and the date." (P.J. warehouse operator)

As it is much slower to write a label manually as to print one, this action might even cause delays sometimes. Mainly when an urgent delivery arrives, the incoming inspection is required and it has to be shipped "immediately" to the customer.

„Of course in this case the office people come here to the warehouse, stand here right next to me, and if they can, they help, so the delivery can be shipped as soon as possible." (G.F. warehouse operator)

An other manual practice exists in connection with the storing locations. At the time of the research, a comprehensive project was running in the warehouse aiming to change from static locations to dynamic locations.

„The more advanced warehousing module of Oracle is very expensive, so we have to find other ways to improve the usage of the locations." (N.L. IT manager)

At the moment the system is under development, so much more manual actions are necessary, but – if everything goes as planned – after the current developments still several steps have to be done outside of the system.

„Let's say, beforehand it took ten minutes to receive the goods in the system, now with this manual writing it takes twenty! This takes terribly much time and if we are in a hurry, we are not even writing it down. I hope we do not get checked… [*He laughs*]" (G.F. warehouse operator)

One of the manual steps which had to be introduced because of the changing to dynamic locations is related to the ISO standards system. According to ISO standards, all locators have to be tagged with a label containing the actually stored part numbers.

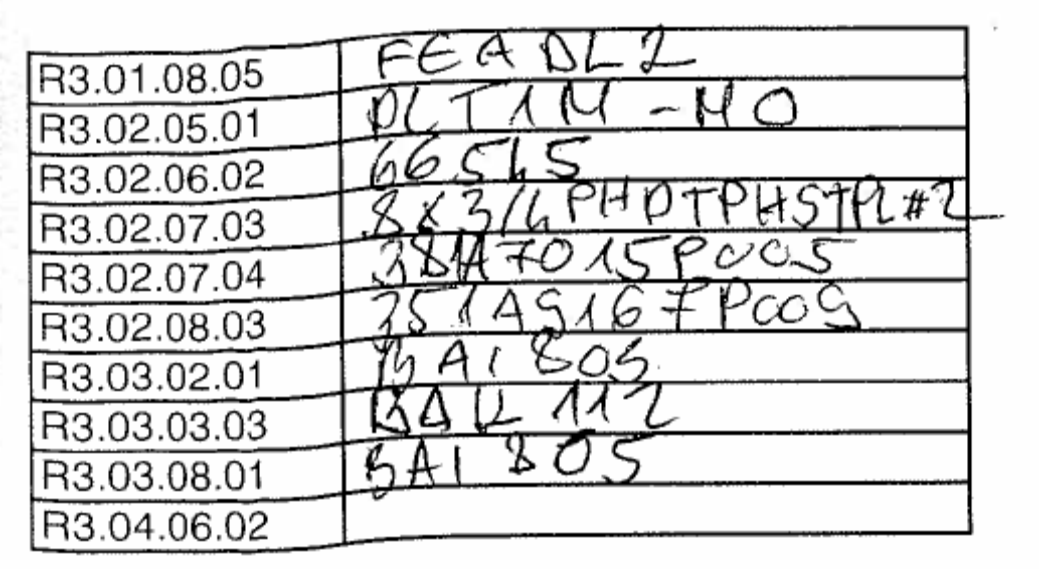
> „Currently, these labels can not be printed from Oracle, so we have to write down the locator's number and the part number on a piece of paper and we stick it on the locator shelves." (P.J. warehouse operator)

An other, more complicated solution outside of the system helps to determine in which location the incoming goods should be stored. The locations can only be chosen from the non-fixed ones in this transitional period. In this solution, the warehouse operator who knows the most about the system, from time to time puts together an Excel table.

> „...This Excel table is merged from two different Oracle reports. Oracle does not consider the locators with zero pieces as empty. So, in a separate Excel table I filter the locators with zero amounts, and I delete the zeros manually from the system. I export it into a new Excel table and I print the page. [*see Figure 6.*]. This way we have the list of empty locators for a few days again." (P. J. warehouse operator)

The receiving warehouse operators use the list with the empty locators and they choose the empty locators from the list to store the items. If the empty locators on the list are all used, they ask P.J., who again lists the empty locators and puts together a new list for use.

The warehouse operators choose from the Excel-based list of empty locators. They know by heart which area is reserved for which customer – and also that for which customer the received items are ordered. After putting the new parts on the shelves, the second column gets filled-in manually (Figure 6), and the fully used paper sheets are filed.



R3.01.08.05	FEADL2
R3.02.05.01	PLTIM-HO
R3.02.06.02	66545
R3.02.07.03	8x3/4PHDTPHSTPL#2
R3.02.07.04	38A7015PC05
R3.02.08.03	25 1A916 7PC05
R3.03.02.01	4A1805
R3.03.03.03	BAL112
R3.03.08.01	BA1805
R3.04.06.02	

Figure 6: Manually filled table of locators (Gamma)

> „The kits are a bit of challenges. [*These are tables of parts prepared by Gamma* – E.B.]. The items ordered for the kits need to have fixed locators next to the kitting area." (P.J. warehouse operator)

> „In Oracle we could solve this so that with a setting of a parameter the locators for kitting parts must not empty. This way the Oracle never considers the locators of kitting parts as empty and never offers it as available for the received goods." (N.L. IT manager)

Uploader program

Upon my explanation of the research question and focus, every interviewee first mentioned the so called uploader program as "the" workaround.

The Excel macro called "Uploader program" is very useful for the procurement or for the customer representatives if they need to enter a large amount of data into the Oracle. N.L., who is known for being an "Excel-guru" prepared the uploader macro. He explains the essence as follows:

> „This is an Excel macro. I have seen that it is a big pain for everybody to load up so many part numbers. I have asked what the exact process was and I prepared this macro for them. The parameters have to be entered into the macro, this takes approximately 20 minutes. Then the macro has to be ran which might even take hours – depending on the number of lines to be uploaded. While running the macro

> they can not use their computers, so I think the best is to use lunch time for example."

> „This macro basically simulates typing. I have written several other macros. Now for example there is a new project on the customer side and we are simulating the receiving in the warehouse because there are so many items arriving." (N.L. IT manager)

Paper based lists

For filtering is very difficult in Oracle, nobody really uses this function – they much rather export the data in Excel. N.L. IT manager explains:

> „It is possible to filter data within Oracle, but it is not efficient and not transparent. Also, not so many details are visible. People do not really know it, so they rather export everything into Excel and work with the spreadsheet.
> In Oracle the filtering options have to be entered manually and the data are divided between more tabs. You can scroll down only one line by one using the PGDOWN and PGUP keys. It also loads very fast because it has to access the database and we have our database server in the USA."

Due to the large number of transactions almost all employees use small paper sheets to list the daily urgent tasks.

K.A. buyer for example collects the part numbers where the documents are missing; K.P. (transportation specialist) gathers the delivery notes where the urgent items are to be found. A.E. customer representative writes down the items which are urgent for the customer. B.R. works with the most paper sheets:

> „I like to file everything. I have separate folders for every customer. This way I can find anything I need very fast." (B.R. customer representative)

These paper sheets usually have colour codes, or underscores, or later, once the task is done, the lines get crossed over.

In the warehouse the paper sheets are used to follow up which shipment has to be sent on the current day. As Gamma is a customer focused company, the shipments are organized per customer. This way the shipping side warehouse operators know very well what has to be picked and packed and if the shipments have already left. In case

the shipment was not yet sent, he knows it is stuck somewhere and requires special attention. It needs to be sent immediately – gets a red mark on the paper.

The system of workflows

The workflows are available in the whole company internationally. Every workflow consists of a sequence of process steps and the workflow rests with the employee who has to execute the next step.

> „We could solve all these in Oracle, but it is much easier to set up a workflow. For that I have writing rights, for example. Oracle modifications and developments, on the contrary, can only be done by expensive IT professionals." (N.L.IT manager)

Once the next employee has to execute the task within the workflow, he or she gets an e-mail message. The actual step can be putting together an Excel table or upload a calculation, or entering data into Oracle (e.g. supplier, price, invoice number). The most workflows are still aiming for simply getting an approval of managers what can be followed by the material process and the Oracle process.

This also means that most of the data used in the workflows are gained from Oracle and colleagues in other functional areas can use them for other steps of the supply chain process – executed also in Oracle.

The user routines existing next to the system which I have collected and introduced in the above section I overview in the below table:

Characteristics	Routine
Spreadsheets or data base software (MS Excel or MS Access)	Open order report
	POR list
	SO list
	Costbook
	Uploader program
External software	Storage of scanned documents
Manual actions	Warehouse – manual labelling
	Warehouse – semi-dynamic locators
	Paper based lists
Group level external software	System of workflows

Table 8: Summary of the user routines found at Gamma company

6. DATA ANALYSIS

In this chapter I first analyse the previously introduced data which I collected. The described case studies are analysed individually based on the suggestion of Miles and Huberman (1994 – within-case analysis). With the individual analysis of the cases characteristic patterns are revealed and the casual relationships deeper understood. In my research the systematic cross-case analysis does not offer too much insight, so I am not dealing with it explicitly.

The objective of data analysis is to structure the collected data in order to answer the research questions developed in the theoretical sections.

According to the objective of the current research, I seek to study and understand the

(1) reasons behind,
(2) the realization (the tools and connections used for them), and
(3) the usefulness

of the routines developed next to the ERP system.

6.1 The process of data analysis

Ideally, in the case of an interpretive research based on ethnographic principles, the researcher arrives to the research field without any previous assumptions and knowledge (Schultze 2000: p7., Yin 1994). However, as Lincoln and Guba emphasize

> „…it is impossible to start a research without any idea what we are looking for and it would be a mistake not to make them explicit." (Lincoln and Guba 1985).

Similarly, Eisenhardt, (1989, p536.) also reinforces that without a clear focus the researcher gets easily lost in the field offering an abundance of data.

Accordingly, the goal of data analysis is to help answering the original research questions – which practically define the objective of the research. Based on Kvale (1996) during data analysis several processes run parallel: (1) structuring the interview

text and the collected data, (2) summarizing the explicit meanings and (3) revealing implicit meanings through which we aim for a fuller understanding.

Gelei (2002, p180.) also emphasizes that the phases of data collection and data analysis can not be clearly separated from each other, instead, the data analysis is an ongoing process from the very beginning of the research.

Indeed, I, as a researcher, experienced a dual process during the research: (1) on the one hand the pre-assumptions formed by my own experience and the literature were either proven or confuted – which will be discussed in a separate section, and (2) on the other hand, the initial concept of research was shaped by newer and newer discoveries and insights. This is confirmed by Eisenhardt (1989) as she emphasizes that as the qualitative data analysis is an open and iterative process, it is a completely common phenomenon that as a result, the original coding categories get more numerous and rich.

I shaped my own research concept through such a process and as a result, also the structure of the description got crystallized and the analysis of the data got structured.

The appearance of the researcher's own interpretation naturally conflicts with the standards of objectivity expected from a scientific research, which are required for the results to prove reliable for the scientific public (Schultze 2000, p8.). In order to limit (ideally eliminate) subjectivity, I insisted on the original citations and the acquired written or drawn sources during data collection, case study description and analysis. Similarly, based on van Maanen (1988), Schultze (2000) and Gelei (2002) at the end of the chapter I will discuss the possible influence of the subjective elements on the interpretation of the data.

6.2 Data analysis

In the following sections I analyse the data collected at Beta and Gamma companies (within case analysis). In the first part of the sections I briefly analyse the usage of the system. This is followed by the introduction of the revealed workarounds, their development and usefulness. At the end of both sections the users' opinions are introduced.

6.2. 1 Analysis of the collected data: Beta case study

In the case of Beta the usage of the system is radically different comparing the status before and after the re-implementation of the system. In the first period, practically only the Finance Department was using the system on a regular basis. Consequently, the data stored by the system was unreliable and not reflecting the reality. The re-implemented system followed the material processes better (mainly due to the collected experience) and the top management's new rigour resulted in reliable data stored in the system.

6.2.1.1 Reasons behind workarounds at Beta Company

I analysed the developed routines at two levels: on the one hand I analysed directly why the given routine was necessary; on the other hand I tried to understand the triggers at a more abstract, more general level. This latter viewpoint is necessary because in many cases there are multiple reasons behind one certain routine – as discussed below in more details. My analysis is summarized in the below table:

Workaround	Immediate reason	Classification of reason
Excel listings	Excel is more user friendly, and transparent;	Lacking functions, Inflexible, sluggish system
ITO calculation	Developing a local idea	Missing function
Dynamic storage	Existing module, but too expensive	Cost considerations
Setting up the production plan	Not enough parameters in the system: not suitable to approximating reality	Lacking functions; Inaccurate programming of reality;
Deleting orders manually	Improving data accuracy through using acquired experience	Data accuracy
Registered manual order form	Managing orders fully out of the system	Inaccurate programming of reality
Cooperation between departments	Data closer to reality (manual modification, overwriting)	Data accuracy
Picking note	Development too expensive	Cost considerations
Changing receiving date	Closer to reality – to measure real performance of the supplier	Data accuracy / Approximating to reality
Changing system time	Inflexibility of the system – approximating to reality;	Lacking functionalities, missing parameters;
Ordering CC materials	Approximating to reality / simpler solution;	Lacking functionalities, missing parameters;
Kan-ban system	Visual illustration; Flexibility	Lacking functionalities/ simpler usage
External software	Acknowledging the existence of workarounds , supporting their integration	Lacking functionalities / simpler usage

Table 9: Reasons of development of workarounds at Beta Company

Out of the revealed workarounds the Excel listings and the preparation of the picking note serve the comfort of the users. The other routines have been developed because they offer cheaper or simpler solutions for the tasks outside of the system, or the system data is approximated to reality. When manually deleting orders, unlike in case of other routines, human intelligence overwrites system data, but this is not about issues with the local ERP system, but the unreliability of the arriving data.

What needs to be considered is the change of system time. This data manipulation started at the very beginning and the pioneering users are still using this trick. We could say, this move survived the re-implementation of the system and half-officially the few key users are still solving some rarely, but systematically appearing discrepancies.

Also interesting is to consider the reasons behind the group-level decision to buy the complementing software. As these software link the ERP system with MS Excel, it also means that practically the frequent usage of Microsoft Excel for important calculations and actions is acknowledged at the highest level.

6.2.1.2 Analysing the development of workarounds at Beta Company

When analysing the development of the revealed workarounds, I aimed to learn about (1) what was the trigger to their development, how they arose and (2) what type of out-of-ERP tools are used for the given routine.

Reviewing the structure of the revealed routines, we fundamentally find three types:

- Using external software,
- Manual data modification in the system,
- Physically existing system next to the ERP system.

For me it was surprising that in many cases the managers (the top manager or the functional manager) decided to initiate or establish a routine next to the ERP system.

I provide a detailed overview in the below table:

Workaround	Trigger	Realization	Type of WA
Excel listings	Obvious / Spreads through training	Other software (MS Excel)	Complementing the existing system
ITO calculation	Top management initiative	Other software (MS Excel)	Complementing the existing system
Dynamic storage	Top management decision / initiative	Other software (MS Access)	Replacing the missing module
Setting up the production plan	Top management decision	Other software (MS Excel)	Complementing the existing system
Deleting orders manually	Observation, experience	Manual	Replaces data entry
Registered manual order form	Top management decision	Other software (MS Excel, MS Word)	Bypasses the system
Co-operation between departments	Experience / informal, ad-hoc	Manual	Data manipulation
Picking note	Usage issues (readability)	Other software (MS Excel)	Replaces existing function
Changing receiving date	Functional initiative for more accurate data	Manual	Data manipulation
Changing system time	Trick / "Shortcut"	Manual change of system data	Data manipulation
Ordering CC materials	After difficulties a smart simplification	Physical (visual) marking instead of system data	Replacing system function
Kan-ban system	Management decision, visual communication	Physical (visual) marking instead of system data	Complementing the existing system
External software	Group level decision to ease data transfer	Other software (specially targeted developments)	Complementing the existing system

Table 10: Development of workarounds: Beta Company

6.2.1.3 Analysing the usefulness of workarounds at Beta Company

To measure and evaluate the usefulness of the revealed routines would certainly be a very interesting and challenging research topic. Most probably relatively acceptable results would derive from measuring process or activity time and analyse the differences. Nevertheless, for such measurements a serious intrusion would be necessary into the daily life of the users which was not supported at neither of the companies. Consequently, I attempt to use my experience and logical reasoning to analyse and evaluate the usefulness of the single workarounds.

In the first column of the below summarizing table I embrace the essence of the routine's usefulness: through what does the routine improve the situation? I attempt to formulate the usefulness at a more abstract level as in many cases (mainly in the case of Excel spreadsheets) the used routines are useful from multiple aspects.
The second sub-question inquires about the (company-) hierarchical level of usefulness. With every workaround I analyse if the routine is useful at individual, at functional (departmental), or at company level. This aspect is very interesting in the case of the manual modification of orders at Beta Company: the usefulness of this workaround – resulting in better control over the inventory level as an indicator of performance – is unquestionable at all levels (individual, departmental and company).

I assume that the routines introduced to me have survived their trial period: their existence somehow offers more benefit than their non-existence. My third aspect analyses what is required for – or what hinders – the integration of the given steps or solutions into the ERP system.

In the last column of the table I make a subjective evaluation of the usefulness of each routine. I consider the future possibilities, cost factors, current risks and the expected benefits and summarise them intuitively. I consider the data manipulation type routines dangerous as it brings individual risk factors because - as discussed above – the system calculates on with the modified data. Most of all, changing the system time brings further dangers and risks. It is also worth considering the manual changing of invoices, although in this case the rigorous formal rules of invoicing minimalise the risks.

Workaround	Usefulness:		Solving within the system…	Researcher's evaluation
	Essence of -	Level of		
Excel listings	Users' convenience	Individual	--	Useful (not realistic to abandon)
ITO calculation	Local development	Company	--	Useful
Dynamic storage	Replaces existing module	Functional	Cost considerations	Useful (cheaper)
Setting up the production plan	Necessary to further adjust the system output	Functional	More complex parameters, better data accuracy	Useful
Deleting orders manually	Experience based control of inventory level	All levels	Using human experience	Risky (source of errors, lack of control)
Registered manual order form	Control	Company	Essentially non-system solution!	Useful
Co-operation between departments	Data accuracy	Functional	Additional administration, close attention	Useful (the interested party acts)
Picking note	Users' convenience	Individual	Readability / development	Useful (solved without costly development)
Changing receiving date	Accurate measurement	Functional	Development (rare, easy → not in question)	Not worth to act upon (small scale)
Changing system time	Trick	Functional	Parameters and development in multiple processes	Risky, requires action
Ordering CC materials	Easier / More practical solution outside of the system	Functional	Accurate estimate and disciplined usage of materials	Useful (logical solution)
Kan-ban system	Visual illustration is more transparent	Functional	Development (visual function)	Useful, although less accepted at lower levels
External software	Eases data trans-fer/consolidation	Individual		Useful (accepting workarounds!)

Table 11: Analysing the usefulness of workarounds at Beta Company

6.2.2 Analysing the collected data: Gamma case study

In Gamma Company, practically all employees are users of the ERP system. Although the users said themselves that Oracle is indispensable, at individual levels their attitudes and their remarks suggest that they only use the system because the status of data-loading is regularly monitored.

6.2.2.1 The reasons behind the development of workarounds at Gamma Company

In the case of Gamma the opinion of the users reflected that their Oracle system is

- Very slow: the IT manager explained that test measurements proved the users' complaints. According to test measurements, every transaction takes more than twice as long as the same transaction in the United States (where the central server is located);
- Inflexible: it is not possible to acquire customized lists and to work with them within the system (filtering, ordering or tracking the data);
- Not transparent: the user surface does not support the management of tables consisting of several hundred lines.

These are the reasons behind most of the external user routines: with such a high number of daily transactions and with the unease of handling data within Oracle everybody chooses to use Excel.

The reason of the non-system routines in the warehouse are the expensive upgrade of the Oracle warehousing module. The company does not see the investment returning, so the necessary functions are solved outside of the system.

Workaround	Immediate reason	Classification of reason
Costbook	System is not able to flexibly store prices (one part – more prices, price changes upon quantity or time, currencies, etc.)	Missing functionality;
Open order report	Transparency of the large number of order lines	Missing functionality
POR list	Procurement data re not correctly stored and not transparent for the buyers	Data accuracy
Sales Order	Grouping and transparency of arriving sales orders	Transparency
Warehouse – Manual labels	Not possible to print labels	Missing functionality
Warehouse – semi-dynamic locators	"Bringing dynamics manually" into the fixed location warehousing – steps replacing expensive new module;	Cost considerations
Uploader program	Automatised uploading of large number of part numbers	Convenience / automa-tising manual functions
Storage of scanned documents	Storing technical drawings for most of the parts is necessary	Missing functionality
System of workflows	Efficiently linking cross functional steps of (global) processes	Efficiency / communication

Table 12: Reasons behind the development of workarounds at Gamma Company

6.2.2.2 Analysing the development of workarounds at Gamma Company

At Gamma Company most workarounds are regulated and presumably stem from the managers of the early times. Even if they are developed by a single individual, all colleagues in the same job use the same or one with a similar structure. In my eyes, the main reason for it is the repetitive characteristic of the jobs: practically in all areas people execute the same or similar transactions with large number of data from day to day.

MS Excel offers such options and functions to support the work with large number of data, while being easy to use as well, which is necessary for the users. The below citation demonstrates it well:

> „In Excel I can filter, order, colour and look up data very efficiently. I can refer to an other Excel table and I can just attach them to an e-mail message. Oracle is slow and can do none of these functions." (K.A. buyer)

From the below summary table it is also apparent that most of the routines discussed are in fact complementing the system. This can be explained by one of the statements of the managing director:

> „Oracle is designed for manufacturing companies. For us it does not really fit, our transactions are of much larger number and of much simpler nature. The main point is that the Americans can exert financial control over us through Oracle." (Gamma managing director)

Consequently, the missing functions are supplemented with spreadsheets which are developed centrally or have a very similar structure. These spreadsheets are practically the complements of the ERP system.

Workaround	Trigger	Realisation	The WA step…
Costbook	Managerial	MS Excel	Complements existing system
Open order report	Individual	MS Excel	Complements existing system
POR list	Managerial initiative / control	MS Excel	Manual calculation instead of system data
Sales Order	Individual	MS Excel	Complements existing system
Warehouse – Manual labels	Functional manager	Manual	Complements existing system
Warehouse – semi-dynamic locators	Top management decision	MS Excel	Complements existing system
Uploader program	IT professional help	MS Access	Complements existing system
Storage of scanned documents	IT initiative	External software	Complements existing system
System of workflows	Group level	External software	Complements existing system

Table 13.: The build-up of the workarounds at Gamma company

6.2.2.3 Analysing the usefulness of the workarounds at Gamma Company

Previously we have seen that most of the workarounds developed at Gamma aim to complement the ERP system. Analysing the data further, we can see that most of the routines support individual tasks and some of them are uniformized at functional level. The majority could be solved with system development steps.

The issue with developments is that there are numerous needs so Gamma's managing director decided to review the priorities and progress regularly. The decision about new

developments are made by the managing director, or, in case of a larger budget project, the whole global management is involved. Consequently, developments are slow and always Excel comes first as a possible solution.

The question of Costbook is interesting – which was one of the first developments to implement after the data collection period. The managing director explained:

> „We can not have the Excel table collapse again. Our supplier's prices are extremely confidential; they can not leave this office building." (Gamma managing director)

In the case of Gamma, because of the difficulties of organizing and handling data there is no doubt about the usefulness of the Excel spreadsheets. There is, however, a function, which, due to the risks in connection with the extensive usage of Excel, might be better to solve within the ERP system.

Workaround	**Usefulness**		**Within ERP?**	**Researcher evaluation**
	Essence	**Level**		
Costbook	Storing multiple prices	Functional	Yes	Needs a solution (confidentiality)
Open order report	Filtered per buyer, transparent	Individual	No	Useful, risky
POR list	All data available as required	Individual	Yes	Necessary
Sales Order	Organises incoming orders	Individual	No	Useful (organizing)
Warehouse – Manual labels	Exception handling	Functional	Yes	Needs a solution
Warehouse – semi-dynamic locators	Substitutes expensive module/ adds to efficiency	Functional	Yes	Useful
Uploader program	Automatisation	Individual	No	Useful
Storage of scanned documents	Organised storing of documents	Individual	Yes	Useful
System of workflows	Co-ordinating cross functional / global work	Global	Yes	Useful

Table 14: Usefulness of workarounds at Gamma company

7. CONCLUSIONS, CONCEPTS

This chapter introduces the concepts I built based on the analysis of data and my conclusions drawn. The sections will follow the same structure as the data analysis and the original research questions: the developments of routines, their build-up and finally, their usefulness.

7.1 How have the routines developed?

As I have already discussed within my pre-assumptions, it was surprise for me (and prior to the field research I expected the contrary) that the top management knows about most of the routines existing related to the ERP systems. Instead of tilting at windmills – as I have imagined before starting my data collection – in both cases the top management rather took the role of regulating the use, content, or structure of routines. In some cases they organized forums to improve the workarounds, even triggered the development of new functions or new routines. In the case of Beta I learnt that most of the workarounds were actually initiated by the managing director.

Necessarily the ERP system is not as flexible as the reality. Consequently, the handling of exceptions often leads to solutions outside of the system. Also, in many cases the required developments or changes in the system are first "tested" outside of the system, and – if there is funding available and the decision makers agree – the required solution or change can be implemented in the system.

7.1.1 Local IT champion

At both companies I could observe the presence and focal role of such non-IT professional users who know a lot about the system and understand its internal logic. These people used the functions logically, not mechanically and were keen on discovering new and more functions. In many cases these users were testing the system; they are the key users, or the *power users* with additional rights.

It is very interesting to observe that the interpretation tools and steps how these users use the system influences the interpretation and system use of the other users as well. Orlikowski et al. (1995) analyse in detail the roles and types of such local IT gurus. Of the types discussed by Orlikowski et al., I experienced at both companies that (1) the

roles are not formally acknowledged and (2) these people understand the IT requirements of different user groups and the operating principles of the software and lastly, (3) they share their methods, tricks and settings with others.

At **Gamma** I could identify 3 "local IT gurus": the inventory planner, one of the warehouse operators and one of the buyers who just joined the company from an other large multinational (P.A. buyer used Oracle at his previous employer as well). All three users comprehended the whole process of the given functional area and their answers proved that they have a very deep understanding of the operating logic of the ERP system.

I could follow the traces of their solutions (key combinations, using profiles, written macros by one of them, etc.) in other users' daily work. Answering my questions they admitted that several of these solutions are fruits of trial-and-error, and they were open and available to spread the efficient tricks.

At Gamma the solutions of these "gurus" were acknowledged in the form of semi-formal internal trainings (so called "lunch-and-learn" initiatives): at every occasion two or three issues, Excel functions or tricks were introduced and trained. Interestingly, practically all employees were participating at these sessions, where everybody had to take their laptops and practiced the new knowledge simultaneously on the available practice data base.

Interestingly, at **Beta** also none of the local gurus were working in the IT area. The IT manager, who of course knew the system very thoroughly, was a rather a reserved type of personality who expected to follow strict rules. His personality and age pushed him rather to the edge of the company's social network and he did not share his solutions with the users. Generally, he did not have informal relationship with his colleagues. The two young engineers, both members of the original pioneering team, knew the system inside out. They were approachable, popular and socialized to disregard rigid rules. They enjoyed experimenting and looking for "smart solutions" – maybe the best example being the changing of the system time. One answer from S.T. to one of my questions regarding a system setting sounded as follows:

„I do not know, I have not thought about it yet. It sounds like a good idea. I will try it today after working time. I will run a test with these settings." (S.T. project engineer)

7.2 The tools of the workarounds

After the experiences from the research fields, the most obvious question became why the users so often turn to the spreadsheets of Microsoft Excel.

7.2.1 The almighty Excel

This spreadsheet management program is the number one tool for the users if the data needs to be transparent, if orders have to be sent out, if orders have to be overviewed and in many more cases. Hiring for this positions, during the interviewing process one of the entry criteria is the knowledge of the basic functions of data management in Excel. In some positions the promising candidates have to solve tasks in Excel. This is understandable, as they use this software practically their whole working time.

After I noted this phenomenon I made an interesting observation: during the time of field research I was measuring during an average working day for how long the Excel application is running on the user's computers. On the two research fields I had different results:

- In Gamma, with the exception of the managing director and the warehouse operators, the MS Excel programme was always running. In many cases 10-18 separate spreadsheets were open simultaneously. After turning on the computer in the morning, most users started the e-mailing program and then Excel. These two applications were open during the working hours and closed only when the working day was finished.
- In Beta the running of the Excel application was not so continuous. In general, the colleagues working in physical jobs directly connected to the assembly lines (quality controllers, material movers), used Excel less often. People in these jobs used Excel in preparing weekly reports or an ad-hoc report. In other jobs Excel's usage varied, but only very rarely was it running the whole day, with the exception of material specialists and customer service representatives. They were also using Excel

continuously: individually prepared tables containing materials or items which required special attention.

As a conclusion we can summarize that where exception handling was a recurring issue, or the speed or flexibility (e.g. adding notes) of the system, users turned to Excel.

Based on the explanation of the users, the data in Excel spreadsheets can be handled easier. There are two reasons behind it:

— Firstly the filtering and the ordering of data, additionally the possibility to insert notes makes everyday work easier and more transparent.

— Secondly, speed is also important. All users mentioned that the systems (both Oracle and Axapta) are slow, occasionally computers had to be restarted and sometimes applications on the central server were not available (this last note was mentioned at Gamma only). Excel is always available.

In summary the flexibility of use and the speed of the application are the areas where Excel offers more advantages. This requirement was the most intense at both companies at the procurement and customer service departments.

Emphasizing the central role of Excel Gamma's managing director explained:

> „Oracle has the key role in exercising financial control over the single branches. All other tasks in the area of operations are fulfilled with satellite systems. Just think about how many Excel spreadsheets we use!"

Once Excel is so flexible and easy to use, why is this relatively cheap application not sufficient for supporting the company processes? This provoking question can be best answered with Howard's arguments. Howard (2005) mentions five main areas of risks:

- Error potential – referring to a PriceWaterhouseCoopers research, the author claims that 90 per cent of the Excel tables contain significant errors. The cost of these mistakes is estimated between 1000 and 10 000 US dollars per decision per month (ibid. p3);
- Data security – the lack of data security functions;
- Auditing – to track the changes or modifications;
- Spreadsheets as an enterprise resource: compared to it's significance, Excel is not handled with care (lack of formal processes or user trainings, for example);

- Data maintenance – there is no appropriate mechanism to maintain the data integrity.

For these arguments I found several examples at both research sites:
At **Gamma** many interviewees mentioned the (in)famous case when at the end of March the Costbook "collapsed". This resulted, amongst others, in several hundred order lines sent out with wrong prices. As a consequence of this Excel spreadsheet error, large number of invoices was returned and orders cancelled. The investigation showed two main reasons behind the collapse of the Excel table:

1. In the large table, due to the shift of the decimal separators, differences of magnitudes evolved in the stored data. The public opinion says, the issue was that in the English Excel the decimal separators are points, while in the Hungarian version of the software uses the comma character for this purpose. As beforehand the writing rights were not managed, anybody could modify the spreadsheet in the central server and could download and convert it into his or her Excel version.
2. The table containing more than 6000 lines stored many links pointing within the table, to cells in an other file or sometimes internet locations. The size of the file grew so large that the saved versions were not reliable anymore.

The cleaning up of the Costbook took 10 weeks extra work for an experienced colleague. The key was also to manage the access rights: only one person has writing rights. In the last days of this current research a project was launched to make Oracle able to store multiple prices and consequently, the price information. The project is estimated to take 4 months and bring significant extra administration for the sourcing engineers.

In the case of **Beta** Excel filled in a central role in those (long) months when the order quantities became larger (and therefore the pioneering team could not keep track of the customer orders and the assembled items in their heads anymore), but the Axapta system was not used and did not contain reliable data.
In this time – and we are talking about more than a year! – in manufacturing, all areas of logistics and also for financial reports, Excel tables were used. The most serious difficulties were experienced at the monthly finance closes, which also serves as the

control of the organization's operation. The ad hoc Excel tables caused difficulties when the daily changes in the exchange rates had to be followed up and it resulted in recurring discrepancies in the value of the inventory and the cost of sold goods. Additionally, there was not reliable information available on the costs and the turnover of the company.
One Beta employee stated that "Excel is a key tool" (S.T. project engineer).

Sz. Z. IT manager believes that Excel is an excellent tool to manage the ad hoc needs of the users. However, he also mentions the risks:

> „We have to know how current are the data used for the calculations. This can be managed through processes or through control. For example we can make a daily archive of the system data and everybody should use the latest file. I introduced this at my previous company for example.
> But there is no cure for human errors. [Mistake in a function for example – E.B.]"

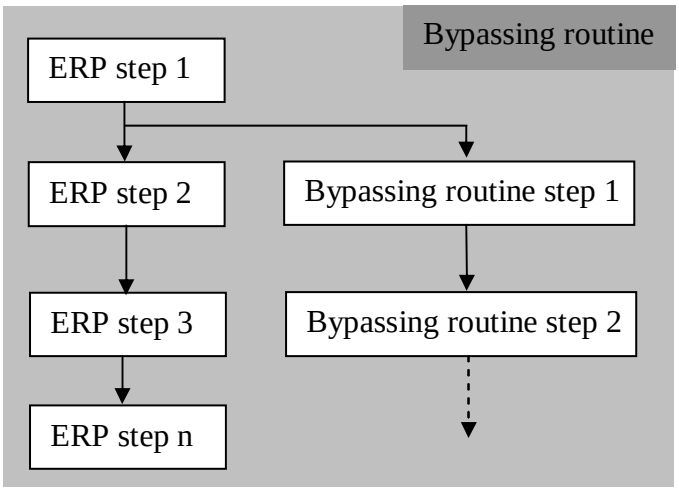
Next to the widespread use of Excel, I also observed certain typical characteristics regarding the internal logics of the user routines.

7.2.2 Typology of the user routines

In line with the original objective of my research, I differentiated the user routines based on their relationship with the ERP system. I could identify three basic types: the bypassing, the substituting and the complementing routines.
Besides these three types, I found a different type of routine: the manipulation of data. However, based on the definition, this type of activity can not be classified as a workaround, as the subject of the activity is not the system, but the data: the unit of information already stored in the system (entered manually or automatically), and for some reason the users modify it.

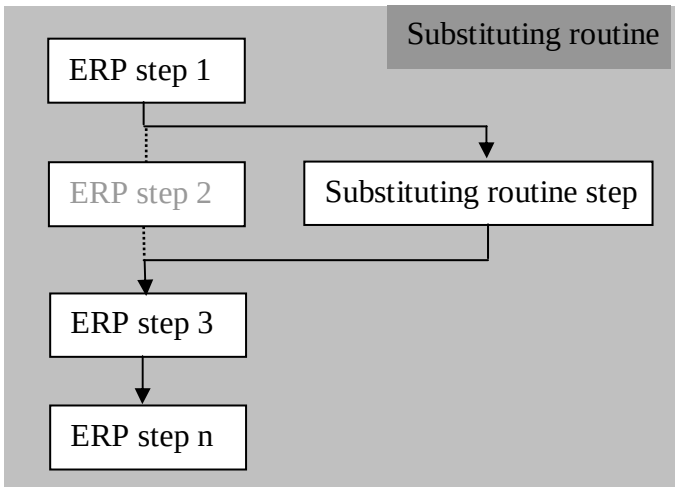
Bypassing routine

If a sequential external step follows the step outside of the system, we talk about **bypassing routines**. This practically means that a process is built on the step bypassing the ERP system which uses data from the system. Generally these types of routines

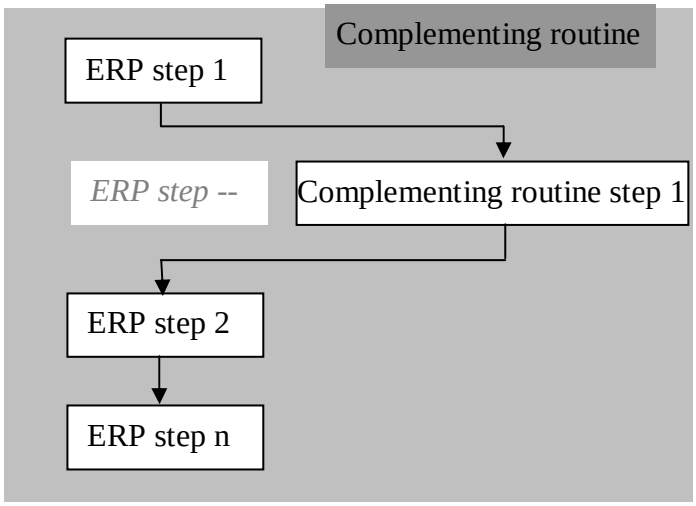


evolve if the external process can not, or due to its exceptionality, it is not intended to be programmed within the ERP system. The manual invoicing is a good example for the bypassing type of routine.

If the system is capable to execute a certain function or step, but for some reason the users execute it outside of the system, we can identify a **substituting routine**. The key difference between the substituting routine and the bypassing routine is that the process is continued within the system. The ordering of consumption control materials at Beta is a good example, as well as the preparation of the picking note in MS Excel.

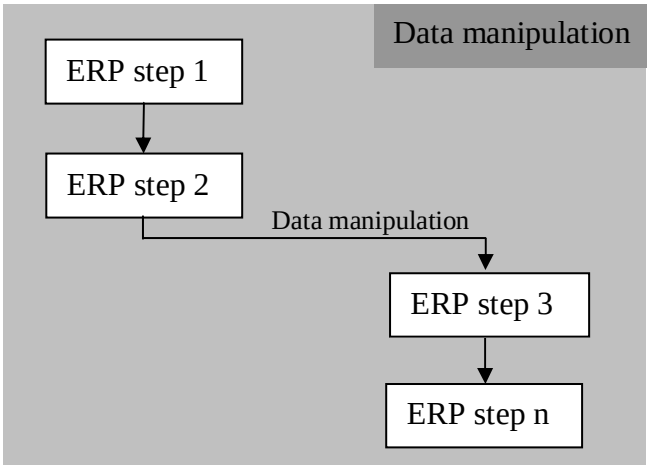


In the case of a **complementing routine** the function is not available or not existing in the system and therefore the users have to find a solution outside of the system. They afterwards continue their daily work in the ERP system. One example for the complementing type of routine is the ITO calculation at Beta.



In the below illustration I use the logics of illustrating the three types of user routines to show the key difference in the case of data manipulation. When manipulating data, the subject of activity is the data stored in the system.

Data manipulation is when a user overwrites or modifies the data stored in the system and the system uses the modified data for executing tasks. Examples for data manipulation are the changing of system time or the manual deletion of orders.



Data manipulation can bring solution in certain situations and the practice can survive amongst inordinate circumstances as the times following the first ERP introduction at Beta, however as they bring true risk, these type of routines should be addressed as soon as possible.

As a consequence of the development of the above typology, I find the term "workaround" not appropriate, as this phrase does not include all three of the bypassing, substituting and complementing categories. We might need to consider modifying the central term – in my logic for example the term *co-system routine* seems suitable.

7.3 The usefulness of the revealed routines

Based on the above we can already conclude that the existence of bypassing, complementing and maybe even substituting routines next to the ERP systems are inevitable.

Beta's managing director explains:

> „The reason for the existence of the workarounds is that the [local] basic processes are not accurately worked out by the developers of the ERP systems. These parameters have to be customized and adjusted after system implementation. In the beginning the managers – although they do not like to admit it – do not see clearly what is necessary, what is important, and additionally, the IT specialists do not know the industry specifics. Therefore workarounds evolve, which are time consuming, not efficient, non-transparent and they get out of control."

Gamma's managing director summarizes:

> „Oracle works well for manufacturing companies, but for us different functions are important. We have a high number of transactions; very important is the follow up of orders line by line, and very high frequency of exception handling. These make the ordering of data a key function and transparency inevitable.
> Our processes are also unique and it is more different to customize them in our system, so workarounds are unavoidable."

Apparently, in the eyes of the top managers the existence of workarounds is natural and inevitable. What are they doing and what can they do to minimalise and manage risks? I organize my experiences in three sections below. First, I discuss what exactly brings the risks, and second, the two types of reactions of management: on the one hand they introduce a controlled use of the ERP system, and on the other hand I identify two different phases of system development activities.

7.3.1 Risks related to the workarounds

The essential issue with the user routines existing next to the ERP system lies in the doubled data storage. Every colleague (user) from different functional units handles and stores data in their own spreadsheets and makes the daily decisions based on them. On the one hand, the spreadsheets are not linked together either per users or per functional units, they are not updated and not secure. On the other hand, the financial calculations and reports, as well as the invoices are issued using system data.
As discussed above with regarding to the usage of Excel, the "cost to pay" for the flexibility and the relatively easy use of MS Excel is the lower level of security.
An other source of risk is the possibly different interpretation of the commonly used data. Not only in the case of Excel-based external routines pose the new colleague's training or the working together with different people all sources of risks. The existing workarounds are mostly results of individual's ways of thinking and the sources of information, the exact processes and the data links are not necessarily documented.

The both managing directors and the both IT managers – completely independently from each other – highlighted that an important and common source of problems is the wanting knowledge of users. An average user does not (or can not) consider the consequences of his or her decisions on other (functional) areas.

In the following sections I introduce some common managerial practices addressing the above risks.

7.3.2 Controlled use of the ERP system

At both companies I experienced an obvious intention of the managing directors to control the user routines existing next to the company ERP system.

One group of the managerial tools is what I termed as the "controlled use of the ERP system". The management both at Gamma and Beta used a set of managerial tools to ensure that the raw data in the system are *accurate to the level necessary* for the normal daily functioning of the processes.

Connected to the steps outside to the system, a process must be developed and operated what ensures that data calculated outside of the system gets loaded eventually into the system. Processes must ensure that data is as current in the system as required for the company's seamless functioning.

Accordingly, one important pillar of the usability of the company ERP system that the real material processes are programmed systematically and reliably in the system as well.

In the case of **Beta** the controlled use of the system has a uniquely interesting story as in the "early times" it practically did not exist. A radical change in the attitude towards the system was necessary to ensure that stored data in the system became reliable. Let's take a closer look to understand what were the steps necessary to recover the integrity of the data stored in the system!

In Beta, the top management measurements had a central role in ensuring that the data becomes and stays reliable in the re-implemented ERP system. Consequently, users could experience that it is worth to use the system as the data stored can be trusted.

> „We had a slogan during the second implementation: "*Do not go to bed with an open transaction*". This meant that every afternoon at 4 p.m. we had a meeting in my office with the management and we reviewed the open transactions in the system. In every case we defined who has to do what to close that transaction. In the beginning I had to ask, afterwards they automatically explained. Finally, we could skip these meetings." (Beta managing director)

During the second implementation the managing director paid close attention to ensure the system processes actually work and data in the system is reliable. This required a radical change in the company culture.

He introduced an explicit responsibility system for the system data quality. Every functional manager was responsible and involved in the "*Data clean-up*" project launched. There were several slogans (recurring expressions) to bring change in the attitudes: for example there could be only "*one valid price*" stored in the system which has to be "*exact to the penny*" ("filler" in Hungarian) and there is "*zero tolerance*" towards inaccuracy. All my interviewees independently and automatically used these terms proving the success of the initiative of the managing director. A list was put together to ensure that all required steps were executed by the users (mainly the material specialists) entering data into the system. Not only price information, but all data had to be entered accurately: unit of measure, currency, minimum order quantity for example.

If entering new raw material in the system, all required fields had to be filled in. Paper based documentation had to be filed and signed by the material specialists to enforce the feeling of individual responsibility.

In connection with any meeting, calculation or presentation the managing director made it obvious that any calculation is unacceptable if the data is not gained from the system: "*The data is what is in the system*", or during the meeting: "*And how much is it in the system?*".

Consequently, everybody in Beta learnt the importance of the data integrity and to safeguard it in his or her own area.

To preserve these principles at every level of the organization, rules of thumb were introduced which had to be used in the given jobs. For example:

> „The goods can only be shipped if they have reached the "ready" status in Axapta." (L.G., warehouse supervisor)

> „Anything related to a financial transaction, has to be followed up in Axapta." (H.I. lead project engineer)

The controlled use is also connected with the acknowledging of the existing workarounds: at Beta the managing director introduced strict rules regarding who, when

and with what settings can run reports from the ERP system when it serves as raw data for external calculations.

At **Gamma** the controlled use of the system has three main pillars. The first pillar is that for every colleague the individual performance measures are calculated based on the data stored in the system. Consequently, it is in every users' interest to ensure data follows reality. Any manager can ask about any data related to single transactions, as they might need immediate status if the customer asked a question.
The widely known slogan of the managing director is "*Know your numbers!*" reinforced the efficient execution of the transactions. The managing director often walked around in the office and asked everybody about current numbers regarding sales, transportation or any highly important or exceptional delivery. It was kind of expected to know the answers – with exact numbers – immediately and by heart.

The second pillar is the Operation meeting on every Monday. During the Operation meeting everybody making basic transactions in the system has to fill-out an analytical table. The data can only be gained from a report run in the system. The operations manager reviews every single measure of every user and the trends, the exceptions and the salient numbers are discussed, action plan is set up.
There is a measure of which the aim is solely the regular use of the system: the *blank promise date* (the date when the delivery is promised to arrive at the customers' warehouse) has to be fewer than five per cent of all transactions of the individual.

The third pillar is the rule that is strictly forbidden to make any transactions outside of the system which is related to any financial transaction. If this rule is broken, the user automatically gets a written warning – as it happened already once.
From this aspect, the two days of the monthly financial close are quite paradoxical. On the last Thursday and Friday of the month all Oracle modules are closed where the transactions have financial consequences. However, if there is an urgent delivery in these days, the managing director and the finance manager has to approve it's shipping – in writing. The transaction has to be immediately entered upon the opening of the new month in the system.

The same discipline applies to the received goods, too. This rigor results in a basically strong control in the financial transactions and the invoicing and practically bans (even punishes) the actions outside of the ERP system.

In summary we can state that at both companies the managements express large importance on the accuracy of the data stored in the system and to maintain data integrity. Consequently, the users invest additional efforts in updating and maintaining the data. This brings additional tasks for individuals (see the term 'viscosity' of Poelmans 1999), therefore the systematic control mechanisms are important. This prevents users to execute their daily tasks practically outside of the system.
At both companies as a result of all these efforts and introduced control mechanisms the data was accurate on a *weekly* level – this fact in my opinion is worth thinking about!

7.3.3 Continuous improvement – post-implementation phases

Immediately after the implementation of the system several procedures or tasks are not executable within the system, and the other necessary managerial (re)action is the continuous improvement of the system.
In this regard, I was able to identify two characteristically different phases at both companies researched. The first phase immediately following the system implementation has the transitional characteristics of a project with regular meetings and user testing. Nobody really knows how exactly the system works and what to expect. The system errors, deviations from the processes and small tricks are more accepted – the information system has not yet congealed. In this time several urging development projects run parallel, several of which can be critical. The top manager regularly checks the status of the single developments and exercises rights to set and change priorities. User's requests for developments are very prevalent; to launch a project is more simple and obvious. The IT staff has a central role co-ordinating and mediating between users, developers and management.

In the second phase, which might begin only three or even five years after system implementation, developments are not inevitable and high risk tricks are (should) not existing anymore. This phase has no transitional characteristics anymore and development activities become more planned and calculable. By this time the initial

difficulties are solved and the customized local processes are programmed within the system as a result of perseverant developing activity and significant additional investments of time, energy and money. To launch a new IT development project in this phase requires detailed cost-benefit analysis and these requests must be documented. The details and status of the single projects are not in the close attention of the top managers. The IT staff gets distanced from the users, their tasks become more administrative, and at the same time more strategic: to help putting together the cost-benefit analysis and manage the small development projects, respectively to define a long term direction of system improvements.

By this time users accept the necessity of the system. From the user's aspect the speed and the user friendliness of the system are of key importance.

Characteristics	First phase	Second phase
Time	Immediately after implementation	Three-five years after implementation
Characteristics of workarounds	Numerous, accepted, ad-hoc, might even relate to base data	Limited number, regulated, congealed, widely known, low risk
System developments	More parallel projects, some critical; Request and launch of projects are obvious	Administrative, regulated process, more difficult to launch projects, less critical, rare large projects aim comprehensive system development
Top management	More projects managed at top management level	Rarely reaches top management
Users	Low satisfaction, initial resistance	Accustomed to the system, main problem is the system speed
Expected role of IT staff	Mediates and co-ordinates between developers, users and management; Understanding and accessible	Develops improved system concept and vision, Prepares cost-benefit analyses , Administers development process
Data risks	High risks	Low, regulated risk

Table 15: Characteristics of the two system development phases following system implementation

7.4 Summary: Social dynamics following system implementation

In the above sections I have discussed the development process and triggers, the tools and usefulness of user routines evolving next to the ERP systems with controlled use. Related to their evolution I highlighted the informal process when the colleagues with a better system understanding support and consequently shape system usage in an informal (sometimes slightly formalized) way. I have introduced a typology of the user routines depending on if they complement, bypass or substitute one or more steps in the system. I have shown that data modification, though exists, due to the high risk related, should be a solution for only a limited timeframe.

Evaluating the co-system routines I have reviewed the risk factors residing in the data modifications occurring outside of the system. I have discussed how the decision makers manage this risk: the concept of the controlled use and the inevitable continuous system developments. I have identified and characterised two phases which typically follow the implementation of an ERP system.

7.5 Evaluating the pre-assumptions of the researcher

In the below table I review the pre-assumptions which I made explicit in chapter 2 and with the help of a table I systematically compare them with the experiences acquired.

Pre-assumption	Experience
Workarounds are fruits of users' creativity; they are smart, witty solutions.	Although found truly smart solutions, most workarounds are rather fruits of necessity or exigency.
Workarounds are essential, without them it would be impossible to use the system for daily work.	This pre-assumption was proven completely right.
We can find IT-gurus in the organizations who regularly and readily help to other users. Their solutions and interpretations of the system influence the system usage in the given organization.	Indeed it is possible to identify informal IT gurus with important roles in the organizations and users do use their solutions. However, their interpretation and mainly their knowledge of the system are much deeper. They know and use several solutions and ways which are too complicated, not handy, or not comprehendible for most users.
Workarounds are rather concealed, irregular solutions, not known for top management and not mentioned and dealt with on official forums (like departmental meetings, decision makers).	Although there are indeed some "secret" ways (most of which might have remained hidden from me), most of the workarounds are known and acknowledged by he management, and some workarounds are initiated and regulated, developed by the managing directors.
The majority of the workarounds are solutions used at individual level	At both companies visited by me the routines related to the information system are well known and used by many. Gamma even organized internal trainings to teach certain solutions.

Table 16: Comparing the pre-assumptions of the researcher and the experiences

Most of the pre-assumptions or parts of them were verified but some were refuted by the experience collected at the research sites. The importance and necessity of the workarounds were proven and the top management knows and acknowledges this. I would like to highlight that earlier research had not dealt with the aspect of decision makers; this is the first research discussing the managerial viewpoint.

8. Evaluation and Further Research

In this chapter I evaluate and summarize the results of the current research. Firstly I review the scientific and practical results of my research, placing it into a wider context of the relevant literature. Secondly I evaluate my research: I consider its limitations, I evaluate the chosen research method and scientific paradigm. At the end of the chapter and the thesis I highlight some directions which could be a possible meaningful continuation of the current research.

8.1 The scientific and practical results of the research

I aimed to study the process how a less flexibly used system, like the ERP systems of the companies, and its users mutually shape each other in the period following the system implementation. While excellent researchers have conducted significant research studying information systems where users had more freedom using the system, this piece of research has shown that ***in case the usage of the technology is strictly regulated, the interpretive flexibility evolves outside of the system***. My research discusses a new appearance of interpretive flexibility, therefore enriching the term.

As a scientific result of my research I have shown that the user routines developed next to the system are of very high significance but this significance is gradually declining over time after implementation.

I identified two consecutive phases following the system implementation: the first, more risky and more elementary phase where it is possible that users make data transformations outside of the system with raw data. This initial phase is characterized by significant customization projects and system developments involving external consultants and internal teams.

In the second phase the outside steps risking data integrity are eliminated, only those workarounds survive which are smart (thus optimal on company level) or serve the

convenience of the users. System developments, if exist, are less comprehensive and do not relate to the basic data transformation processes.

An other result of my research is the typology of the user routines, as well as the analysis and evaluation of the risks related to them.
Earlier research has not considered the viewpoint or the role of decision makers related to the workarounds. To my knowledge, this is the first research discussing this aspect, bringing new insights about the nature of user routines.

I hope to further support the establishment of the interpretive research tradition in Hungary through conducting and conducting research using and introducing the newest theoretical directions and methods in Hungarian language.

For practitioners I suggest the following aspects for considerations:

1. If users execute calculations with raw data outside of the system is a source of considerable risk. In this case the managerial control of the ERP system usage is of key importance. If certain tasks do require such type of workarounds, the access of data, the running of reports and the transformation of data has to be controlled. If possible, the internalization of this step or function into the ERP system should be a priority.
2. Similarly, to regulate access rights and monitor them are highly important in order to manage and reduce risk. This way the possibly risky “user solutions” are avoidable and controllable.
3. Right after the system implementation it is worth to pay attention and spend resources on user trainings so they can get accustomed and acquainted with the system use. Based on my experiences a documented local users guide is very beneficial for the newcomers, which should be updated regularly. This helps avoiding that certain practices taught by colleagues are faulty or incomplete.
4. Similarly in the period following the system implementation, the management needs to pay a close attention to the system development requirements. The first step should be the understanding of the requirements and to match it with system possibilities. The decision

makers have to review and prioritize then according to business needs to set up a manageable order between the numerous parallel user needs. If the management does not get involved, the more influential users might be more successful enforcing his or her individual needs.

5. It is worth to learn about and consider the user routines developed next to the system. The IT manager can be in charge for it, or the decision makers can set up cross-functional teams of power users to enable the delineation of user opinions and experiences. This ensures that system developments stay close to reality and optimal, workable solutions are born.

8.2 Evaluating the chosen research method

The majority of data discussed in my current thesis was collected through semi-structured interviews and observation. I believe the chosen **research method** served well the answering the research questions: I succeeded in understanding the individual users' interpretations of the system and develop a satisfactory understanding of their daily work.

I can identify two factors which could possibly improve the quantity and quality of data collected:

(1) To spend longer time in the research fields. Longer time helps to develop a deeper understanding and to collect more examples, exceptions or experiences related to the daily operation. Also the users can understand better "*workaround*" as the central term of the research and as well the research objectives.

(2) Own user experience. Although I was granted test access to the system at Gamma, however I was not in a real situation where I would be required to solve a problem in the system on my own. This way I could not live through and therefore fully understand the situation of the users of the ERP systems. The solution to this issue is not straightforward as I could only gain full user experience as an employee of these companies (participant obsetrvation).

In summary, I evaluate the chosen research methodology as appropriate to answer the proposed research questions.

Based on the article of Klein and Myers (1999) I review to what extent my thesis fulfils the expectations towards interpretive research. In the below table I summarize the seven fundamental principles for interpretive field research collected by the authors. In the second column I give a brief summary of the principle and then evaluate to what extent my research fulfils them.

Principle	Brief explanation	Presence in my thesis
The fundamental principle of the Hermeneutic Circle	This first, most fundamental principle suggests that all human understanding is achieved by iterating between considering the interdependent meaning of parts and the whole that they form.	Connecting the single findings with other phenomena, with the post-implementation organizational circumstances and with the external world in general.
The principle of Contextualization	Requires critical reflection of the social and historical background of the research setting.	Detailed discussion of the history of the companies, the systems and their introductions.
The principle of Interaction between the Researchers and the Subjects	Requires critical reflection on how the research materials (or "data") were socially constructed through the interaction between the researchers and the participants.	I discuss how I could enter the research fields, what role I had and I evaluate how my connection to the managing directors could influence the collected data.
The principle of Abstraction and Generalization	Requires relating the idiographic detailed revealed by the data interpretation through the application of principles one and two to theoretical, general concepts	The development of the concepts of „IT-guru", „Excel-empire", the controlled use of the ERP and the two post-implementation phases, connected to the existing literature
The principle of Dialogical Reasoning	Requires sensitivity to the possible contradictions between the theoretical preconceptions guiding the research design and actual findings with subsequent cycles of revision	I reflect on my preconceptions in detail; I briefly review how my research approach was shaped; The formal structure of the thesis offers less opportunities to discuss the latter process in more details
The principle of Multiple Interpretations	Requires sensitivity to possible differences in interpretations among the participants	Citations from participants (also offering insights into their personalities); as well as introducing relevant contradicting opinions
The principle of Suspicion	Requires sensitivity to the possible "biases" and systematic "distortions" in the narratives collected from the participants	In less explicit ways, but organically built-in I considered the goals, hierarchical positions and histories of the participants.

Table 17: Review of the presence of the seven principles for Interpretive Field Research in my thesis based on Klein and Myers (1999, p:72)

According to the table above, as well as considering the full article of Klein and Myers (1999) my thesis fulfils requirements of the interpretive field research.

There are two areas where further development is possible: one being the principle of Dialogical Reasoning. This principleis present in my thesis – very excitingly and interestingly for myself – as my understanding of the research topic had been shaped and developed already before the data collection had started as well as during the writing of the thesis. Regrettably in the formal structure of the thesis I am given less opportunities to discuss this reflexive process. In a nutshell, my journey started from the failures of system implementations and the discrepancies in their narratives by different stakeholder (Bartis-Mitev 2008), arriving to what exactly is happening after the systems are implemented.

The other principle to further elaborate in my thesis is the Principle of Multiple Interpretations. As the focus of my thesis is more the exploration and not the difference between the narratives of the single participants, I could not build my interpretation on discussing the latter. However, I am highlighting the cases, where the differences of approaches are salient. For example the opinions of the more versed IT professionals and even their evaluations of the users' practices are introduced in several cases.

Following the above (self)evaluation, I now discuss the limitations and the directions where the research could be extended.

8.3 Limitations of the research

One of the key limitations is the number of companies I have involved in my research. This brings an obvious limit to the generalization of the research findings. As below, when discussing the further research possibilities, I show the questions it raises. I suppose that both the profile of the company as well as the attitude of the number one manager (which very much defines into the general attitude, actually) influences the results of the research.

To filter this effect and to be able to conclude more general knowledge, it is necessary to collect research data at more companies.

Important factor is that, although I managed to develop a good relationship with the research participants, the collected data was possibly influenced by their interpretation of (1) the term "workaround" and (2) my research and its consequences. They might have forgotten, or decided to rate unimportant, unnecessary – or risky – to share certain tricks with me. This might be in the background of having found a bit less individual solutions than I expected – both during the interviews and the observation. Although the method of observation somewhat counterbalances the possible congruence between their actions and the story told, but due to technical details I sometimes had to ask questions to complement the observation – this made the observation less neutral and less "invisible". Therefore, it has to be highlighted that the collected data is very much defined by the explanations of the users. This window for biases brings some weakness to the reliability of the collected data.

It is important to mention that I entered both companies through connections to the Managing Directors. I have to assume that as a consequence, my person, my presence and my research was also connected to the top management. This might result in the participants being less open with me – with or without intention. Naturally they were not able to see the consequences of showing me a practice what might be forbidden. As a further result, the top management perspective is strongly present in the thesis.

At both companies we can find examples for the lack of replicability: in the case of Beta the re-introduction of the system is an extremely interesting momentum which is a very rare occurrence at companies. In this case also the radical change in the managing director's attitude is a very interesting. This is a unique and highly intriguing occasion, not replicable and difficult to compare with anything else.
In the case of Gamma the collapse of the Costbook is a unique episode, highlighting problematic issues and bringing considerations to the surface.

We can conclude that both companies' cases are unique and I have developed the interpretations ex post, based on my subjective insights. This brings serious limitations for generalization.

8.4 Recommendations for future research

I can see crystallizing more further research directions as the organic continuation of the executed research (next to perform similar data collections at more research fields to further elaborate and check the developed concepts and the results of the research).

One of the highly exciting opportunities directly connects to the current research. To be able to directly connect the results of this research to the research and proposed structuration theory of Orlikowsi and her colleagues, one more step is necessary: the system use and the change of the system as an interaction has to be explored, and considered how they interact with the institutional environment of the organization. At both companies we could follow the changes in the processes and rules which are the consequences of the introduction of the information system. Adding one more perspective to the focus of the current thesis makes possible to work out the detailed process and this way to involve the structuration of technology elaborated by Orlikowski (1992 and 2000), Orlikowski et al. (1995) and Orlikowski and Gash (1994).

Already changing the research approach we can extend our knowledge on the social dynamics of the introduction of an information system. The critical approach could yield several intriguing insights about the systems where the use is very much controlled. This would further elaborate the chapter discussing the "Controlled use of the system": how users live through this or how they try to avoid inconvenient limitations. Further research could focus on the process of the social process as well: examining the influence and power differences of different social groups. For this inevitably a participative, ideally an ethnographic research would be necessary.

A further step can be made towards the social factors of the information systems, changing the approach of the research. An interesting question could be whether the national culture influences the routines developed by users. To measure this, Trompenaars' factor of particularity (Primecz and Sóos 2000), the culturally defined level of rule following, would be an excellent tool: can we show connection between the rule following in a society and the extent of turning to workarounds?
We could also further examine how the top manager's attitude influences the use of the system (this question was mainly brought forward by the case of Beta).

APPENDICES

Appendix 1: The theory of Social Construction of Technology (SCOT)

Appendix 2: List of interview questions

Appendix 3: The list of interviewees per jobs per companies

Appendix 1: The theory of Social Construction of Technology (SCOT)

In this Appendix section I review the theoretical frames, scientific basis and the basic vocabulary of SCOT.

As Wilson and Howcroft (2005: p18) point out, one reason to use a social constructionist perspective is that "…it emphasises a view of technological development as a social process thereby enabling and understanding how social factors shape technologies as well as providing a framework for understanding the context in which technologies are displaced". In summary we can say that this is the perspective which interprets the interaction of technological and human factors as a dynamics of mutual shaping.

I introduce the social construction of technology (SCOT) based on the Dutch authors, Trevor Pinch and Wiebe Bijker's (1987) often-cited pioneering work. One of the central elements of the approach is the term '**relevant social groups**' (RSG). RSG means the groups which attribute similar meanings and problems to the technical artefacts. This process results in **interpretative flexibility**: different social groups perceiving different problems will render different solutions to the 'same' technological artefact.

Identifying homogeneous relevant social groups enables the discovery of a collection of different meanings and interpretations of the situation and of the technology. Also, conflicting viewpoints about how to resolve problems and use technology will be unfolded. Therefore, SCOT suggests that what is a success for someone can be a failure (or disaster) for someone else. As Wilson and Howcroft (2002) argue, using the terms

‘failure’ and ‘success’ does not indicate “for whom the technology presents itself as such” (p239).

According to Pinch and Bijker (1987), stabilisation of the artefact eliminates the different interpretations of problems. Here “the key point is whether the relevant social groups see the problem as being solved. In technology, advertising can play an important role in shaping the meaning that a social group gives to an artefact.” (ibid. p44). **Rhetoric moves**, therefore, play a crucial role in the unification of different interpretations and can be means of power and manipulation.

SCOT has also been criticized. An important critique was formulated by for example Orlikowski (2000) saying that after stabilisation, the interpretatively flexible period ceases and the perspective becomes deterministic (e.g. Orlikowski, 2000). An other relevant deficiency is that the differences in power relationships between the single RSGs do not get enough emphasis (Bartis 2007). This addition of the theory could bring an interesting opening towards the critical paradigm.

The approach focusing on the social construction of technology suits well the investigation of situations where the technology (the system) does not fit the intentions of the users (Mitev 2005). This situation is very current in the world of modular and customizable systems, as usually there is a vast difference between the purchased “turn-key” system and the processes, the operation and the culture of the company (Cadili and Whitley 2005).

Appendix 2: List of interview questions

I. Introduction, introduction of research, next steps

II. Discussing the term workarounds (no examples!)

III. Questions:

- For how long have you been working for the company?
- What kind of tasks do you fulfil with the ERP system?
- To what extent can the ERP system support your daily work?
- How much do you work within the ERP system? (what percentage of daily working time?)
- Are you using any other software to fulfil your daily duties? If yes, which one and what is what you are doing with it? Why are you using / preferring it? Can you show it?
- Who and how has developed these tools / tables / spreadsheets? Who has shown you these tricks? Have you changed something in the originally shown/ trained table?
- When and how do you refresh the data in the system?
- What data and information do you need from others? In what way / format do you receive this information / data?
- Are your colleagues use these or other workarounds? Do you need to co-operate with others? Do you know somebody who uses different methods?
- Why are these workarounds good? What are they good for?
- If you have questions regarding the system, who do you turn to?
- Are you satisfied with the system? What are the main challenges / issues / difficulties? What is their root cause? Why do you think you have to use this system? Could you do it without the system?

Appendix 3: List of interviewees per jobs per company

Beta company

Initials	Job
B.	Managing director
S.T.*	Project engineer
H.I.*	Lead project engineer
T.Sz.*	Logistics manager
Sz.L.	Project engineer
Sz.Z.	IT manager
T.G.	Warehouse supervisor
Cs.L.	Production planner
Sz.B.	Material specialist
Cs.M.	Material specialist
J.I.	Customer representative
	Customer representative
Expatriot	Finance manager
V.K.	Chief accountant
	Quality manager
	Quality controller
	Shift leader
	Assistant
* = key user / power user	

Gamma company

Initials	Job
Anonym	Managing director
N.L.	IT manager
P.Á.	Customer representative
A.E.	Customer representative
B.R.	Customer representative
K.N.	Customer representative
K.A	Buyer
F.Sz.	Buyer
T.B.	Commodity leader
K.G.	Commodity leader
J.R.	Sales manager
S.R.	Strategic sourcing manager
P.J.	Warehouse operator
G.F.	Warehouse operator
K.Zs.	Warehouse operator
K.P.	Transportation specialist
	Finance manager
	Chief Accountant
	Quality engineer

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