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Understanding the Role of IT in Management Control Systems

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Abstract

Motivation: Organizations face the challenge of meeting multiple control regulations and reporting on their compliance with these. Information Systems for Governance, Risk Management, and Compliance (GRC IS) support organizations by integrating information throughout the organization with control mechanisms to ensure compliant behavior with organizational goals and external regulations. We argue that the current understanding of GRC IS is incomplete because of five challenges that have not been addressed in existing research: (1) conflicting findings on the impact of IT-enabled management control systems such as GRC IS, (2) Unclear value drivers of IT-enabled management control systems, (3) new technical developments in data analysis allow new forms of control, (4) the missing understanding of the role of IT in balancing exploitative and exploratory management control systems, and (5) organizational struggles in implementing IT-enabled management control systems. We address these challenges by examining how organizations adopt and use GRC IS.

Research Approach: This thesis followed an inductive and qualitative research approach to address the challenges mentioned above. We reviewed control regulations, guidelines, standards, and frameworks and conducted a review of the relevant literature in order to identify useful concepts for our analysis. The identified concepts were used within the following exploratory study to stimulate category development. The empirically grounded conceptual ideas were revised and extended in case studies. Throughout these studies, the primary data source was semi-structured interviews. Secondary data sources were archival data such as process and control descriptions, as well as project documentation.

Results: The thesis provides several empirical findings. We review existing literature on IT-enabled management control systems and suggest a pattern catalogue for the evaluation of such systems. We identify four value drivers of GRC IS and develop a model that structures these value drivers. The model highlights the importance of a coherent design of control mechanisms. We extend a prominent taxonomy for designing management control systems and suggest ‘synchronicity’ and ‘certainty of actions’ as new antecedents for control mechanism design. We provide a description of the GRC IS implementation process that focuses on first improving existing control practices and then developing new controls to cope with uncertainty.

Contribution: This thesis provides several contributions to theory and practice. We enhance management control research by suggesting how IT-enabled management control systems improve existing and enable new control mechanisms. We provide empirical evidence for exploratory control mechanisms and explain how IT supports these. We extend control theory by suggesting new antecedents that are based on timeliness of control information and certainty of derived activities. For practice, the developed pattern catalogue provides structure for analyzing and evaluating GRC IS. Vendors may use the developed value drivers to identify and develop new functionalities of their solutions. Organizations implementing GRC IS gain additional understanding of the technological capabilities of GRC IS and may use the value drivers for structuring the business value of such systems.

Limitations: There are several limitations that have to be taken into account. The papers included in this thesis have been written over a period of four years and the concepts and thinking have developed considerably over that time. We focused on a particular class of IT-enabled management control systems, examined the balance of exploitation and exploration as a specific trade-off in management control systems, and selected control mechanisms as level of granularity. The data stems from a limited number of organizations in a small number of industries and thus our conceptual developments need further testing to ensure generalizability.

Future Research: This thesis suggests several fruitful avenues for future research. Complementing the current concepts with additional data and with quantitative research methods could address the existing threats to validity. A deeper understanding of the dynamics of the technology behind IT-enabled management control systems would enhance the knowledge on this topic. It would be interesting to further examine information-intensive controls such as risk management and focus on external information provided for management control activities. Future research could provide further understanding of balancing management control activities by examining the concept of control coherence in more detail using existing theoretical work on ambidexterity and balance. It would be fruitful to examine human perspectives on IT-enabled management control systems on different levels, including management and employees. The perception of exploratory control mechanisms that are supported by IT and the development on workarounds could also be investigated further.

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List of Abbreviations

BI	Business Intelligence
BPR	Business Process Reengineering
BPM	Business Process Management
CA	Continuous Auditing
CAiSE	Conference on Advanced Information Systems Engineering
CCM	Continuous Controls Monitoring
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CG	Corporate Governance
CUP	Compliant User Provisioning
DWH	Data Warehousing
ECIS	European Conference on Information Systems
ERM	Enterprise Role Management
ERP	Enterprise Resource Planning
EURAM	European Academy of Management
GRC	Governance, Risk Management, and Compliance
GRC IS	Information Systems for Governance, Risk Management, and Compliance
GTS	Global Trade Services
ICS	Internal Control Systems
IFIP	International Federation for Information Processing
IS	Information Systems
IT	Information Technology

JMAR	Journal of Management Accounting Research
MCS	Management Control Systems
OCT	Organizational Control Theory
RAR	Risk Analysis and Remediation
RBDM	Risk Based Decision-Making
SEC	Securities and Exchange Commission
SEM	Strategic Enterprise Management
SOX	Sarbanes-Oxley Act
SUP	Superuser Privilege Management

Publications Embedded in this Thesis

No.	Authors	Title	Outlet	Type
P1	Wiesche, Berwing, Schermann, Krcmar	Patterns for Understanding Control Requirements for Information Systems for Governance, Risk Management, and Compliance (GRC IS).	CAiSE 2011	CON (VHB: C)
P2	Wiesche, Schermann, Krcmar	Understanding the Role of Information Technology for Organizational Control Design: Risk Control as New Control Mechanism.	IFIP 2011	CON (NR)
P3	Wiesche, Schermann, Krcmar	Exploring the Contribution of Information Technology to Governance, Risk Management, and Compliance (GRC) Initiatives.	ECIS 2011	CON (VHB: B)
P4	Schermann, Wiesche, Krcmar	The Role of Information Systems in Supporting Exploitative and Exploratory Management Control Activities.	JMAR 2012	JNL (VHB: B)
P5	Wiesche, Bodner, Schermann	Antecedents of IT-Enabled Organizational Control Mechanisms.	ECIS 2012	CON (VHB: B)
P6	Wiesche, Schermann, Keskinov, Krcmar	Why Do Organizations Prefer Exploitative IT-enabled Management Control Systems? An Exploratory Case Study.	EURAM 2013	CON (NR)

CAiSE: Conference on Advanced Information Systems Engineering, IFIP: International Federation for Information Processing, ECIS: European Conference on Information Systems, JMAR: Journal of Management Accounting Research, EURAM: European Academy of Management, CON: Conference, JNL: Journal, NR: Not Ranked, VHB: German Academic Association for Business Research.

Table 0: Embedded Publications.
Source: Own research.

Part A

1 Introduction

1.1 Motivation

> *"Compliance doesn't happen because a group of overextended, far-flung executives flies in 10 times a year to examine books. Compliance happens because control systems are carefully monitored by internal managers, who are understandably in a state of hyperawareness" (Welch/Welch 2006).*

This quotation from former General Electric CEO Jack Welch illustrates that just writing reports to meet audit requirements does not align organizational members' behavior with the organizational goals. Indeed, managers typically implement a variety of control mechanisms to ensure that organizational members' behavior is in compliance with organizational goals and values (Cardinal et al. 2010; Kirsch 1997). Depending on their preferences and situational conditions, managers assemble multiple control mechanisms in management control systems (Chenhall 2003; Cardinal et al. 2010; Simons 1995). In modern organizations, such management control systems comprise vast amounts of information that is integrated from different information sources in different locations. Hence, information provisioning is a central challenge in management control systems (Chenhall 2003; Simons 1995). Organizations implement IT-enabled management control systems to support the tasks of data collection and the implementation of control mechanisms (Quattrone/Hopper 2005; Rom/Rohde 2007; Lorange/Scott-Morton 1974; Orlikowski 1991).

However, the impact of IT-enabled management control systems is discussed controversially in literature. Information systems such as Enterprise Resource Planning (ERP) systems automate existing control mechanisms (Cooper/Kaplan 1998), reduce separation (Quattrone/Hopper 2005), and explore new ways of implementing existing controls (Dechow/Mouritsen 2005). However, ERP systems could not fulfill the promises made by research for drastically improving control mechanisms (Hedberg/Jönsson 1978; Rom/Rohde 2007). Research identified workarounds (Hanseth et al. 2001), facades of compliance (da Cunha/Carugati 2009), and lack of accountability (Ignatiadis/Nandhakumar 2009) as reasons for inadequate management control systems.

Inadequate management control systems can results in serious consequences for the organization and its members (Power 2000; Syed Abdullah et al. 2010). Various examples from the last several years illustrate the consequences ranging from not meeting performance goals to severe regulatory penalty payments and bankruptcy. Table 1 lists examples of major corporate scandals that involved control failure in the last years including the consequences for the organization or the estimated losses for stakeholders. Enron Corp., an energy company and at the time one of the biggest organizations in the US, managed to hide billions of dollars in debt from stakeholders, including the board of directors and pressured auditors to ignore this accounting fraud (Thomas 2002). Enron filed for bankruptcy in 2001, leading officials to question existing accounting regulations and ultimately to the development of the Sarbanes-Oxley Act (SOX) of 2002. SOX is an US federal law that requires management to verify the accuracy as well as timely reporting of their financial results and establish procedures and

management control systems which ensure the quality and integrity of their financial data (Volonino et al. 2004).

Organization	Year	Industry	What happened?	Consequences
Enron	2001	Energy	Fraudulent accounting to hide debts	Bankruptcy, estimated $60 billion losses
WorldCom	2002	Tele-communication	Overstated earnings and balance sheet	Bankruptcy, estimated $186 billion losses
Parmalat	2003	Food	False accounting to hide debts	Bankruptcy, estimated $3 billion losses
Refco	2005	Financial	False accounting to hide debts	Bankruptcy, estimated $4 billion losses
Siemens	2007	Engineering	Wide scale bribing of foreign officials	€1.3 billion in fines
Société Générale	2008	Financial	One employee traded with more money than the bank had capitalized	€4.9 Billion lost in 3 days, $20 billion total
Olympus	2010	Optical equipment	False accounting to hide losses	CEO resigned; 7 arrests, $7 billion losses
Daimler	2010	Automotive	Wide scale bribing of foreign officials	€185 million in fines
Diamond Foods	2012	Food	Incorrect accounting on farmer payments	CEO and CFO resigned; $96 million settlement

Table 1: List with Major Corporate Scandals that Involve Control Failure.
Source: (Thomas 2002; Sidhu 2009; Da Silveira 2012; Peters 2013).

In practice, a new class of IT-enabled management control systems has developed that supports organizations in implementing adequate management control systems. Such systems are often summarized under the label of Information Systems for Governance, Risk Management, and Compliance (GRC IS) (Rasmussen 2007). GRC IS support management control systems in data collection, data analysis, control management, risk management, and compliance documentation (Vicente/da Silva 2011; Hagerty/Kraus 2009; Caldwell/Eid 2007).

The market for GRC IS developed from supporting existing control functionalities to developing new control functionalities (Kelly et al. 2012; Caldwell et al. 2012). Organizations used GRC IS to ensure compliance by supporting existing control activities (Teubner/Feller 2008). Today, organizations increase flexibility and cope with uncertainty by improving their risk management functions (Caldwell et al. 2012). A recent study identified management complexity, integration, and regulatory complexity as the three most important challenges in GRC programs (Tero 2012): Today's most critical challenge in GRC programs is to gain oversight of the organization's control information. The author identifies the absence of standards and the GRC IS' inability to provide transparency across organizational functions as hindering factors. Similarly, the lack of integration manifests in the inability to develop a common understanding of standards, risks, and controls across functional domains. This is caused by dependencies between functions, unclear accountability, and incomparable metrics. Finally, regulatory complexity refers to the challenge of meeting a plethora of requirements

and objects. The study identified the lacking comparability, the challenges in identifying overlaps and changes, and continuous technological developments as factors that increase complexity (Tero 2012).

While various aspects of management control systems have been addressed in research, the role of IT in this context is not fully understood. Research in management, organization theory, and accounting supports organizations in developing adequate management control systems. Organizations are guided in setting top-down strategy, pursuing standardization, reducing deviations, and monitoring performance (Tannenbaum 1962; Fayol 1959; Merchant/Otley 2006). In contrast to this conceptual understanding, the role of IT in management control systems is not fully understood (Hardy/Leonard 2011; Racz et al. 2010). Current research lacks granularity and innovation as it only focuses on implementing existing control activities and does hardly consider new technological developments (Quattrone/Hopper 2005; Dechow/Mouritsen 2005; Rom/Rohde 2007). In contrast to other IT-enabled management control systems, GRC IS combine two previously separated sources of organizational information: functional information and information on control mechanisms. Functional information includes operational information such as process definitions, throughput times, and storage capacities. Information on control mechanisms includes risk assessments, compliance requirements, control designs, and control information (Dechow/Mouritsen 2005; Schäfer et al. 2012). It remains unclear, how such systems could assist managers in developing and maintaining adequate management control systems (Hardy/Leonard 2011).

Overall, control is an important topic in organizations and has been extensively examined in management control research. The role of IT in changing existing management control systems has been unquestioned. The effects of IT are however discussed controversially. New technological developments led to new information systems such as GRC IS that provide additional functionalities and focus on integration. While such technologies find broad acceptance in practice, they remain poorly understood in research. Consequently, the goal of this thesis is to examine how organizations adopt and use GRC IS.

1.2 Problem Statement

Despite its prominence in practice, little is known about how GRC IS are used in organizations (Hardy/Leonard 2011; Racz et al. 2010). Few studies have examined GRC IS in different contexts (Schäfer et al. 2012; Spanaki/Papazafeiropoulou 2013; Gericke et al. 2009; Chou et al. 2010) and focused mainly on improving existing control practices. Similarly, several unresolved issues exist on a conceptual level. Debate continues about how IT-enabled management control systems support existing control mechanisms (Dechow/Mouritsen 2005). Literature does not provide enough insights on the purpose of IT-enabled management control systems and how they are used to support and enhance control activities in organizations. The following five challenges provide an overview of the current shortcomings in literature on IT-enabled management control systems that will be advanced in this thesis:

Challenge 1: Unclear knowledge about how organizations use IT-enabled management control systems

IT-enabled management control systems such as GRC IS find broad acceptance in practice. Such systems reduce control costs (Menzies et al. 2012), improve control practices (Caldwell et al. 2011), and ease managerial decision-making (Caldwell et al. 2012). In practice, GRC IS most often automate the segregation of duties – commonly referred to as access control (Teubner/Feller 2008). But new solutions promise improved process control and better risk management (Menzies et al. 2012). Current market analysis identifies a shift in focus of existing GRC IS from internal to external requirements (Wheeler 2013) and predicts that in future, GRC IS providers will continue to develop new functionalities to meet emergent risks (Wheeler et al. 2013). Considering these technological developments, the role of IT in supporting and enhancing management control systems is still not fully understood (Hardy/Leonard 2011; Teubner/Feller 2008).

This insufficient understanding is increased by lacking conceptual consensus in research. Existing research on management control systems experiences false differentiation, false consensus, fragmentation, singularity of concepts, and rigidity (Cardinal et al. 2010). False differentiation refers to different terms for identical concepts. False differentiation hinders integration of existing research on IT-enabled management control systems that apply different theoretical models (Hardy/Leonard 2011). False consensus refers to the use of identical terms for different concepts. In research on IT-enabled management control systems, the conceptual assumptions are not clearly defined and thereby challenge integration (Racz et al. 2010). Despite its long history, research on management control systems comprises a fragmented collection of typologies and concepts that hinder an integrated perspective on this issue. GRC IS studies build on different concepts, including strategic aspects (Chou et al. 2010) and practitioner standards (Racz et al. 2011). Singularity refers to lacking multi-faceted concepts that acknowledge the breadth and complexity of control in organizations. Existing studies on GRC IS focus only on specific aspects such as environmental issues (Hoffmann 2009) or modeling (Gericke et al. 2009). Finally, rigidity refers to the fact that the current body of knowledge strongly focuses on static concepts that do not acknowledge the dynamic developments in organizations. Previous work on the adoption of information systems suggests that this adoption is a dynamic process and changes organizations over time (Markus/Keil 1994; Volkoff et al. 2007). Initial research on the implementation of GRC IS suggests its complexity and dynamism (Spanaki/Papazafeiropoulou 2013).

This thesis examines the way in which GRC IS are used in organizations and thus provides further insights on how such systems provide benefits for the organization. Our research strategy samples for diversity in industries, stakeholders, and maturity degrees to identify general value drivers of GRC IS. We follow an exploratory strategy in analyzing our data to overcome the lacking conceptual consensus. However, we consider various theoretical concepts to integrate our findings in existing research.

Challenge 2: Conflicting advice on how to use IT-enabled management control systems

The potential of IT to change existing management control activities has been recognized early on (Lorange/Scott-Morton 1974). A considerable amount of empirical findings have

been published on how IT affects management control systems. These studies review existing technology, ranging from basic information technology such as e-mail (Finnegan/Longaigh 2002), to integrated systems such as ERP systems (Chapman/Kihn 2009). Information systems that make control information accessible and support the management of existing and the development of new controls such as GRC IS are also discussed in literature (Schäfer et al. 2012; Bamberger 2010). However, the findings regarding the impact of IT on management control systems are conflicting.

Existing research on the role of IT in management control systems has identified positive, negative, and no effect of IT on management control systems. For example Beniger (1986) argued that the potential of IT in coping with complexity, increased reliability, and information processing will increase control in organizations. Similarly, Zuboff (1985) identified various IT effects such as integration, automation, and consistency as foundation for increased control and used the concept of Foucault's panopticon to identify mainly positive effects of IT for management control systems (Foucault 1977). However, several other studies suggest a negative impact of IT on control: Building on similar observations as the studies above, Hanseth, Ciborra, and Braa (2001) suggest a loss of control as organizational members will find a way to avoid the information system, what is commonly referred to as workarounds (Ignatiadis/Nandhakumar 2009). In her groundbreaking analysis of an organization that implemented IT in its production process, Orlikowski (1991) was able to outline the contradictory capabilities of flexibility and control in more detail. Following her line of argument, other studies suggest that the positive effect of increased control and the negative effect of how organizational members react to the information system would cancel each other out (Ignatiadis/Nandhakumar 2006).

This thesis aims at providing additional insights on how IT changes management control systems. We use GRC IS as an example of analysis-oriented IT-enabled management control systems that are currently prominent in practice. We focus on understanding how IT changes the context in which management control systems are implemented, the design of specific control mechanisms, and how decision-makers use control information.

Challenge 3: Unclear knowledge on how organizations use vast amounts of data for exploratory management control activities

Management control activities usually are of an exploitative nature, i. e., focus on efficiency and reducing performance deviations and include standardization, refinement, and routines (Simons 2010). Organizations that focus on exploitation are not able to develop new competitive advantages (March 1991; Raisch/Birkinshaw 2008). Exploratory management control activities focus on innovation and include experimentation, risk taking, and search and thereby enable new competitive advantages (Simons 2010; Chapman/Kihn 2009; Speklé 2001). The idea of using control for exploratory purposes was at the basis of research on management control systems from the beginning (Fayol 1959; Lorange/Scott-Morton 1974). However, the main difficulty of implementing exploratory control mechanisms is coping with the vast amounts of data (Speklé 2001).

Modern information systems support organizations in coping with these vast amounts of data, enable exploratory control mechanisms, and thereby may change existing control practices.

Technologies such as business intelligence (BI) allow a data-driven approach to control. Instead of collecting information for a specific management control activity, such technologies use a variety of organizational information to detect anomalies and deviations that may lead to future threats or benefits (Ansoff 1975). Recent studies found a positive effect of BI and data mining technologies on the development of new controls (Elbashir et al. 2011; Chou et al. 2010; Debreceny/Gray 2010). GRC IS build on such technologies, integrate the information throughout the organization, and add knowledge on existing control mechanisms. GRC IS thus build promising groundwork for developing exploratory controls (Racz et al. 2011; Vicente/da Silva 2011; Butler/McGovern 2009).

This thesis examines how GRC IS turn IT-enabled management control systems from predominantly supporting exploiting control activities (Dechow et al. 2007) to exploratory control activities as well. We use a framework that structures the role of IT in improving existing control practices and the development of new controls (Lorange/Scott-Morton 1974) to analyze existing research on the role of IT in management control systems and discuss our findings on GRC IS. We explore how IT supports the relationship between exploitative and exploratory management control activities.

Challenge 4: Unclear role of IT in balancing exploitative and exploratory management control systems

Finding and maintaining a balance between exploitative and exploratory activities is a common managerial challenge in organizations (March 1991; Raisch/Birkinshaw 2008). Several studies outline the need for organizations to reduce deviations in performance and foster innovation (Weick/Sutcliffe 2007; Speklé 2001; Adler/Borys 1996; Hedberg/Jönsson 1978; Davila et al. 2009). While these studies highlight the importance of simultaneously pursuing exploitation and exploration, others outline the challenge in achieving an appropriate balance between exploitation and exploration (Raisch/Birkinshaw 2008).

Simons' work on the strategic use of management control systems suggest that exploratory control systems, especially interactive control systems that serve to encourage organizational members to report on strategic uncertainties, require a multitude of information that strongly builds on exploitative control systems (Simons 1995; Simons 2010). O'Reilly and Tushman argue that managers need to ensure that organizational structures remain and integrate innovation only on senior management level (O'Reilly/Tushman 2004). Their findings imply that managers cannibalize their own organization to transform it into a balance of exploitation and exploration (Tushman/O'Reilly 1996). Cardinal, Sitkin, and Long (2004) suggest that management needs to actively consider exploitative and exploratory information to determine an appropriate balance.

This thesis investigates how IT supports managers in achieving this balance by providing the relevant information across units while organizational structures keep the units separated. ERP systems integrate information across organizational functions and geographic barriers (Dechow/Mouritsen 2005). Such systems collapse spatial and temporal separation (Quattrone/Hopper 2005) and thereby provide integrated information to management (Marx et al. 2012). We argue that IT-enabled management control systems support managers in mastering the organizational transformation to achieve a balance between exploitation and

exploration with more concrete information and prepared decision-making. This research therefore aims at developing an understanding of how IT-enabled management control systems support organizations in achieving a balance of exploitative and exploratory management control activates.

Challenge 5: Organizations struggle with implementing IT-enabled management control systems

IT-enabled management control systems comprise complex information systems, which are highly integrated in organizations. Such systems support the collection, storage and processing of financial and accounting data that is used in existing accounting practices, integrate data sources such as ERP systems, and implement context specific designs (Rom/Rohde 2007; Vicente/da Silva 2011; Granlund 2011). Practitioners report on the challenging implementation of IT-enabled management control systems (Caldwell et al. 2012; van Decker/Caldwell 2009; Cangemi 2008). Some studies report on establishing integration and overcoming complexity as key challenges in implementing IT-enabled management control systems (Tero 2012), while others highlight the volatile regulatory environment (Kartseva et al. 2010; DeVita 2013).

Similarly, research points out the challenges in implementing IT-enabled management control systems. Implementing GRC IS does not only require collecting information on organizational value creation (Dechow/Mouritsen 2005), but also incorporating existing control mechanisms and reporting structures (Alles et al. 2008; Hulstijn et al. 2011). Coping with complexity (Schäfer et al. 2012; Hardy/Leonard 2011), existing structures (Gericke et al. 2009; Chou et al. 2010), and configuration (Marx et al. 2012) are among the key challenges identified in literature. Similar to ERP systems implementation, GRC IS involve different data sources and stakeholders and integrate several business processes (Dechow/Mouritsen 2005; Rom/Rohde 2007; Quattrone/Hopper 2005). In addition, GRC IS not only collect and analyze organizational data, but also implement existing control mechanisms to make sense of this data for managerial decision-making (Spanaki/Papazafeiropoulou 2013; Gericke et al. 2009).

This thesis examines the implementation of IT-enabled management control systems. We examine how organizations select, introduce, and integrate GRC IS. We particularly examine rationales, dependencies, and value drivers to identify strategies, routines, and best practices.

1.3 Research Questions

This thesis aims at enhancing the understanding of IT-enabled management control systems. We focus on GRC IS as a new class of IT-enabled management control systems and seek to understand how GRC IS impact management control systems. We identified five challenges that increase the difficulty of researching IT-enabled management control systems. Based on these challenges, we conducted six distinct research endeavors (embedded publications in Part B) that address specific research questions in relation to these challenges. In the following, the motivations behind the research questions will be explained briefly.

In order to understand the effect of IT on management control systems, it is important to understand the underlying motives, guidelines, and best practices that guide organizations in

implementing IT-enabled management control systems. The first research question of this thesis therefore seeks to understand how various regulations impose compliance on business processes and management control systems. It aims to identify legal constraints, corporate governance standards, corporate governance frameworks, IT-security and accounting standards. Selected pertinent industry-specific regulations from banking, insurance, medical, and chemical industry that recommend control mechanisms for organizations are included as well. Classifying the broad set of control requirements into patterns allows the exemplification of the effectiveness of GRC IS. We therefore ask the research question of:

RQ1: How can control requirements be classified to evaluate existing information systems in the field of GRC?

A central challenge of controlling organizational processes is the identification of the control mechanism that fits the situation. Research has extensively examined this issue (Jaworski 1988; Cardinal et al. 2010; Fayol 1959; Cardinal et al. 2004) and provides guidance on designing control mechanisms (Flamholtz et al. 1985; Simons 1995; Ouchi 1979). While there are several arguments, that IT-enabled management control systems change existing control activities in organizations (Dechow/Mouritsen 2005), far too little attention has been paid to the role of IT in organization control design (Rom/Rohde 2007). We argue that existing organizational control taxonomies omit the rising uncertainty in organizations as well as technologies for automation and mass-data processing. We therefore aim to address the following research question:

RQ2: How does information technology affect organizational control design?

Existing research has suggested several effects of IT on management control systems. While several studies found positive effects of IT on improving existing management control systems (Cooper/Kaplan 1998; Quattrone/Hopper 2005), others questioned these effects (Poston/Grabski 2001; Granlund/Malmi 2002) and even found negative consequences, such as workarounds and lack of accountability (Ignatiadis/Nandhakumar 2009; Boudreau/Robey 2005). We therefore aim to identify value drivers of GRC IS as an IT-enabled management control system and provide initial links to existing literature. We use a broad sample with different perspectives, different implementations, and different management control systems to examine the research question:

RQ3: What are value drivers of GRC IS and how can they be structured?

Building on the results of the research questions above, the value drivers of GRC IS provide initial insights on how organizations use GRC IS and on designing information systems to support management control systems. However, the complex designs and their implications lack structure (Doty/Glick 1994). We therefore ground our research in the organizational trade-off of exploitative and exploratory control activities (March 1991; Simons 2010) and derive a framework that explains the role of IT in management control systems. We therefore ask the research question of:

RQ4: How do information systems support exploitative and exploratory management control activities?

The preceding research questions addressed the effect of IT-enabled management control systems from an organizations perspective. To better understand the implications of IT on individual organizational control mechanisms (Ouchi 1979; Cardinal et al. 2010; Kirsch 1996), we examined a GRC IS on the level of individual control mechanisms. We focused on one single organization and examine a complete set of controls within their GRC IS. We aimed to consolidate our findings by examining the following research question:

RQ5: How does information technology influence the design of organizational control mechanisms?

Several studies have addressed the trade-off between exploitative and exploratory management control activities (Simons 2010; Mundy 2010). Organizations are challenged with allocating scarce resources to achieve a balance between exploitative and exploratory management control activities (March 1991). However, little is known about the dynamics of achieving this balance (Gregory et al. 2013; Cardinal et al. 2004). We argue that the dynamic process of allocating resources to exploitative and exploratory management control activities can be better understood if we provide insights on how an IT-enabled management control system is implemented. In particular, we will address the following research question:

RQ6: How do organizations allocate IT resources to exploitative and exploratory management control activities?

Table 2 maps the research questions that guide this thesis to the challenges outlined above.

Challenge	RQ1	RQ2	RQ3	RQ4	R5	RQ6
1. New functionalities			•		•	•
2. Conflicting advice	•			•		
3. Enabling exploration	•		•	•		
4. Balance		•	•	•	•	•
5. Implementation						•

Table 2: Research Questions and Challenges Addressed in this Thesis.
Source: Own research.

1.4 Structure

This cumulative thesis has been divided into three parts. Part A provides an overview of the topic. It consists of three chapters. The first chapter motivates this research, outlines the problem statement and defines the research questions. The second chapter provides the conceptual background of this thesis by outlining existing research on control in organizations, presenting mechanisms of control, illustrating existing frameworks, and summarizing existing research on IT-enabled management control systems. The third chapter provides an overview

of the overall research strategy and describes the applied research methods. Part B comprises the six peer-reviewed publications that were published in the context of this thesis. Finally, part C discusses the results from this thesis. After a short summary of results, the findings are discussed, followed by an outline of the limitations, implications, and further research opportunities. A conclusion closes the thesis.

2 Conceptual Background

Understanding and explaining management control systems has received considerable attention in management, organization theory, and accounting research (Otley et al. 1995; Cardinal et al. 2010; Merchant/Otley 2006; Giglioni 1974). While control has early on been identified as one of the central functions of management (Fayol 1959; Anthony 1965), the complexity and dynamics of the concept have challenged researchers from the beginning (Cardinal et al. 2010). This ambiguity of the term control has led to various definitions. As early as the 1960s, Rathe (1960) identified 57 definitions of control concepts. Several other reviews analyzed the existing understanding in many different disciplines, such as accounting (Merchant/Otley 2006; Otley et al. 1995), organization theory (Cardinal et al. 2010), and management (Giglioni 1974) and concluded that a fragmented body of knowledge exists on control research.

This thesis will use the broad definition proposed by Flamholtz, Das, and Tsui (1985) who saw *control* as attempts to influence organizational members in behavior that lead to the attainment of organizational goals.[1] Examples include interpersonal influence activities (Tannenbaum 1962), verifications of plans and directions (Fayol 1959), or supervision, evaluation and feedback (Merchant/Otley 2006). For this thesis, we understand each individual attempt – the molecular unit of control – as a *control mechanism* (Cardinal et al. 2010; Kirsch 1997). Examples of control mechanisms include financial incentives, rules and procedures (Kirsch 2004), as well as values, norms and beliefs (Ouchi 1980). The configuration of multiple control mechanisms is understood as a *management control system*[2] (Chenhall 2003; Cardinal et al. 2010). The predominance of certain types of control mechanisms in management control systems depends on managerial preferences and situational conditions. Typical management control systems can be market control systems that primarily focus on outcome-oriented control, bureaucratic control systems that focus on the definition and enforcement of guidelines and rules, and clan control mechanisms that comprise informal control mechanisms that motivate employees by aligning their values and beliefs with those of the organization (Ouchi 1979). When a manager uses certain control mechanisms within a management control system for one specific purpose[3], this is referred to as *management control activity* (Chenhall 2003).

The following sections provide an overview of the control concepts relevant for this thesis. While there are different streams of research that build on different concepts of control, the bulk of the control-related information systems research builds on three concepts, which will

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[1] The concept of control experiences false differentiation in different disciplines (Cardinal et al. 2010). In accounting-based studies, the term *management control system* is predominant (Merchant/Otley 2006; Otley et al. 1995), in management research, the term *control theory* is predominant (Giglioni 1974), and in organizational theory, the term *organizational control* is predominant (Cardinal et al. 2010). In this thesis, we will examine the influence of IT on different control concepts. Therefore, we will use a broad understanding of control with the term *management control system* and will use the terms *control theory* and *organizational control* only when referring to this particular literature.

[2] In IS project literature, the configuration of control mechanisms is referred to as control *modes* (Kirsch 2004; Cram/Brohman 2013; Kirsch 1997) or *coordination mechanism* (Nidumolu 1996).

[3] In organization theory literature, this is referred to as control *target* (Cardinal et al. 2010), in accounting, this is referred to as *goal* (Chenhall 2003).

be introduced in the following paragraphs: the idea of control to ensure pre-specified behavior in bureaucratic organizations (Fayol 1959), control as a mechanisms to design and monitor transactions in and between organizations (Ouchi 1979), and control as a vehicle to formalize and implement strategy (Simons 1995). Building on these concepts, existing work on IT-enabled management control systems will be introduced.

2.1 Conceptual Assumptions on Control

The origins of current understandings of control are based on Weber's core elements of an ideal bureaucratic organization (Weber 1980): division of labor into jurisdictional areas, hierarchical organizations that impose accountability to superiors and authority to give instructions, and abstract rules that guide decisions and actions. Based on this understanding, the notion of control as structuring the process of value creation and monitoring the behavior of employees has quickly evolved alongside planning, organizing, command, and coordination as one of the five elements of management (Fayol 1959). Early studies characterize control as ensuring that organizational value creation occurs in conformity with the strategic plan, specific instructions, and organizational principles (Fayol 1959; Anthony 1965).

Exercising bureaucratic control necessitates social and informational requirements (Ouchi 1979). As social requirements, organizational members need to give up autonomy in certain areas in exchange for monetary compensation. The reduced autonomy allows superiors to direct work activities, monitor performance, and take correcting actions. This is usually referred to as norm of reciprocity (Ouchi 1979). In addition, the implementation of bureaucratic control requires legitimate authority, empowering superiors to command and monitor organizational members. Informational requirements for developing a bureaucratic organization require an explicit set of rules about behavior and output. While it may be impossible to include all possible events in these rules, a legitimate authority can resolve these. Accepting that superiors may specify an employee's duties allows incomplete specification of an employee's duties. This understanding of control is particularly effective in mechanistic organizations in stable environments (Elmes et al. 2005). As soon as tasks become more complex, uncertain, or less transparent to superiors, defining rules and procedures becomes more challenging.

To cope with the challenges of dynamic organizational environments, control concepts based on the theory of transaction cost economics (Williamson 1985) do not determine whether the intended production and delivery process is the most efficient, but prices solve the problem of goal incongruity. Agents are rewarded purely on their contribution; the employee who contributes little is paid less than the employee who contributes more. Transaction cost economics assumes that an organization's goal is to minimize the costs of initiation, bargaining, and enforcement of exchange processes. Keeping in mind the idea that efficiency determines the control structure, the bureaucratic idea of employing organizational members and controlling their behavior for value creation may become more cumbersome than using a market mechanism. In certain situations, markets are more efficient as they omit internal costs, such as costs for management, accounting, or human resource management. A market as a form of control has the least amount of social requirements, but high information requirements. In contrast to the bureaucratic form, the market does not require legitimate

authority, but only the norm of reciprocity. The market form requires a price as information requirement. Prices are negotiated through competitive bidding and no administrative effort is necessary to produce this price (Ouchi 1979).

These thoughts on efficient coordination of market or hierarchical control within or between organizations are extended by Ouchi (1980). Markets are inefficient when transaction costs of exchange processes exceed acceptable limits and bureaucratic organizations are challenged with the ambiguity of individual performance and goal misalignment. Ouchi suggests here the idea of a clan, an organization or a group within an organization that is culturally homogeneous and shares common values, norms, and beliefs (Ouchi 1979). The clan as control mechanism has social and informational requirements as well. Besides a norm of reciprocity and legitimate authority, a clan requires social agreement on a broad range of values, norms, and beliefs (Ouchi 1980, 1979). In contrast to market and bureaucracy, a clan does not have the informational requirements of formal prices and explicit rules, but relies on peer monitoring and sanctions to propagate shared values and beliefs. (Chua et al. 2012).

These three ideal types of control differ in terms of social and informational requirements (Table 3). Both market and clan require certain prerequisites, which are difficult to accomplish. A market is most demanding in informational requirements. Organizations are challenged with arriving at market prices through ah process of competitive bidding and research suggests that such situations seldom occur in practice (Ouchi 1979; Williamson 1985). Similarly, a clan is most demanding in social requirements. A clan does not only require a norm of reciprocity and legitimate authority, it also requires social agreement on a broad set of values and beliefs. Social norms define what appropriate behavior is and thus have to be internalized by all members of the clan. Therefore, Ouchi (1979) compares a market to a trout and a clan to a salmon, both "beautiful, highly-specialized species" that require uncommon conditions for its survival. He compares a bureaucracy to a catfish, "clumsy, ugly, but able to live in the widest possible range of environments".

Type of Control	**Social Requirements**	**Informational Requirements**
Market	Norm of reciprocity	Prices
Bureaucracy	Norm of reciprocity Legitimate authority	Rules
Clan	Norm of reciprocity Legitimate authority Shared values and beliefs	Traditions

Table 3: Social and Informational Prerequisites of Control.
Source: (Ouchi 1979).

These three types of control are of course only ideal types. Organizations can never adopt a pure market, bureaucracy, or clan. Based on social and informational requirements of the specific situation, divisions, departments, and individual tasks are individually designed with certain control types. In the following, specific control mechanisms are introduced, which can be implemented in these particular situations.

2.2 Design of Control Mechanisms

Based on these theoretical assumptions, research has identified several distinct control mechanisms for organizational actors to influence the behavior of other organizational actors (Ouchi 1979; Kirsch 1997). These control mechanisms differ in terms of timing, systemic form, the target audience, control target, formality, and traceability. Formal control mechanisms are codified and thus unambiguous, specific, and officially sanctioned (Cardinal et al. 2010). Informal control mechanisms on the other hand are unwritten mechanisms, often initiated by controlees (Kirsch 1997). They are ambivalent, interpretable, and dependent on the respective situation. The point in time of management intervention differs in ex ante and ex post of creating the output (Jaworski 1988). The control target can either be organizational inputs, controlee behavior, or organizational outputs (Cardinal et al. 2010). The target audience may address the whole organization or a small group of controlees (Jaworski 1988). The unambiguousness of decisions made based on control information depends on the traceability of control adherence (Fayol 1959).

In the following, five types of control mechanisms will be introduced (see Table 4 for a summary): behavior control mechanisms, output control mechanisms, clan control mechanisms, input control mechanisms, exploratory control mechanisms, and self-control mechanisms. When applying *behavior control mechanisms*, organizations develop and assert specific rules and procedures that guide organizational members in achieving desired outcomes (Ouchi 1979; Kirsch 1997). Management observes the behavior of organizational members and rewards and sanctions are based on compliance with the imposed guidelines.

Criteria	**Behavior control**	**Output control**	**Clan control**	**Input control**	**Self-control**	**Exploratory control**
Timing	Ex-ante	Ex-post	Ex-ante	Ex-ante	Ex-ante	Ex-ante
Systemic form	Embedded in technology	Embedded in technology	Embedded in social norms	Embedded in social norms	Embedded in social norms	Embedded in technology
Target audience	Individual/ group	Individual/ group	Group	Individual	Individual	Individual/ group
Formality	Formal	Formal	Informal	Informal/ formal	Informal	Formal
Control target	Value creation process	Result	Involved employee	Input	Involved employee	Expected result
Traceability	Traceable	Traceable	Not traceable	Not traceable	Not traceable	Traceable

Table 4: Characteristics of Control Mechanisms.
Source: Own research.

When applying *output control mechanisms*, organizations communicate desired organizational outcomes or set goals that should be achieved (Ouchi 1979; Kirsch 1997). Rewards are given based on the quality of the results. Therefore, management compares the desired goals to the actual outcomes. Compared to other types of control, output control

mechanisms are unambiguous, but as they control the output of value creation processes, are an ex post measure.

Clan control mechanisms refer to common values and beliefs within the clan, which is a group of people that depend on each other and share a common goal (Ouchi 1980). The clan's strategy of integrating new members, rituals, and ceremonies identify and reinforce acceptable behavior (Kirsch 1997). Rewards are given based on compliance with the clan values, norms, and, objectives.

As an alternative to the informal clan control mechanisms, researchers refer to *input control mechanisms* to describe the formal selection and training of controlees (Snell 1992). Input control mechanisms thereby regulate the staffing and training of controlees as important antecedent of organizational performance. They help prevent performance problems, which may have had to be resolved later. However, as this is an early intervention, it cannot be as precise as other types of control. They manage the potential of future controlees, but cannot guarantee performance in advance.

Speklé (2001) develops the concept of *exploratory control mechanisms* by combining theoretical assumptions of transaction cost economics with agency and contingency theory. Exploratory control mechanisms are characterized by a high autonomy for the controlee. The goals that have to be met will emerge during the process and thereby turn into the performance evaluation measure. Focus lies on long term performance in contrast to short term performance. Exploratory controls exist in situations with high uncertainty such as flexible software development (Harris et al. 2009). In flexible software development, the goal of the project, where usually performance is measured against, is not fully specified. Here, the purpose of exploratory controls is to allow corrective actions instead of evaluation as in output control. The control is designed to steer software development on a continuous basis and thus steers development (Harris et al. 2006).

Self-control mechanisms refer to controlees setting their own goals for assigned tasks (Kirsch 1997). Controlees monitor progress themselves and are able to reward and sanction themselves accordingly. Self-control mechanisms are a function of individual objectives and intrinsic motivation (Jaworski 1988). Rewards are based on the quality of the controlee's self-control.

A prominent taxonomy (Figure 1) predicts the selection of a control mechanism depending on two antecedents, 'ability to measure output' and 'knowledge of the transformation process' (Ouchi 1979). *Ability to measure outputs* refers to the controller's ability to formulate concrete managerial intentions, which are used as goals in the early phase of value creation and are used as basis for performance evaluation after value creation (Snell 1992). When controllers cannot formulate their intentions precisely, they cannot establish performance targets for controlees to achieve. Thus, controllers cannot evaluate the achieved results against the desired outcomes (Ouchi 1979). *Knowledge of the transformation process* describes the controller's knowledge of cause and effect relations that link the actions taken by controlees to the results they achieve (Snell 1992). In situations, when controllers do not fully understand the cause-effect relation, no formal behavioral guideline can be developed, leaving controllers with no basis for evaluating the appropriateness of controlee's behavior (Ouchi 1979).

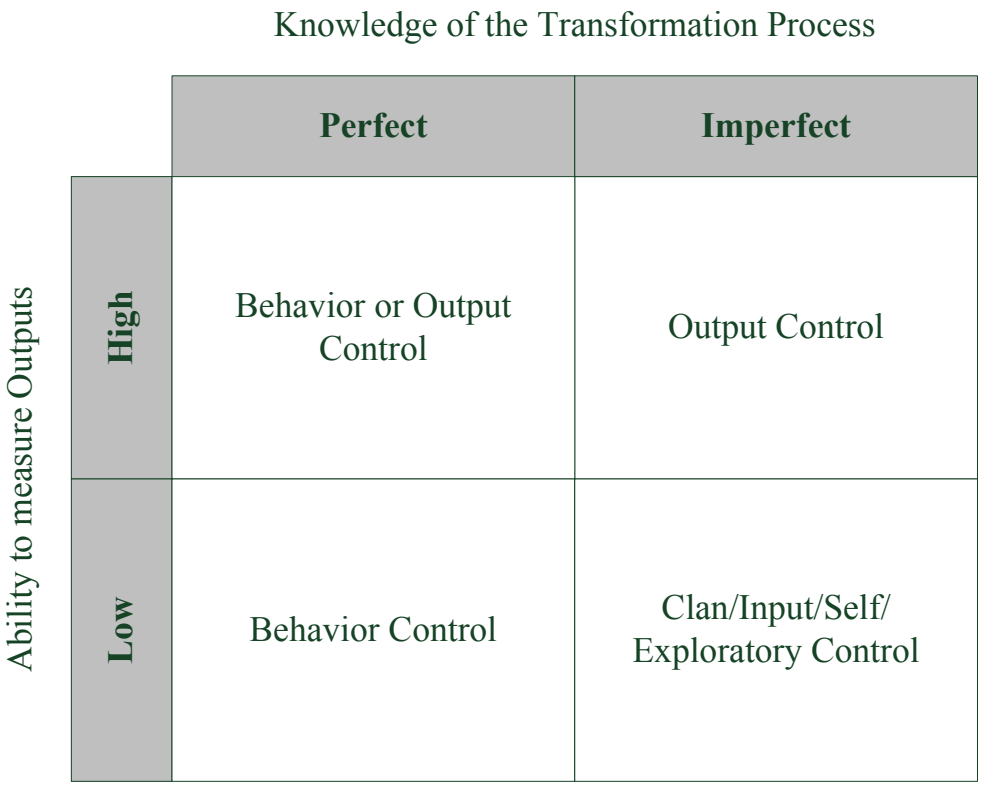

Figure 1: Conditions Determining the Selection of Control Mechanisms.
Source: Adopted from (Ouchi 1979).

This taxonomy predicts that in situations when management has perfect knowledge of the transformation process behavioral control mechanisms are applied by monitoring controlee's behavior (bottom left corner in Figure 1). In situations where management is able to measure outputs, output control mechanisms are applied (top right corner of Figure 1). In situations with high ability to measure outputs and perfect knowledge of the transformation process, the less expensive control mechanism is selected (Eisenhardt 1985). The controller compares the cost of exercising behavior control mechanisms to the costs of outcome control mechanisms and chooses the least expensive alternative. When management has little knowledge of the transformation process and no ability to measure output, clan control mechanisms are enacted through social norms or self control mechanisms are exercised by empowering organizational members in assessing and evaluating their own performance (bottom right corner of Figure 1). Speklé (2001) suggests the implementation of exploratory control in situations with imperfect knowledge of the transformation process and low ability to measure output as well as low ex-post information asymmetry.

Ouchi's (1979) taxonomy has been criticized and extended several times in literature (see for example Kirsch 1996; Snell 1992; Liu et al. 2010; Cardinal et al. 2004). Snell (1992) tested the relationship between the ability to measure output or behavior and the selected control mode of executives in bureaucratic control systems. Kirsch, Sambamurthy, Ko, and Purvis (2002) investigated predictions on the chosen control mode from a client's perspective. Their results suggest associations of outcome measurability with exercising output control in the context of client-company relations. The hypothesis on positive relations between behavior observability and the application of behavior control was also supported. Liu, Yetton, and

Sauer (2010) argue that the framework does not consider the consequences of choosing a certain control mode on performance. In addition, the focus on one single control does not reflect developments in practice, which most of the time require integrated and balanced control systems. This idea has been adopted by several researchers, that investigate packages (Malmi/Brown 2008) or combinations of control (Jaworski et al. 1993). Cardinal, Sitkin, and Long (2004) reflect on Ouchi's taxonomy (1979) and find little guidance on the development of control systems and dynamic developments in control systems in general. In the dynamic, frequently changing environment of system development projects, these configurations of task and control sets are modified frequently (Kirsch 1996; Kirsch 1997; Choudhury/Sabherwal 2003; Gregory et al. 2013).

Studies agree on the shortcomings of existing theory and concede Ouchi's taxonomy (1979) less and less relevance (Cardinal et al. 2010). But this is only one of several severe issues: the framework is criticized for its focus on single control mechanisms (Henderson/Lee 1992; Kirsch 1997; Malmi/Brown 2008), lacking relationships to performance (Liu et al. 2010), as well as not acknowledging the developments from hierarchical structured organizations to dynamic, network structured supply chains (Otley et al. 1995). While we agree with these arguments, we see Ouchi's taxonomy as a sound skeleton of theory on control design, which needs enhancements in terms of integration and dynamics of control.

2.3 Control as a Vehicle to Balance Formalization and Innovation

In addition to ensuring that pre-defined behavior is followed without exception, modern organizations also strive for employee initiative and creativity (Simons 1990). A strategy for control purposes that suggests a top down approach may not meet customer or market requirements: following a standardized plan prohibits product or service customization and continuous improvement. Thus organizations need to simultaneously balance control and innovation (Simons 1995).

The simultaneous goal of control and innovation is based on in an enduring concept in organization science: the balance of exploitation and exploration (March 1991; Raisch/Birkinshaw 2008). Exploratory activities focus on innovation and include experimentation, risk taking, and search. Exploitative activities focus on efficiency and reducing performance deviations and include standardization, refinement, and routines. Organizations that solely focus on exploration are not able to transform their innovative ideas into competitive advantages. Organizations that focus on exploitation are not able to develop new competitive advantages. Hence, the challenge to management is to achieve appropriate trade-offs between exploitative and explorative activities.

This notion gained importance in management control research as well. As early as the 1960s, Burns and Stalker (1961) identified an organization form that differed from the classical bureaucratic and hierarchical organizational form. The authors suggested an organic networked structure of control that enables knowledge-sharing and information exchange on different hierarchical levels. In recent years, this notion gained prominence in management control research (Davila et al. 2009). Weick and Sutcliffe (2007) studied high reliability organizations, which are organizations that operate in uncertainty or under threat, where mistakes and errors lead to serious disaster. They found high reliability organizations use

mindful organization to manage the expected and the unexpected. Mindful refers to the mindset of constantly observing the environment (Weick/Sutcliffe 2007). Adler and Borys (1996) identify two types of control: enabling and coercive. The authors find that control either enables employees to better master their tasks or is a managerial attempt to enforce employees' compliance (Adler/Borys 1996). Simons' work on Levers of Controls (Simons 1995) is particularly interesting for this study, as it assumes a strategic perspective on management control systems (Figure 2 and Figure 3). This strategic perspective serves as a contrast to the rather operational concept of control mechanisms and thus allows a broad range of theoretical concepts for our analysis.

Figure 2: Information Needs of Top Managers in Implementing Strategy.
Source: (Simons 1995).

In contrast to organizational control theory, the Levers of Control framework (Simons 1995) does not focus on the design and orchestration of certain controls, but on the usage of systems of controls by management. Thus, his understanding of management control systems centers on "formal, information-based routines and procedures managers use to maintain or alter patterns in organizational activities" (Simons 1995, 5). Management and lower organizational levels share information for different purposes. Management identifies and communicates domains of interest for the organization to conduct business in. Furthermore, strategic plans and goals are set. Management uses information on the accomplishment of these intended plans and goals to monitor progress. Management further uses information on risks and opportunities for decision-making. Deviations from strategic plans are examined and their consequences are outlined (Figure 2).

Based on these different information needs a framework for controlling strategy formulation and implementation was developed - the Levers of Control (Figure 3). The framework centers on business strategy as the way of organizations doing business in competition with other organizations (Simons 1995). The business strategy consists of four constructs that have to be analyzed and understood: core values, risks to be avoided, critical performance variables, and strategic uncertainties. Organizations introduce management control systems to control each construct: *beliefs systems* control core values by formal communication and systematic reinforcement of basic organizational values, purpose, and directions. Examples for beliefs systems include credos, mission statements, and statements of philosophy and value. Since beliefs systems are too broad to measure performance against, boundary systems impose restrictions to beliefs systems.

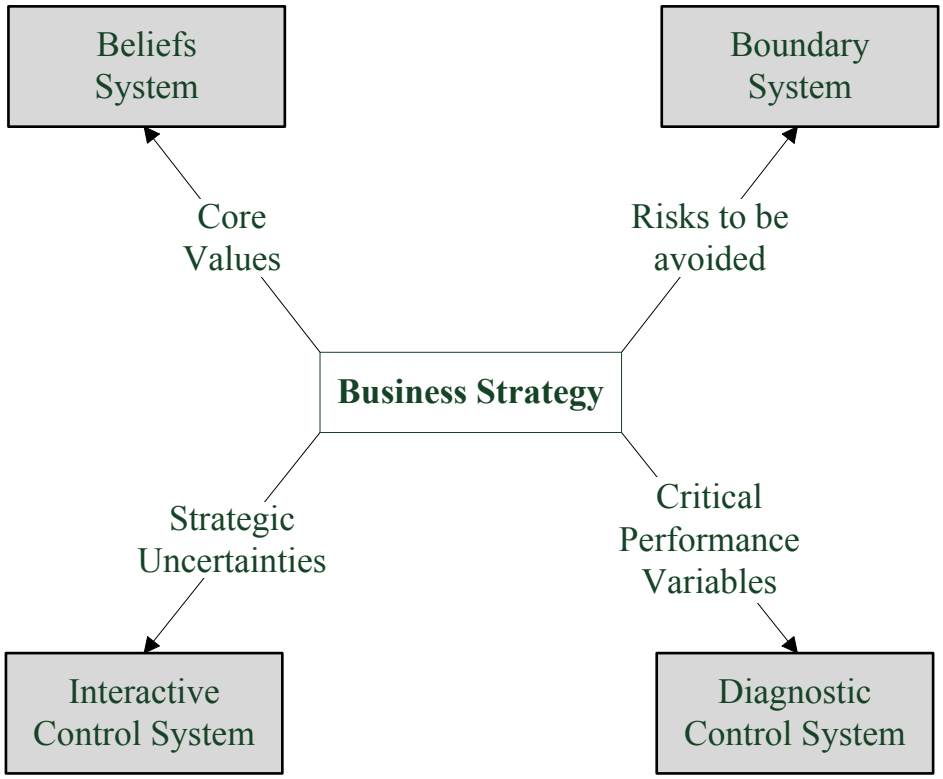

Figure 3: Controlling Business Strategy: Key Variables to be Analyzed.
Source: (Simons 1995).

Boundary systems control risks that have to be avoided by business. Thus, they limit opportunity seeking. Managers delegate decision-making by stating formal rules that must be respected. Those rules dictate what employees are not allowed to do. Within these boundaries, employees use individual creativity to search for value creation. *Diagnostic control systems* are feedback systems that control critical performance variables. Diagnostic control systems compare outputs to set goals and highlight mistakes and negative variances against these goals. These measures inform managers about process deviations that necessitate actions to get back on track. Such measures can be subjective or objective, complete or incomplete. *Interactive control systems* control strategic uncertainties by establishing information networks within the organizations to identify and report new developments. Interactive control systems stimulate innovation and experimentation, as well as suggest actions to cope with new developments, thereby fostering new strategies to adapt to future opportunities and

cope with emerging threats. Usually, interactive control systems are other control system, which are used differently: a diagnostic control system might be used interactively by developing new strategies bottom-up and adopting organizational procedures accordingly.

The simultaneous balance of innovation and control is reflected in this framework. While the beliefs systems and interactive control systems foster innovation, creativity and empowerment, boundary systems and diagnostic control systems ensure compliance with pre-defined strategic plans and ensure accountability. Thereby, these contradicting levers help resolve tensions between competing strategic demands of freedom and constraint. We will use this framework to structure our understanding of role of IT in balancing exploitative and exploratory management control activities.

2.4 IT-enabled Management Control Systems

The potential of IT for supporting management control activities has been subject of many different research streams. Research studies differ in terms of their understanding of the impact of IT in its context and the understanding of the IT artifact itself. In the following paragraph, we will introduce the three major IT artifacts that are particularly important for the usage of management control systems and their implications for control activities: the initial occurrence of the personnel computer which we will refer to as 'basic IT' from now on, integrated information systems such as ERP systems, and analytical control systems such as GRC IS. Each of these developments is discussed in regards to its impact on the usage of management control systems. Finally, the framework by Lorange and Scott-Morton (1974) is used to structure the impact of IT in support of management control systems:

- **Support control system (collect)**: In order to properly support control activities, IT has to support the whole control system. Therefore, information has to be collected on every aspect of organizational value creation in every organizational function. This data has to be prepared for and made accessible to organizational decision makers.

- **Measurement techniques (measure)**: IT can support control activities by providing measurement techniques for non-financial measures. Examples of non-financial measures include innovation, environmental impact, customer satisfaction, or process quality.

- **Mathematical techniques (compare)**: IT can support decision-making between different objectives that are measured on different scales. Especially strategic decisions such as decisions where to locate, the selection of production networks, IT systems, or organizational designs are based on multiple criteria that are hard to compare and require trade-offs.

Basic information technology functionalities

Early work on the effect of IT on management control systems focuses on reducing elements of a control rule set to a routine computerized approach. As pioneer for IT-enabled management control systems, military applications implemented analytical feedback loops to

ensure real-time control, variable limits, formalized decision rules, and performance evaluation (Malcolm/Rowe 1961). While early work saw the effects of integration, rapid responses, precision, consistency, and visibility, researchers were unsure about predicting positive and negative consequences. Table 5 provides an overview of the relevant studies. The table summarizes existing research depending on the impact of IT following Davenport (1993), the direction of the IT impact on management control systems, an illustrative example, the effect dimension of the Lorange and Scott-Morton (1974) framework and the domain.

Several researchers predicted positive effects of IT on control activities. Early work by Malcolm (1961) identified the potential of IT in centralizing, analyzing, tracking, and disintermediating organizational procedures to achieve "real-time" control for corrective actions. Similarly, Beniger (1986) found IT to support organizations in coping with complexity, increase reliability of organizational processes and foster information processing. Thus, IT increases control and predictability of organizational processes. Zuboff (1985) acknowledges the power of IT to increase control and continuity, but points out the strength of creating transparency and increased understanding of organizational procedures. Later, she developed the "information panopticon", an analogy between surveillance through IT and the panopticon (Foucault 1977). She found this "informating" ability as a result of the information-driven capabilities of IT on business processes. This ability allows management to improve existing organizational procedures as it "can provide a point of origin for new conceptions of work and power" (Zuboff 1988, 11). Similarly, Bruns and McFarlan (1987) see benefits of integrating information to explore new solutions to problems and take advantage of opportunities. IT supports the centralization of information from remote locations for central performance analysis as well as the identification of synergies, and provides organizational members with decentralized information to improve their daily work. The authors conclude that when integrated with the right incentives, IT increases organizational control in organizations. In networked organizations telecommunication networks, electronic mail, and integrated databases facilitate organizational control (Wilson 1995; Finnegan/Longaigh 2002).

While these studies examined the effect of IT on control in the workplace in general, other studies focused on particular elements of work. Sewell (1998) examined how electronic surveillance affects team dynamics and found that besides vertical and horizontal control, IT-enabled surveillance also enables chimerical control. The author characterizes chimerical control as a hybrid version of vertical and horizontal control. Vertical control relates to panoptic control as the surveillance of organizational members, horizontal control relates to concertive control as the peer scrutiny within teams. The empirical results indicate that certain process weaknesses that are caused by unproductive activities such as recalcitrance or disobedience cannot be captured by vertical surveillance alone and the gaze of peers in chimerical control can be ignored less easily.

Other researchers argued for a more ambiguous relationship between IT and control. Orlikowski (1991) found that IT simultaneously facilitates and constrains organizational control. On the one hand, IT mediates existing work processes and thus extends existing control mechanisms. On the other hand, IT creates an integrated information environment and thereby enables decentralization and flexibility. Similarly, Bloomfield and Coombs (Bloomfield/Coombs 1992) acknowledge the potential of IT in centralizing and enhancing

control. But they also point out that the centralization of decision-making in formerly different locations leads to a form of decentralization.

Impact of IT (Davenport 1993)	Direction of IT impact	Illustration (of impact on control)	Effect (Lorange/Scott-Morton 1974)	Domain & Reference
Informational, analytical, tracking, disintermediating	+	Real-time control	Collect	Management (Malcolm/Rowe 1961)
Automational, integrative, analytical	+	Increase comprehension, rapid response, precision, consistency	Collect	Management (Zuboff 1985)
Informational, automational, integrative	+	Increase in control and predictability	Collect	Business (Beniger 1986)
Integrate, centralize, disintermediating	+	Increase corporate control	Collect	Management (Bruns/McFarlan 1987)
Informational, automational, integrative	+	Improve existing organizational procedures, information panopticon	Collect	Management (Zuboff 1988)
Integrative, disintermediating	o	Increase control and flexibility	None	IS (Orlikowski 1991)
Automational, informational	+	Increased control	Collect	Management (Coombs et al. 1992)
Informational, Automational, analytical, disintermediating	o	Increase control	None	IS (Bloomfield/Coombs 1992)
Informational	+	Enhanced control	Collect	IS (Wilson 1995)
Tracking	+	Panoptic control	Collect	Organization (Sewell 1998)
Integrative	+	Increase control	Collect	IS (Finnegan/Longaigh 2002)

IS: Information Systems, +: positive effect on control, o: neutral effect on control.

Table 5: Overview of Research on the Effect of Basic IT on Management Control Systems.
Source: Own research.

Enterprise resource planning (ERP) systems

With the rise of enterprise planning (ERP) systems, research on control related issues quickly emerged and examined the potential of this new class of systems for control activities. Yet, there are different contradictory settings and interpretations of the theoretical concepts as well

as inconclusive and contradictory empirical observations in terms of positive, negative and no effects. Table 6 provides an overview of the relevant studies.

Several researchers found positive effects of ERP on control activities. One stream of researchers focused on the integrating effect of ERP systems. Cooper and Kaplan (1998) analyze the potential of ERP systems for integrating operational control and activity based costing systems and find such systems driving real-time information provisioning at a very detailed level. However they also point out that both system require different kinds of information and thus argue for a separated but linked approach. Empirical research found two different effects of ERP systems on control: improving existing control activities and developing new controls. ERP systems improved existing control structures across geographical boundaries (Quattrone/Hopper 2005) and facilitated control through the greater visibility of information (Sia et al. 2002). Dechow and Mouritsen (2005) studied two organizations during their ERP implementation efforts. The authors found that ERP systems incur what they refer to as “techno-logic” for designing management control within the ERP systems workflows.

These studies also found evidence that ERP support the exploration of new ways of exercising management control by altering existing control structures and reduced construction of spatial and temporal separation (Quattrone/Hopper 2005). Yet the underlying accounting structures remain stable in the system and hinder organizational members when developing and testing new and innovative management controls using ERP data (Dechow/Mouritsen 2005). The two effects of improving existing control activities and developing new controls facilitate empowerment of organizational members through increased visibility (Elmes et al. 2005; Sia et al. 2002) and allow an enabling approach to management control (Chapman/Kihn 2009). The provision of an integrated source of control information may not serve as competitive advantage itself as it can be copied easily, but using this information to enhance managerial competence can differentiate organizations from their competitors (Newell et al. 2003).

Impact of IT (Davenport 1993)	Direction of IT impact	Illustration (of impact on control)	Effect (Lorange/Scott-Morton 1974)	Domain & Reference
Automational, informational, integrative	+	outcome controls, refine practices	Collect	IS (Sia/Neo 1997)
Integrative	+	improve existing control structures	Collect	Accounting (Quattrone/Hopper 2005; Cooper/Kaplan 1998)
Integrative	-	Workarounds	None	IS (Hanseth et al. 2001)
Integrative	+	None	Collect	Accounting (Poston/Grabski 2001; Granlund/Malmi 2002)
Automational, informational, integrative	+	empowerment	Collect	IS (Sia et al. 2002)
Integrative	o	Moderate	None	Accounting (Granlund/Malmi 2002)
Automational, informational	+	Develop new management controls	Collect	Accounting (Newell et al. 2003)
Automational, informational	+	collapse spatial and temporal separation	Collect	Accounting (Quattrone/Hopper 2005)
Automational, informational, tracking	-	Control workarounds	None	IS (Boudreau/Robey 2005)
Automational, informational, analytical	+	Panoptic empowerment, reflective conformity	Collect	Management (Elmes et al. 2005)
Integrative	+	explore new ways of exercising control	Collect	Accounting IS (Dechow/Mouritsen 2005)
Integrative	o	rigidity and drift	None	IS (Ignatiadis/Nandhakumar 2006)
Analytical, disintermediating	+	Panoptic control	Collect	Management (Kayas et al. 2008)
Integrative	-	Lack of accountability	None	IS (Ignatiadis/Nandhakumar 2009)
Integrative	+	Enabling control	Collect	Accounting (Chapman/Kihn 2009)

IS: Information Systems, +: positive effect on control, o: neutral effect on control, -: negative effect on control.

Table 6: Overview of Research on the Effect of ERP Systems on Management Control Systems.
Source: Own research.

Another stream of scholars researched the impact of automation and standardization on control activities and found that existing practices could be refined and outcome controls became predominant (Sia/Neo 1997). Yet, other researchers found evidence for an increase in behavior control: a study of the ERP implementation in a non-profit organization revealed that management used ERP systems to evaluate organizational members' data input accuracy, thus, leading to an increase in control (Kayas et al. 2008). An exploratory study of the effects of enterprise systems on control systems identified what they referred to as 'reflective conformity', the simultaneous discipline and reflection of organizational activates (Elmes et al. 2005). ERP systems enforce discipline through embedded rules and procedures in the systems. On the other hand daily business is often too complex to be fully considered in the embedded processes, requiring organizational members to reflect on their activities and improve existing practices.

Other researchers could not identify strong effects of ERP on control activities. Several studies found only a moderate impact of ERP on management control activities, arguing that since such systems are often not designed with change in mind they led only to relatively small changes in management control activities (Poston/Grabski 2001; Granlund/Malmi 2002). Examining the implementation of an organization's ERP system, Ignatiadis and Nandhakumer (2006) found two effects, an increase and decrease of control. Implementing the ERP system on the one hand increased rigidity thus increased organizational control, and on the other hand caused drift through unexpected consequences from power differentials as well as how organizational members used the ERP system.

In contrast, several studies identified a negative effect of ERP systems on control activates. Acknowledging the potential of IT in ERP systems through standardization and integration as ideal control technology, Hanseth, Ciborra, and Braa (2001) observed a loss of control. While management enforced standardized, central processes, each subdivision developed its own variant of the process and extracted ERP data into separated systems that were not connected to the integrated data-base. Similar decreases in control were found by other studies as well. Ignatiadis and Nandhakumer (2009) found that the implementation of ERP systems led to workarounds by users to avoid rules and procedures. This resulted in a loss of organizational control since the organization was not able to collect information to ensure that organizational members use the ERP system as intended by management. Taking a human agency perspective, Boudreau and Robey (2005) argue that users can resist ERP systems and reuse them for different purposes. Organizational members redefine the information systems through their actions, the system loses in importance, and existing control activities are weakened.

Information systems for Governance, Risk, and Compliance (GRC IS)

As a consequence of bank capitalization rules, laws governing information-privacy protection, and the U.S. Securities and Exchange Commission's (SEC) emphasis on effectiveness of internal controls since 2002, organizations were required to ensure accuracy of financial reporting, compliance with laws and regulations as well as effective and efficient operations. Especially in large organizations, this requires information technology to support internal controls (Bamberger 2010). The market for compliance-technology products grew bigger and bigger and a new class of information systems emerged: Information systems for Governance,

Risk, and Compliance (GRC IS). Table 7 provides an overview of research on information systems that support organizations in distributing and gathering and managing information for managerial control purposes that we consider relevant in the context of GRC IS (Racz et al. 2010). In contrast to following the panoptic dream of collecting free-floating information, GRC IS now provide specific control information and combine existing control information in order to design new controls.

Impact of IT (Davenport 1993)	Direction of IT impact	Illustration (of impact on control)	Effect (Lorange/Scott-Morton 1974)	Domain & Reference
Integrative, analytical, informational	+	Improve existing control activities	Collect	IS (Spanaki/Papazafeiropoulou 2013; Gericke et al. 2009)
Analytical	+	Explore control information	Compare	Accounting (Elbashir et al. 2011)
Integrative, analytical	+	Transparency, accountability	Measure	IS (Hardy/Leonard 2011; Teubner/Feller 2008)
Integrative	+	Reduction of complexity	Collect	IS (Schäfer et al. 2012)
Integrative, analytical	+	Improve control activities in quality and timeliness	Measure, compare	IS (Chou et al. 2010; Marx et al. 2012)
Integrative	+	Transparency, efficiency, better risk management	Compare	IS (Racz et al. 2011)
Integrative, automational	+	Reduce cost of control	Collect	IS (Hoffmann 2009)
Integrative	+	Transparency	Measure	IS (Butler/McGovern 2009)
Automational	+	Data management	Collect	Accounting IS (Alles et al. 2008; Hulstijn et al. 2011; Bamberger 2010)
Integrative, analytical, informational	+	Increase compliance, information mining	Collect	IS (Volonino et al. 2004)
Automational, informational	+	Increase performance, real-time control	Collect	IS (Vicente/da Silva 2011)

IS: Information Systems, +: positive effect on control.

Table 7: Overview of Research on the Effect of GRC IS on Management Control Systems.
Source: Own research.

GRC IS support management in analyzing information for control purposes using existing technologies such as business intelligence (BI) or data warehousing (DWH) on existing data sources such as ERP systems. In contrast to other accounting information systems, they are not designed to support one certain control activity, but provide useful tools to fulfill information requirements for several different organizational controls (Elbashir et al. 2011). But GRC IS differ in terms of how they serve this purpose. While BI technologies provide an extensive set of pre-defined reports and metrics that meet management's control requirements, GRC IS focus on making control information accessible as well as managing existing and designing new controls (Schäfer et al. 2012; Vicente/da Silva 2011).

Recent reviews of existing research concluded that the current understanding of GRC IS is still limited (Teubner/Feller 2008; Hardy/Leonard 2011; Racz et al. 2010; Vicente/da Silva 2011). The authors identify several research gaps in existing literature, among others how organizations use GRC IS. Studies call for a consistent understanding of the GRC concept in order to build the right tools to support organizational functions (Hoffmann 2009; Racz et al. 2010). Empirical findings reveal the complexity in terms of technological functionalities and implementation of GRC IS (Racz et al. 2011). Studies of implementing GRC IS for specific objectives illustrate the complexity and ambiguity of different stakeholders regarding the value of GRC IS (Spanaki/Papazafeiropoulou 2013; Gericke et al. 2009). This complexity stems from business process complexity, change frequency, and the degree of regulation (Schäfer et al. 2012).

Yet, there are some studies that try to understand how GRC IS create value for organizational control systems. Racz, Weippl, and Seufert (2011) surveyed GRC IS providers for benefits of GRC IS and found increased transparency and efficiency as well as better risk management to be the benefits mentioned most often. Transparency on the supply chain with all involved parties and an integrated database for GRC information are requirements specifically for environmental issues (Butler/McGovern 2009 2946). In the context of automating the manual audit trails in ERP systems – continuous auditing (CA) – GRC IS are seen as a source for constant control information and as a vehicle to implement an automated control process (Alles et al. 2008; Hulstijn et al. 2011; Bamberger 2010).

Other studies researched the objectives of certain technologies for supporting control functions that are integrated in GRC IS, such as BI (Chou et al. 2010; Marx et al. 2012) or DWH and data mining (Volonino et al. 2004). Chou, Weng, and Wu (2010) identify several effects of BI technology in Simons' Levers of Control (1995): An integrated information system can deliver accurate and timely data and thus increase responsiveness and transparency. It also enables the exploration of new critical performance variables, and improves existing control activities. Therefore, middle management in organizations has to be able to recognize, understand, and use the value of new, external information and top management has to support this control exploration. Marx, Wortmann, and Mayer (2012) highlight the potential of individual drill-down functions of BI technology for management to improve reporting, planning, and consolidating.

While there has been initial insight on technological features of GRC IS (Racz et al. 2011; Teubner/Feller 2008; Hoffmann 2009; Vicente/da Silva 2011), it remains unclear how organizations use GRC IS as a form of IT-enabled management control systems that provide

specific control information and combine existing control information for designing new controls (Racz et al. 2010; Vicente/da Silva 2011; Bamberger 2010). The importance of IT in supporting exploratory control activities has been recognized early on (Lorange/Scott-Morton 1974) and recent studies confirm that understanding the role of integrated information systems and tools for analysis is a promising avenue of research on how new controls can be developed (Elbashir et al. 2011; Chou et al. 2010).

Reflecting on Lorange and Scott-Morton's (1974) framework, we see that the bulk of research on the effect of IT on management control systems centers on the collect function of IT for improving existing control activities. This can be explained by the assumption that the basic IT und ERP systems only provide functionalities that support management control activities in data collection. With the rise of modern and analysis-based IT-enabled management control systems such as GRC IS, additional functionalities enhance measurement and mathematical techniques. Considering the developments in new areas such as fraud detection, continuous control monitoring, and mass-data analysis (Trotman/Wright 2012; Hoyer et al. 2012; Jans et al. 2010), further enhancements for measurement and mathematical control techniques can be expected.

Overall, there is extant research on various aspects of IT-enabled management control systems. However, focus lies on specific elements of technologies, specific control systems, and specific contexts. While there seems to be growing agreement on the positive effect of IT on management control systems, the different use cases of different GRC IS remain unclear. Our analysis suggests a development toward measurement and mathematical control techniques with the rise of new technologies. In this thesis, we will examine IT-enabled management control systems for analytical functionalities in different contexts.

3 Research Approach

3.1 Research Strategy

To answer the research questions for this thesis, we followed an inductive and qualitative research design. There are several reasons, why we considered this research approach particularly suitable to examine the phenomenon of interest (Bhattacherjee 2012). An appropriate empirical research inquiry in this context needs to cope with the complexity which comes with the tight integration of management control systems within the organization and provide a rich understanding of antecedents and assumptions underlying management control system design decisions. This can be addressed by qualitative research methods such as grounded theory or exploratory case studies. For this thesis, we are interested in a new phenomenon that is prominent in practice, but has not been researched thoroughly. We therefore ask open-ended research questions in order to address new constructs in this context (Edmondson/McManus 2007). Finally, we are interested in ways how technology is used in practice rather than its functionalities per se. We therefore examine how organizations in practice adopt IT-enabled management control systems.

As a first step in this thesis, the existing control regulations, guidelines, standards, and frameworks are analyzed to anchor our analysis deeply in practice. This is complemented by a

review of the relevant literature. This allows us to identify "clearly useful theoretical concepts" that will be used for stimulating research endeavors and for category and property development for the following grounded theory study (Glaser/Strauss 2001, 46). The developed conceptual ideas will be revised and extended in case studies. Throughout these studies, the primary data source will be semi-structured interviews, complemented with archival data such as process and control descriptions, as well as project documentation. We aim at observing reoccurring patterns of IT usage in management control systems. These observations allow us to build an explanatory theory that provides explanations of IT-enabled management control systems (Gregor 2006). We thus hope to offer a suggestive theory that invites further work to examine the identified issues (Edmondson/McManus 2007).

3.2 Research Methods

Literature Review

Reviewing the literature is an essential step when conducting a research project (Webster/Watson 2002). The goal of a literature review is to identify the publications relevant for the topic at hand. By identifying the related literature the danger of reinvestigating something that is already know is reduced and the intended research project builds on the existing knowledge (Levy/Ellis 2006; Fettke 2006).

When conducting a literature review, the relevant publications have to be identified, assessed, and analyzed. To identify the relevant literature, scholarly databases are reviewed using keywords and backward as well as a forward searches are conducted (Webster/Watson 2002). The selection of keywords is based on the unit of analysis and is redefined during the review. Identified publications from the keyword search are analyzed for references that may be relevant for the study at hand. This is referred to as backward search. Forward search includes reviewing publications that cite the publications that were identified within the keyword search (Levy/Ellis 2006). The resulting publications have to be assessed for relevance for the research project. The analysis of the relevant literature includes the identification, grouping, and structuring of the underlying concepts (Fettke 2006).

This thesis reviewed existing literature on the role of IT in management control systems. The relevant literature was identified using the keywords control, management control system, organizational control system, IT, ERP, GRC, empowerment and various modifications in the AIS senior scholar basket and organization, management, and accounting journals ranked A and B by the German Academic Association for Business Research Journal Ranking 2.1. Backward searches identified early work on control and helped identify the underlying control concepts for the studies. The forward search, especially for seminal publications such as Orlikowski (1991) and Zuboff (1988) helped identify more recent studies and studies published in outlets other than the ones named above. The identified publications were reviewed for relevance based on title, keywords, and abstract. The analysis focused on the studied IT artifact, the technological functionality of the artifact, the underlying control concept, and the identified or suggested effect of IT on management control systems.

Pattern Development

Patterns describe reoccurring problems and suggest solutions to resolving these problem (Alexander 1979). The idea stems from architecture and originally identifies and describes reoccurring architectural structures. In suggesting solutions that can be reused to address future problems, designing architecture becomes more efficient (Alexander et al. 1978). As patterns describe the abstract characteristics of a problem and suggest a solution, they can be adopted to be used in specific situations without losing the tested core of the solution. A pattern describes an independent solution to a problem, but can be combined to solve a complex problem. Each pattern is described in the relationship to other patterns and can be orchestrated into a pattern language, consisting of a collection of various patterns (Alexander et al. 1978). The concept of the architectural design patterns is frequently applied in software engineering (Gamma et al. 1995; Fowler 2002). In object-oriented information systems, classes and communicating objects reoccur frequently and can be documented using the concept of patterns.

The initial idea of patterns consisted of three elements: (1) The context that describes the situation, in which the design problem occurs. (2) The problem is characterized by imbalanced and conflicting forces and parameters that influence the intended result. (3) The solution describes a spatial configuration that resolves the conflicting forces (Alexander 1979). In software engineering, these three elements were extended with characteristics specific to software development, such as applicability, explicit consequences, related patterns, and concrete implementations (Gamma et al. 1995).

Organizations face a plethora of control regulations and are challenged with implementing these and reporting on the compliance with these regulations (Syed Abdullah et al. 2010). We argue that a pattern repository serves as a disjoint collection of various control requirements, as it extracts concrete requirements from existing regulations and summarizes similarities. We reviewed existing guidelines, laws, best practices, as well as standards and identified reoccurring elements to develop the patterns and to structure these (Buschmann et al. 1996).

Grounded Theory

In the 1960s, Glaser and Strauss (2001) introduced their seminal work on developing an inductive methodology for generating theory that is grounded in empirical observation, which they called grounded theory. Grounded theory is particularly suitable to develop context-based, process-oriented descriptions and explanations of information systems phenomena in situations, where little research has been conducted before (Urquhart et al. 2010). The underlying goal is to develop conceptual categories and theory based on the empirical data (‘emerging’) in contrast to enforcing them through an ex-ante chosen theoretical lens (Kelle 1996). A topic of ongoing discussion is the role of prior knowledge in grounded theory research (Glaser 1992; Glaser/Strauss 2001; Kelle 1996; Urquhart et al. 2010). Suddaby (2006) argues that focusing on prior knowledge mislead researchers in testing pre-defined hypotheses instead of observing phenomena in practice. However, the idea of the researcher entering the field without prior knowledge is problematic as well. Conducting research without a clear research question and theory will ultimately lead to researcher drowning in the data (Suddaby 2006). Drawing on Glaser and Strauss’ argument of substantive theory for stimulating grounded theory (2001), Suddaby (2006) suggests three techniques for coping

with this challenge. By (1) drawing from several different bodies of knowledge suitable for phenomenon, researchers avoid research from one single perspective. The (2) constant awareness of the external influence of existing theories during the research process helps researcher reflect and challenge their empirical findings. Finally, by (3) contributing to existing theory instead of generating fundamentally new ones, researcher avoid overextending the underlying objectives of grounded theory. Figure 4 provides an overview of the coding process.

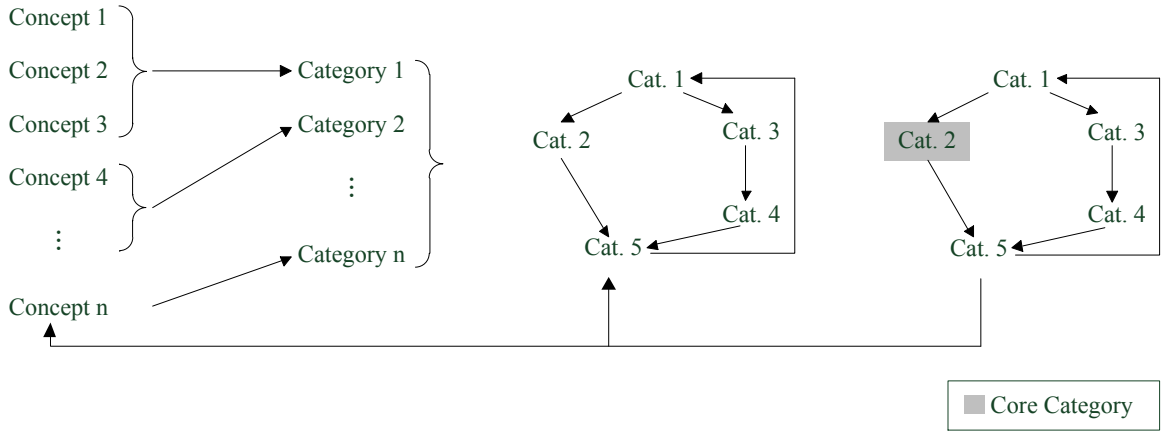

Figure 4: Overview of the Process of Coding empirical Data using Ground Theory.
Source: (Glaser/Strauss 2001).

Literature suggests several principles for conducting ground theory (Suddaby 2006; Urquhart et al. 2010; Strauss/Corbin 1998): theoretical sampling, open coding, axial coding, selective coding, theoretical coding, and constant comparison. During data collection and analysis, theoretical sampling describes the process of continuing the coding and simultaneously selecting data from situations, which are promising to extend existing concepts and find new ones (Urquhart et al. 2010).

- Open coding is the first step of coding empirical data and refers to the ad hoc identification and labeling of important concepts with in the data. Concepts are further aggregated into categories.

- Axial coding relates existing categories to new pieces of data in order identify properties and dimensions of the category.

- Selective coding relates existing categories with each other and identifies a core category that integrates all categories into a theory.

At this point, the researcher strives for theoretical saturation, when no new concepts, categories, and properties evolve from the data (Strauss/Corbin 1998). Glaser (1992) suggests the concept of theoretical coding. Therefore, the researcher uses his or her background, knowledge, understanding, and skill combined with a set of pre-defined theoretical codes – Glaser suggests cause, context, consequences, and requirements among others - to develop theoretical links and theoretically relate categories and properties which later can be transferred into hypotheses as the final result of ground theory (Kelle 1996). Finally, the central principal for conducting grounded theory research is constant comparison. Constant

comparison is the continuous comparison of empirical data in the same category with other empirical data in the same category to advance theoretical understanding and to develop theoretical relationships (Urquhart et al. 2010).

This thesis seeks to understand the role of IT in management control systems by examining how organizations use information systems for governance, risk, and compliance (GRC IS). We conducted a grounded theory study to understand the phenomenon of GRC IS and develop theory of how such systems support management control systems. We collected data by interviewing practitioners in different roles including software developers, users, auditors, and consultants. We conducted semi-structured interviews using questions as provided in Appendix A, recorded, transcribed, and anonymized the interviews line by line. We included secondary data whenever possible, and included the data in one hermeneutic unit in AtlasTi for analysis. For data analysis, we followed the guidelines described above and the authors re-coded the empirical data independently to ensure reliability of the coding. We reflected our concepts and categories with existing literature und discussed our results within the scientific community. This caused us to refine the categories, develop a new category, and conduct a second round of interviews that led to theoretical saturation.

Case Study

Case studies are rich, empirical inquiries that investigate and describe particular instances of a phenomenon within its real-life context (Yin 2009). They are applied when the phenomenon at hand is broad and embedded within its organizational context (Benbasat et al. 1987). Typically, case studies are based on different data sources such as documents, archival records, interviews, observations, and physical artifacts. This helps the researcher in substantially explaining causal links in the context of a phenomenon, describe the phenomenon in its real-life context, illustrate theoretical arguments, or enlighten situations in which the phenomenon has consequences for its context. Case studies can be designed either with a single case or with multiple cases within different contexts (Dyer Jr./Wilkins 1991). Single case studies are suitable for research questions that test existing theory, when the case is unique or typical. They are also useful if relevatory or representative purposes are served. Multiple cases should always follow replication logic and thus allow better cross-cases analysis and improve theory building (Eisenhardt 1989). In case studies, there can be either one or multiple units of analysis. Selecting multiple units of analysis enhances the case study design and allows for a more extensive analysis, but the researcher has to return the analysis to the broader case study level (Yin 2009). While conducting case studies can be seen as one of the less systematic research methods, and thus is rather challenging for researchers (Dubé/Paré 2003), there are several suggestions on how to increase the quality of case studies.

Literature suggests several techniques during data collection, composition, data analysis, and when designing the case (Yin 2009). In order to ensure that the correct operational measures for the phenomenon are identified – construct validity – researchers can use multiple sources of evidence, and have informants review drafts of the results. They need to maintain a chain of evidence, by providing elements of the original data and thoroughly connect elements of the resulting evidence. Researchers can increase internal validity – i. e., strengthening the causal link between conditions – by following the analytical techniques of pattern matching, explanation building, addressing of rival explanations, and using logic models. Pattern

matching compares empirically derived patterns to a predicted one. Explanation building refers to explaining a phenomenon through iteratively contrasting causal links to theoretical assumptions. Addressing rival explanations requires developing rival theoretical propositions that are mutually exclusive. In a single case study, the empirical evidence would suggest that one of the explanations would be the right one, in multiple case settings, confirming the same results across cases would strengthen the argument. The logic model integrates several cause-effect relationships into a complex chain of evidence. Similar to pattern matching, empirical findings are matched to theoretical assumptions, but as the single relationships are connected by turning the one effect event into the next causal event. When designing the case study, researchers can better define the context domain in which the study's findings can be generalized – external validity – by using theory in single case studies and replication logic in multiple case studies. As case study researchers strive to generalize empirical results to broader theory, especially in single case studies, researchers have to build on existing theory to structure, contrast, interpret, and generalize their data. In multiple case settings, the case selection is either based on the goal of predicting similar results or predicting contrasting results for anticipated reasons. Hereby it is important, to include all relevant assumptions into one theoretical framework. To increase reliability, i. e., providing transparency on the operations of a study - researchers should maintain an integrated data-base for the empirical data that is separated from the case study narrative. It is further recommended to use case study protocols as this makes every step of the analysis transparent and reproducible.

While all these techniques suggest tools for improving validity and reliability, Siggelkow (2007) looks back on the role of case studies in illustrating remarkable cases and suggesting new food for theorizing. The author suggests three ways for incorporating case studies: (1) motivating a research question by falsifying existing theory within the case, (2) inspiring new food for thought by extending existing theory by pointing out gaps and providing initial thoughts for filling them, and (3) illustrating theoretical arguments by providing concrete examples and reducing the distance between conceptual constructs and measurable variables.

For understanding the role of IT in management control systems this study focuses on a new practice driven phenomenon and links it to existing theory. We applied the case study method to illustrate shortcomings of existing theoretical arguments in the context of this new phenomenon and to explain the dynamics of our empirically derived model. We selected our case study organizations based on the maturity of their GRC IS. We had the chance to examine the introduction of a GRC IS in one particular organization and one mature GRC IS in another organization. We focused on tasks and processes that are not unique to the industry and contrasted our interview-based data with unobtrusive data such as process and control descriptions, as well as project documentation.

Part B

4 Patterns for Understanding Control Requirements for Information Systems for Governance, Risk Management, and Compliance (GRC IS)

Title	Patterns for Understanding Control Requirements for Information Systems for Governance, Risk Management, and Compliance (GRC IS)[4]
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Individual contribution	The author of this thesis participated in the data analysis and conceptual development. He further significantly contributed to the creation of the manuscript.

Table 8: Bibliographic Details for Publication P1.

Abstract. Companies face a plethora of regulations, standards, and best practice frameworks for governance, risk management and compliance. Information systems (IS) for planning, controlling, and reporting on the compliance with these requirements are known as governance, risk management, and compliance (GRC) IS. However, the challenge lies in mapping control requirements with functionality of GRC IS. In this paper, we review existing regulations and derive a framework for key control requirements. We develop a pattern-based approach that allows to systematically evaluate GRC IS based on the current regulatory situation. We evaluate the pattern catalogue by classifying an existing GRC portfolio. As implications for research, we associate existing control requirements and GRC information systems. As implications for practice, we provide decision support for the selection of GRC IS, depending on situational factors and the expected value proposition. In sum, our framework adds to the understanding of the effects of GRC IS.

4.1 Introduction

Internationally acting companies face the challenge of meeting an overabundance of governance regulations and reporting on the compliance with these regulations (Parry 2004; Ashbaugh-Skaife et al. 2008; Volonino et al. 2004). Even nationwide, legislators require companies to account for compliance with multiple regulations. Assuring compliance has turned into one of the key objectives of any chief financial officer (CFO).

Information systems dedicated to plan, control, and report on the compliance with regulations create significant potentials for coping with regulations more effectively (Fisher 2007; Volonino et al. 2004). Commonly, features of such information systems are discussed under the label of GRC (governance, risk management, and compliance). Driven by regulatory compliance, companies established such GRC IS to prevent fines and penalties imposed by regulatory agencies (Parry 2004). Today, companies focus on integrated solutions of GRC without a clear value proposition for their individual situation (Wiesche et al. 2011b). Still, market research predicts that US-based companies spend almost $30B on GRC related technology and solutions (Hagerty/Kraus 2009) and its importance continues to grow (OpenPages 2009).

Organizations face both, a variety of requirements (Volonino et al. 2004; Abdullah 2009) and a broad portfolio of GRC IS with different emphasis (Wiesche et al. 2011b; Heiser 2010; Teubner/Feller 2008). Executives have to rely on product presentations, progress reports from other users, and consulting services to determine an application's potential to meet control requirements. However, they often lack understanding of which application can fulfill a certain control regulation (Wiesche et al. 2011b; Abdullah 2009; Heiser 2010). Hence, there are no methods, guidelines, or procedures for executives to evaluate the potential of compliance assurance through existing GRC IS. This article aims at answering the following research question: *How can control requirements be classified to evaluate existing information systems in the field of GRC?* Our research provides a pattern catalogue, which summarizes central aspects of control requirements. It serves for evaluating potentials and shortcomings of GRC IS with the help of the predefined patterns.

The remainder of this paper is structured as follows: in the first section we develop a conceptual framework of pertinent control requirements for GRC IS. Then we discuss a pattern catalogue for compliance assurance and present two control pattern candidates. We explore SAP GRC 10.0, a prominent GRC IS, using the patterns. We discuss the results and provide implications for practice and research. The paper finishes with a conclusion and an outlook on future research activities.

4.2 A Framework of Control Requirements for GRC IS

In this section, we introduce the terms governance and compliance. We develop a conceptualization of control requirements through constructing a control requirements framework. We review existing control regulations and classify them according to the proposed framework.

All efforts management takes in seeking to assure stakeholders that they get a return on their investments can be defined as corporate governance (CG) (Shleifer/Vishny 1997). Due to regional and industry specific conditions, CG cannot be implemented based on an internationally and intersectorally valid system. It is rather a system of internationally recognized regulations and national requirements, which need to be integrated into an organizational framework. Implementing CG within an organization depends on various factors, which we suggest to structure in three dimensions: (1) the inner circumstances of a company, (2) the national environment including its habits, and (3) regulatory obligations, laws, and standards.

Although there is no formal or generally accepted definition, the understanding of compliance as duty of the board to ensure abidance of legal requirements and internal guidelines and assure appropriate behavior through the employees is out of question. Starting with financial constraints in the 1980s, today various GRC regulations, guidelines, standards, and frameworks have been developed, which organizations have to comply to.

These control requirements can be structured by the dimensions liability, area of responsibility and addressee. Regarding the dimension *liability*, requirements can be differentiated in either obligatory or recommended. *Area of responsibility* encompasses organizational setting, business processes and IT. Regarding *addressee*, GRC regulations can address internal and external dimensions.

The following examples shall demonstrate the broad scope and variety of GRC requirements: To be in compliance with e.g. the Sarbanes-Oxley Act (SOX), chief executives have to verify the accuracy and timely reporting of their financial results and establish procedures and controls which ensure the quality and integrity of their financial data (Volonino et al. 2004). On the other hand, privacy regulations require adequate data storage ensuring integrity and confidentiality. Furthermore, governance guidelines provide best practices for IS management and demand sound risk management.

We reviewed existing legal constraints, CG standards, corporate governance frameworks, IT-security and accounting standards, and selected pertinent industry-specific regulations from banking, insurance, medical, and chemical industry to provide an overview of this plethora of the diverse existing control requirements.[5] We classified them according to the dimensions introduced above.

In order to successfully comply with these regulations, various controls exist which cover the three management functions governance, risk management and reporting (Figure 5). Governance controls include performance measurement, stakeholder integration, and audit. Risk management controls vary from implementing internal control systems, segregation of

[5] In the field of laws, regulations, and standards for external addressees, we reviewed CobiT, COSO II, CGK, GxP, ISO 27000, IT-GSHB, ITIL, OECD principles, OCEG Redbook, EU guidelines 4,7 & 8, IFRS / IAS and US GAAP. Regarding internal addresses, we reviewed Basel III, DCGK, the German privacy regulations, KonTraG, MaRisk, BilReG, Solvency II, SOX, Liabilty, Market constraints, EU guidelines 4,7 & 8, FDA 21 CFR Teil 11, GDPdU, GoBS, and UMAG.

duties, and IT alignment. Reporting controls include proper book-keeping, internal audit, and archiving.

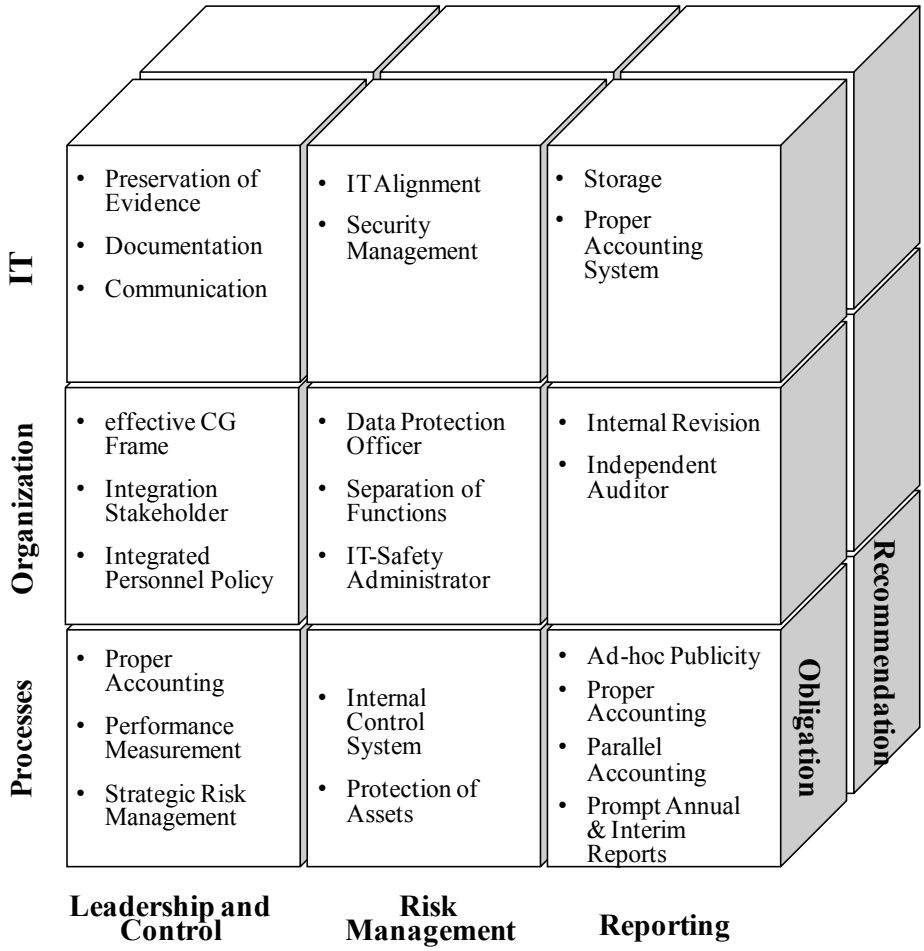


Figure 5: Overview of Categorized Control Activities.
Source: Own research.

4.3 Establishing a Pattern Catalogue of Control Effectiveness

Since organizations face a vast amount of guidelines to comply with, we focus on a pattern repository that might serve as the distilled integration of control requirements. The patterns which will be introduced in the following, provide concrete requirements for IS functionality.

The term pattern was originally made up by Alexander (1979) in the field of architecture and was formally defined as „IF: X THEN: Z / PROBLEM: Y“. A pattern can be defined as the description of a reusable solution to a problem in a way that the solution can be used in similar situations. A pattern comprises the following elements (Alexander 1979): the context comprises causes which lead to the problem described in a pattern and the conditions under which the problem occurs. The *context* should support acquiring the relevance of a pattern. The *problem* is described by explaining contradictions which cause the problem. The next section of a pattern explains the proposed *solution* by dissolving the elements described before. In order to make the patterns more actionable for software evaluation, we extended these dimensions by the elements *alias*, meaning alternative description, aim as key goal of the pattern, *regulation* as the names of the guidelines the pattern was derived from,

consequence as positive and negative effects, and *related patterns* to describe how this pattern relates to others.

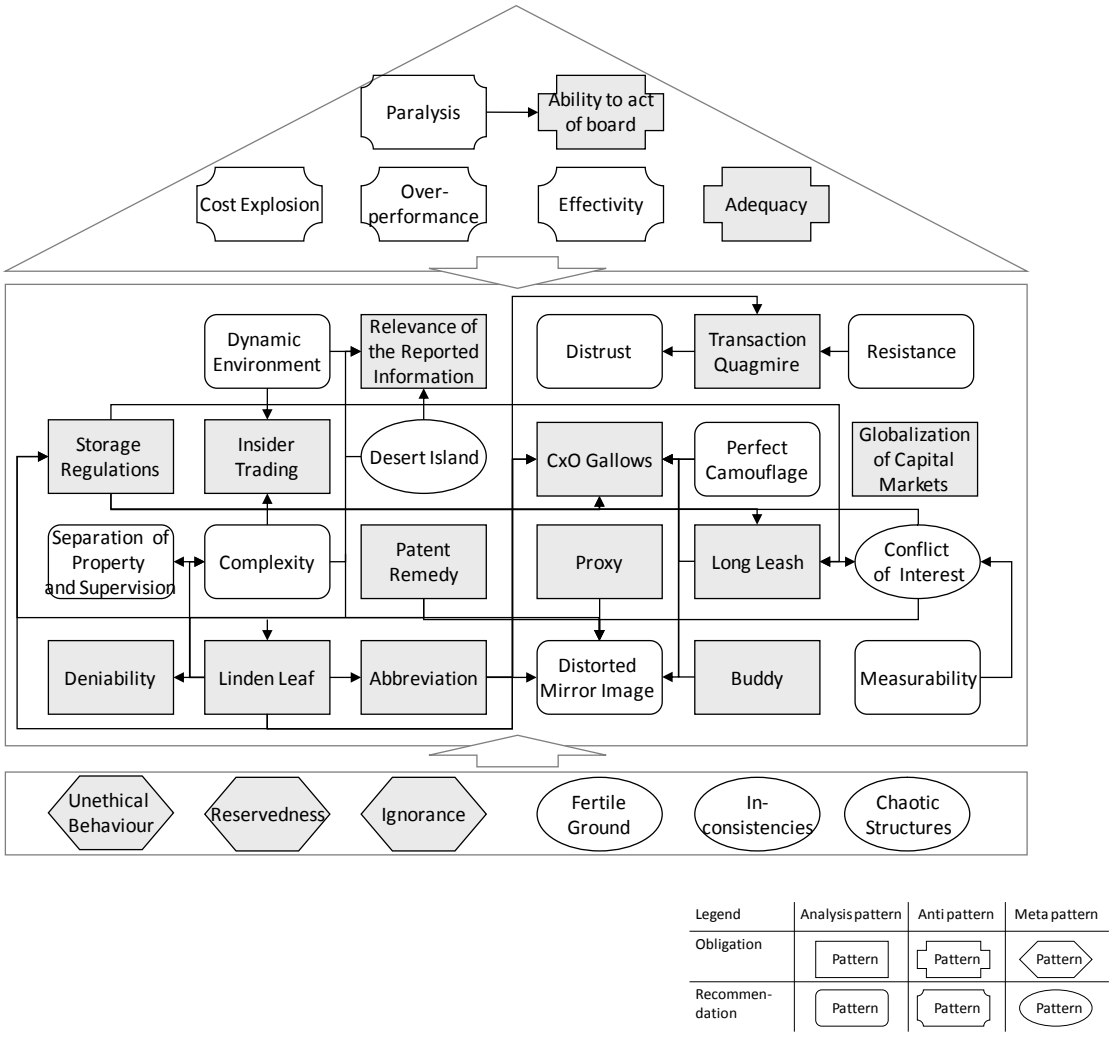


Figure 6: A Control Pattern Catalogue for Structuring Capabilities of GRC IS.
Source: Own research.

To develop the patterns, we followed the suggestions of Buschmann et al. (Buschmann et al. 1996): we reviewed existing guidelines, laws, best practices, and standards and classified them into the categories mentioned above. We reviewed what the guidelines, laws, best practices, and standards described as type of result and matched it to the identified control activities. We matched the requirements with the activities and used the description of the activities to define the supporting and enabling function of information systems. In general, GRC IS can provide real-time data processing, automation, and flexibility in the fields of reporting, logging, communication, simulation, central repository, role-based authorization systems, workflow, and archiving. Having the knowledge about the requirements, necessary activities and IS potentials, we developed a catalogue of 35 patterns to evaluate the potential of GRC IS (Figure 6).

We identified four types of patterns as introduced in the literature: analysis patterns, anti patterns, Meta pattern, and modules. *Analysis patterns* support communicating and

documenting domain knowledge. They ensure proper conceptualizing by helping understand the underlying business problem and define the requirements (Fowler 1997). *Anti patterns* are negative examples of already implemented solutions, which include recommendations on how to fix it properly (Brown 1998). *Meta patterns* are general patterns which are universal and can therefore be used in various contexts (Pree/Sikora 1997). *Modules* support in classifying existing patterns. Each module is a collection of single patterns, which can individually be seen as a pattern catalogue.

To evaluate existing software solutions for GRC, it is important to evaluate the overall potential from management perspective. Management must be able to understand the interplay between certain patterns to reveal the differing value propositions while evaluating GRC IS. Therefore, we propose the following eight categories to structure the control patterns: an effective corporate governance framework, preservation of evidence, segregation of duties, safety of assets, reporting, and corporate management under consideration of profitability and quality. By showing the various relationships between the different patterns the reader is offered a "navigator" for the complex area of corporate governance (Figure 7).

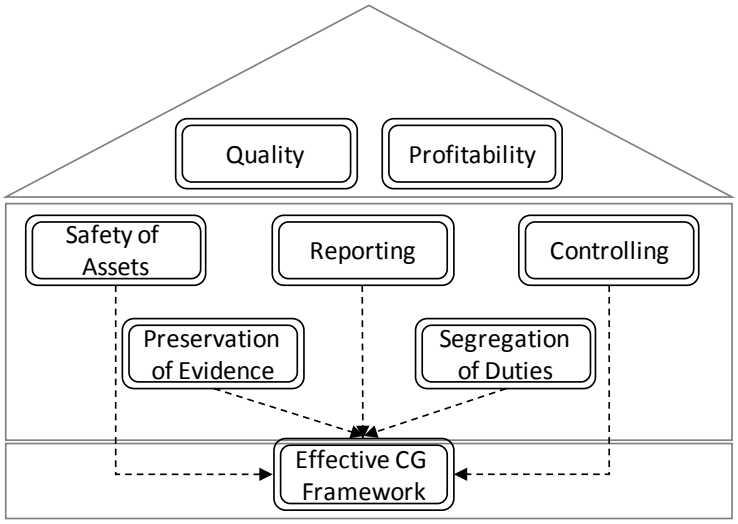


Figure 7: Categories to structure Control Requirements.
Source: Own research.

In the following, we will introduce two patterns to demonstrate the way the patterns are defined and structured. The patterns are structured according to the underlying modules (Figure 7). The pattern adequacy is settled in the context of quality-module and can also be described with the term underperformance (second column in Table 9). The pattern shortcut can be classified in the prominent module segregation of duties with the aim of supervising employee's behavior with controls (third column in Table 9).

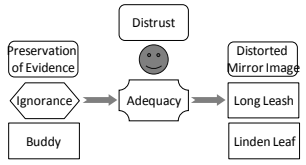
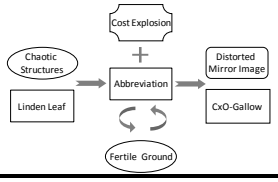
Name	**adequacy**	**shortcut**
Alias	underperformance	effectiveness
Aim	establish security	supervising employee's behavior with controls
Context	It is applied in the context of evaluating the effectiveness of the internal control systems. Since requirements are manifold and the organizational characteristics vary, annual audit also incorporates evaluating control effectiveness and adequacy of internal control system.	Employees conduct compliance work on top of their regular task, without a clear direct benefit. Caused by lack of time or disbelief, employees do not conduct compliance tasks properly or at all, which endangers successful audits.
Problem	The annual audit evaluates the existing internal control system ex-post. Found contradictions might require fundamental adoptions within CG which usually cannot be changed spontaneously and resulting in the auditors refuse the certificate. This situation of non-compliance affects stakeholder relationships and harms the external image.	In the annual financial statement a function check is conducted to reveal the effective match of control and associated risk. It refers to the fact that not only proper controls have to be proposed within the organization but also need to actually be implemented.
Solution	A solution for this issue would be continuous auditing. Internal resources including internal auditors can conduct a final rehearsal of the annual financial statement. Special focus should be laid on top management support to ensure cooperation with internal audit and communicate the importance of such topics.	The pattern provides a solution through workflow-based systems. Such systems services as reminder and provides guidance for employees to conduct compliance work properly. Such systems then document the accurate execution of the compliance task.
Consequence	+ continuous information on implementation of CG and audit acceptability - additional effort for testing and customizing	+ guarantee of the execution of compliance tasks within a reasonable period of time - requirement of initial effort for defining and implementing the system - reduced process performance
regulation	Basel III, IDW PS-330, MaRisk, SOX	MaRisk, SOX
related patterns		

Table 9: Patterns of Compliance Assurance.
Source: Own research.

4.4 Exploring GRC Solutions with Control Patterns

In this section, we will use the derived pattern catalogue to evaluate a popular GRC IS. Therefore, we use the recently launched SAP BusinessObjects GRC 10.0 solution portfolio. The predecessor of this portfolio has been ranked as visionary within Gartner's most recent magic quadrant (Heiser 2010). After giving a short summary of the functionality of the particular modules, we will use the SAP GRC portfolio to reflect the control patterns.

As leading supplier of enterprise software, SAP integrated existing compliance applications into the GRC portfolio in 2006. The GRC portfolio consists of five functional elements (rows in Table 10). Access Control allows securing segregation of duties, compliant provisioning, and consists of the functional elements Risk Analysis and Remediation (RAR) for implementing and monitoring access guidelines, Enterprise Role Management (ERM) for defining and managing organizational roles, Compliant User Provisioning (CUP) for assigning these roles to users, and Superuser Privilege Management (SUP), allowing

automated and fully documented fire fighter solutions for emergency access. Process Control allows managing the internal control systems and consists of control documentation, control analysis, certificates and reporting. Global Trade Services (GTS) allows securing cross border transactions. The module Environmental ensures environmental execution and legal compliance. Finally, the aggregating Risk Management allows the strategic detection of risks and control monitoring across the organization. In addition to using the aforementioned systems as data source, it provides a global risk management process as suggested by best practice frameworks, which complies with legal requirements.

We used test installations and existing documentation to understand the functionality of each module as a basis to evaluate the developed patterns. We assessed the potential of each module for each pattern by means of the following criteria: insufficient when the underlying problem is not addressed at all, to some extent when the problem is mentioned, but not solved, partly, when the problem is solved at least in parts, adequately, when the problem is solved with the help of the system, innovative when an existing solution is used for a new problem-context combination. The results are displayed in Table 10.

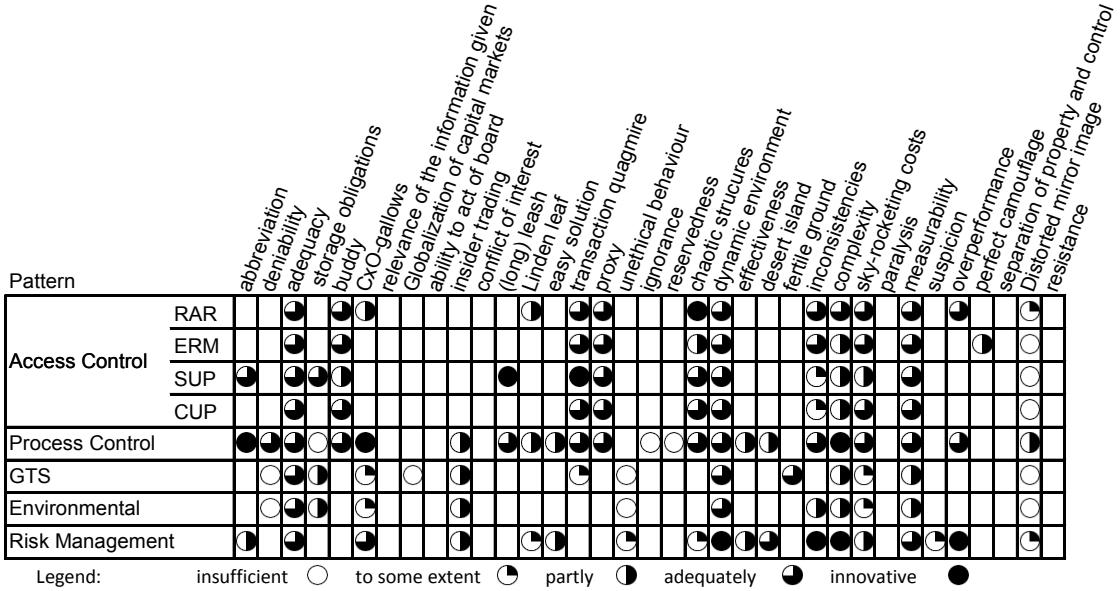


Table 10: Evaluation of SAP GRC 10.0 with Control Patterns.
Source: Own research.

The results in Table 10 reveal that the SAP GRC portfolio has strengths and weaknesses in implementing certain patterns. Especially the patterns CxO-gallows, transaction quagmire, shortcut, chaotic structures, dynamic environment, and complexity are implemented with innovative ideas and solutions, which can provide competitive advantages. Then again, the SAP portfolio reveals gaps regarding the patterns unethical behavior, ignorance, reservedness, globalization of capital markets, and distorted mirror image which are addressed, but lack proper implementation. Further analyses of these patterns reveal that the potential of IS in the context of these patterns can only be established through proper governance and organizational structure. A satisfactory result could be obtained by e.g. combining further solutions of SAP like ERP Financials or ERP Human Capital Management and integration into organizational structures.

4.5 Discussion

In this section we will discuss the potentials of this pattern-based approach regarding the integrated perspective on compliance to balance and resolve conflicts and how this approach enables the determination of GRC effectiveness. We further discuss three implications of applying the pattern catalogue to an existing GRC portfolio.

The developed pattern catalogue provides an overview on control objectives, which GRC IS should address in order to meet control requirements. The pattern catalogue serves as a road map for executives to get an overall perspective over possible control activities. Especially the developed module structure allows navigating through solutions for specific control objectives. This allows the evaluation of potential initiatives depending on their degree of effectiveness within this specific situation and potential of integration with other initiatives. Inefficient applications can be identified easily and duplication of effort can be avoided.

The developed patterns are therefore not only useful to analyze GRC IS value propositions through elaborating actionable control requirements, but also show the need to balance and resolve conflicts. Management has to balance contradictory patterns, e.g. distrust and overperformance, ignorance and paralysis, or transaction quagmire and patent remedy. Using the developed pattern catalogue enables management to prioritize and decide in every situation without losing the integrated perspective.

The integrated perspective further helps reveal GRC IS effectiveness. For example the introduced adequacy pattern ensures an economic perspective on implementing GRC IS. Implementing too much functionality in terms of governance, risk management, and compliance will not only reduce an employee's performance, but also limits his or her motivation regarding the tasks they have to complete. Therefore, using the pattern catalogue allows executives to determine the optimal degree of governance, control, risk management, and reporting, necessary to both create transparency and to run a value adding company effectively.

Companies benefit in three ways from applying the patterns to an existing GRC IS. First, it shows that the developed patterns are useful and can be found within existing applications. It further reveals the patterns which are covered by the given application. In the case of SAP GRC 10.0, not all patterns are covered. Third, applying the patterns to an existing GRC IS and analyzing the underlying concepts reveals that some patterns are not suitable for the automatic approach of GRC IS. The pattern for ensuring the board's ability to act and the anti pattern paralysis require effective organizational structure and integration and cannot be implemented within GRC IS.

This research contributes to the body of knowledge by consolidating requirements for GRC IS through conducting a regulations-driven approach. We thoroughly connect existing requirements with information systems, which are designed to support meeting these requirements. Our research indicates that requirements can be synthesized into a defined set of capabilities, which are necessary to meet the considered regulations. We aid practitioners to soundly evaluate existing GRC IS depending on their individual requirements. The actionable patterns allow the implementation of an output-oriented evaluation of GRC tools. This

research contributes to theory by bridging the gap between actual control regulations and GRC IS through developing requirements and integrating them into patterns. We further show that GRC IS are not suitable to solely fulfill each regulation without an adequate organizational integration.

Limitations of this research include the fact that laws, regulations, and standards were selected from German perspective. We further used an IS perspective on laws, guidelines, regulations, and standards. This could be enhanced with various other regulations from other fields, which might lead to new patterns which should also be taken into account. In order to reflect the patterns, we concentrated on evaluating one software portfolio. Evaluating more vendors might derive further interesting insights into the usability of the patterns. Nevertheless, the pure functionality of software modules does not guarantee proper compliance work within organizations. The patterns might be integrated with additional research on workarounds where employees bypass the established controls within the systems (Ignatiadis/Nandhakumar 2009).

4.6 Conclusion

In this article, we reveal a solution to bridge the gap between complex control requirements and information systems, which support meeting these requirements. We showed the variety of differing requirements and the complex task of understanding how specific applications meet certain requirements. Hence, we developed a framework to classify control requirements and derived 35 control patterns. Here we introduced two control patterns and demonstrated the benefits of using such patterns in synthesizing the variety of regulations and determining the potentials of GRC IS. Although our research is still in progress, our pattern-based approach already supports evaluating GRC IS for their potential to fulfill specific control requirements.

5 Understanding the Role of Information Technology for Organizational Control Design: Risk Control as New Control Mechanism

Title	Understanding the Role of Information Technology for Organizational Control Design: Risk Control as New Control Mechanism[6]
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Publication	International Federation for Information Processing (IFIP) WG 8.6 International Working Conference 2011
Individual contribution	The author of this thesis participated in the study design, data collection, analysis and interpretation as well as in the conceptual development. He further significantly contributed to the creation of the manuscript.

Table 11: Bibliographic Details for Publication P2.

Abstract. Organizational control is one of the fundamental functions of management. Although controls come along with performance constraints, organizations rely on control mechanisms to direct attention, motivate, and encourage organizational members to act according to organizational goals and objectives. Managers build their decision on control design on the degree of knowledge about the value creation process and the predictability of the outcome. In this paper, we enhance a popular theoretical framework for organizational control design by enclosing IT-enabled controls. We explore the framework empirically in a multiple case study on Governance, Risk management, and Compliance information systems (GRC IS), a popular new trend in organizational control design. Our findings provide evidence that IT-enabled controls enable a new control mechanism, risk control, for situations with perfect knowledge about the transformation process and high ability to measure output. As research implication, we recommend an extension of organizational control theory to incorporate the effects of information technology on control design. As practical implication, we provide decision support for the selection of GRC controls, depending on situational factors and the expected value proposition. In sum, this research enhances the body of knowledge on organizational control design with a risk-based perspective.

5.1 Introduction

Organizational control refers to management mechanisms to direct attention, motivate, and encourage organizational members to act according to organizational goals and objectives (Cardinal et al. 2004; Eisenhardt 1985; Lange 2008; Ouchi 1979; Tannenbaum 1962). The dominant model of organizational control design (Ouchi 1979) suggests certain control mechanisms, depending on the dimensions availability of outcome measures and knowledge of the transformation process. The framework allows managers to decide between input control (e.g. employee selection, training), behavior control (e.g., specific procedures for certain tasks), and output control (e.g. quality assurance). However, research criticizes the framework as too static (Cardinal et al. 2004), implementing wrong informal controls (Kirsch et al. 2002), and lacking performance and integration (Liu et al. 2010).

In this paper, we find that the existing organizational control mechanisms decision framework omits the rising uncertainty in organizations and the IT-enabled possibilities of automation and mass-data processing. This leads to the following research question: *How does Information Technology affect organizational control design?* To answer this question, we derive two hypotheses from IS and control literature to reveal the effects of IT on organizational control theory. We evaluate our hypotheses in practice through analyzing the current trend of IT-enabled organizational control design, called Governance, Risk management and Compliance (GRC). We argue that IT enables a new control mechanism for situations with perfect knowledge about the transformation process and high ability to measure output. We propose a new control mechanism, based on extensive knowledge about business processes and management's ability to gather dubious information early enough to permit time for countermeasures.

The remainder of this paper is organized as followed: The next section gives an overview over the current state of GRC IS. The following section reviews prior literature on organizational control. Subsequently, hypotheses are presented, followed by the description of the research methodology and an overview of the empirical results. The paper ends with a discussion of the results, implications for research and practice, and concluding remarks.

5.2 Current State of GRC IS

Looking at the current practical developments in control design, the Sarbanes–Oxley Act (SOX) in 2002 and its equivalent regulations in other nations (Wiesche et al. 2011a) caused the development of new, IT-enabled controls which can be found under the label of GRC IS, which today is certainly prominent in practice (Dittmar 2007; Parry 2004). For this research, we understand GRC as the integrated Governance, Risk, and Compliance perspective on organizational controls for management (Volonino et al. 2004). GRC IS provide a variety of controls ranging from procedures to monitor user access to information systems, to monitor process performance and provide enterprise-wide risk management. Besides controls, GRC also implements mechanisms to report on compliance and to manage existing business processes (Heiser 2010).

In the disciplines of audit and consulting, GRC is discussed as the automation and observation of controls (Doyle et al. 2007; Parry 2004). Research furthermore focuses on control

deficiencies (Ashbaugh-Skaife et al. 2008) and the effects on the financial outcome (Doyle et al. 2007). Research on GRC in governance literature includes the IT-business alignment and adequate and efficient coordination of tasks (Chan 2002). Compliance-related discussions rather focus on effective controls (Jensen 1993), cost reduction (Wagner/Dittmar 2006) and the integrity of information systems (Volonino et al. 2004). Literature on software-based control discusses effectiveness of measures (Nolan/McFarlan 2005). Software development companies selling GRC solutions focus on segregation of duty and process control (Heiser 2010). From an Information Systems perspective, research on GRC IS focuses on frameworks for the design of GRC IS (Racz et al. 2010; Beneish et al. 2008).

5.3 Theoretical Foundation

Before elaborating on control mechanisms and situational conditions, it is helpful to recapitulate organizational control theory. Following Tannenbaum's understanding of organizational control as interpersonal influence relations within organizations, organizations are arrangements of individual human interactions (Tannenbaum 1962). Control enables idiosyncratic behavior and compliance with the strategic plan and is therefore fundamental for any organization. For a broad summary of the various understandings of organizational control refer to Lange (2008) and Walsh et al. (2006). Although there has been criticism (Eisenhardt 1985; Nilakant/Rao 1994), Ouchi's organizational control framework (1979) is still the most prominent in current research (Nixon/Burns 2005) and will be introduced in the following.

Different Control Mechanisms

To control relations within organizations, several control mechanisms exist (Figure 8). All control mechanisms are based on two underlying control strategies (Lange 2008). The first, formal control strategy forces coercion and manipulates rewards and sanctions. This control strategy requires explicit, formal rules, procedures, and policies to both monitor and reward organizational performance. This requires the continuous collection and aggregation of information. The second, informal control strategy aims at minimizing the divergence of personal and company goals. To establish an internal, value based control strategy, the principal has to define norms, values, and culture to ensure goal congruence with the agent. Using e.g. careful recruitment and company-wide beliefs, and norms, the principal can align the agent's behavior to suit the organization's goal. The following four control mechanisms are implementations of the two control strategies (Lange 2008).

When implementing output control mechanisms, the principal monitors the agent's achievements at the end of the given tasks. The monitoring of the output of the value creation process implements the formal control strategy through analyzing the output of the performed tasks. Implementing output control requires a clear understanding of the results of the value creation process and the ability to evaluate the outcome (Das/Teng 2001; Ouchi 1979).

Behavior control implements control mechanisms that help the principal to evaluate the agent's behavior. It implements the formal control strategy through evaluating the tasks that are performed by the employee on appropriateness and alignment with the overall strategy.

Behavior control requires knowledge of the transformation process and understanding of the involved resources (Das/Teng 2001; Ouchi 1979).

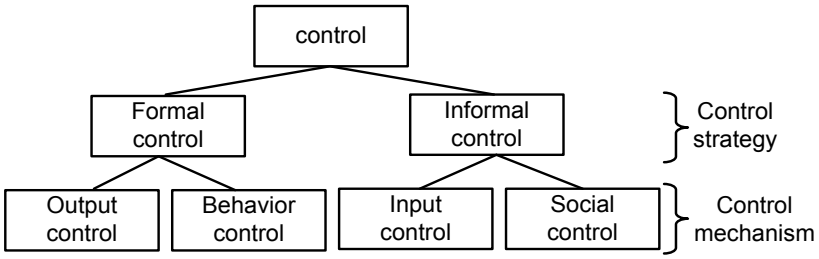

Figure 8: Control Typology.
Source: Own research.

Input control refers to the selection of appropriate agents who reveal goal congruence with the principal. Input control is a way to implement the strategy of socially aligning goals through selecting good employees who share goals that suit the organizational strategy. Implementing input control requires the ability to measure the agent's alignment with the principal's goals and furthermore the existence of agents who have the required characteristics (Ouchi 1979).

Social control refers to the development of shared beliefs, values and norms through guidelines and top management commitment. Implementing social control requires the ability to influence the agent's alignment with the principal's goals through guidelines and code of conducts (Ouchi 1979). For further examples for control mechanisms refer to Kirsch (1997) and Lange (2008).

In the following section we will introduce factors, influencing the decision for either control mechanisms. For now, we assert that behavior control is effective but output control the more efficient choice (Ouchi 1979). Management should commonly prefer behavior control to output control due to the ability to implement the right countermeasures before the end of the value creation process. Input control requires the lowest operational costs and should be chosen if the turnover within the organization is low (Ouchi 1979). Due to phenomena like the ongoing war for talent (Chambers et al. 1998) it might sometimes not be possible to either design effective input controls or find the right candidates.

Decision Model for Control Mechanisms

To decide which control mechanism suits the current organizational decision situation, the underlying information characteristics of the agency situation are important (Ouchi 1979). Depending on the characteristics of the situation, the principal can decide which control mechanism to use. Literature suggests that the ability to design certain controls depends on the principal's knowledge of the transformation process and principal's ability to measure the result of the value creation process early or at a later stage of the process (Figure 9).

The dimension knowledge of the transformation process refers to the principal's knowledge how the value creation tasks have to be performed by the agent (Ouchi 1979). If the principal exactly knows which tasks the agent has to accomplish, the knowledge of the transformation process is high. When the principal does not know, which factors influence the value creation

and therefore the necessary tasks the agent has to perform, the knowledge of the transformation process is low.

The dimension ability to measure refers to the principal's ability to determine the result of a certain task. While literature agrees on knowledge of the transformation process, the second dimension is discussed controversially: It is argued that the suggested dimension output lacks the integration of uncertainty and controllability as fundamental factors influencing the decision (Eisenhardt 1985; Nilakant/Rao 1994). Especially modern, complex organizations struggle with uncertainty about the outcome of the value creation process (Weick/Sutcliffe 2007). Decisions are based on uncertain information, e.g. forecasts or assumptions of employees. Complexity, interdependencies and quick changes in market and other surrounding areas lead to non-predictability of the process outcome and its market success.

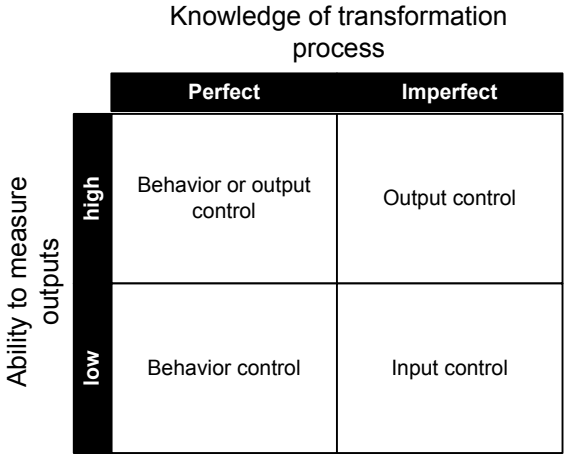

Figure 9: Organizational Control Framework.
Source: (Ouchi 1979).

The author argues that the developed dimensions provide decision support for specific managerial situations (Ouchi 1979). Although this is true for three quadrants of the matrix (Figure 9), the framework does not provide decision support for situations with high ability to measure output and perfect knowledge of the transformation process, e.g. the suggested "Apollo program". Although the author suggests that in this situation, "the lower cost alternative will be preferred" (Ouchi 1979), the framework lacks decision support for the situation with high ability to measure output and perfect knowledge of the transformation process:

> *"We can completely specify each step of the transformation process which must occur in order for a manned capsule to get to the surface of the moon and back to earth, thus giving us the possibility of behavior control. However, we also have an unambiguous measure of output: either the capsule gets there and back, or it doesn't. Thus we have a choice of either behavior control or of output control." (Ouchi 1979, 844)*

5.4 Effects of IT in Organizational Control

Since GRC IS, as the current trend in organizational control design, focuses on the integration of IT, we will discuss the effects of IT on organizational control design in the following.

IT-enabled control mediates direct supervision of the agent through electronic surveillance and therefore adds to management's knowledge on the value creation process. With the evolving of ERP systems in companies, a new form of control emerged: the panoptic control. The panoptic control refers to what Bentham suggested for prison design in the early nineteenth century (Foucault 1977). The prison is built with a central tower that enables guards to see all prisoners from one position. This type of visibility creates an indirect situation of ubiquitous inspection and surveillance (Clegg 1998). Due to its complexity and the required high effort of manual monitoring, this concept could not be transferred on organizational control design. However, the development of integrated IS such as ERP systems enables such panoptic controls (Quattrone/Hopper 2005). Since IT is integrated in almost every employee's task, continuous monitoring like within panoptic control becomes feasible for organizational control design. A study at an Asian hospital confirms that implementing ERP software enables panoptic control (Sia et al. 2002). Similarly to the panoptic prison, all business processes are automatically monitored, gaining management access to all process steps at any time. The authors observe that panoptic control was automatically added as an additional layer on top of existing controls. Introducing ERP systems enables management to take a closer look at all IT-related behavior, performed by their employees. Hence, IT-enabled control adds to management's knowledge of the transformation process.

There has been extant research on the management of organizational processes. Starting with business process reengineering (BPR) as the fundamental redesign and radical new development of the whole organization or the core processes (Hammer/Champy 1993), process management evolved to a less radical and more focused management of organizational processes (Davenport 1993). Literature finds that one of the major reasons for process management is the documentation and visualization of existing processes (Gunge 2000). Introducing IT-enabled control extends this documentation perspective for organizational controls. With the combination of the knowledge on the necessary value creation tasks and IT-enabled control, management is able to closely monitor and control the organizational value creation process. Hence, IT enables the visibility of company processes and creates transparency among procedures and tasks. This leads to the following hypothesis, which adds to organizational control theory:

Hypothesis 1: The adoption of IT increases the knowledge of the transformation process in organizational control situations.

IT-enabled automation allows the processing of mass data. Using IT enables the principal to gather and evaluating high amounts of data efficiently (Orlikowski 1991). Focus can be laid on either value creation related tasks or not value creation related behavior. Since management is able to evaluate not business process related behavior, non-compliant behavior can be recognized earlier (Fisher 2007). The automatic and intelligent pre-selection through thresholds and alerts helps management gather dubious information early enough to permit time for countermeasures. Before the introduction of IT-enabled controls it was not efficient to react on every vague, uncertain possible threat: organizational decision makers focused on precise information (Ansoff 1975). IT-enabled transparency within the organization allows the collection of specific information with reasonable effort. With the introduction of mass

data processing and automation in control design, management can explore dubious, but vague information at an early stage and therefore develop better planned countermeasures.

IT-enabled data processing enables realtime and background data processing. Management can monitor their employees through automated IS which run in the background of the employee's working station. Hence, IT-enabled control does not reduce organizational performance, gives management easy access to vague failure data, and allows the implementation of early warnings (Ansoff 1975; Weick/Sutcliffe 2007). Therefore, using IT to support organizational control mechanisms increases the amount of data that can be processed. Accordingly, the following hypothesis is proposed:

> *Hypothesis 2: Using IT to support organizational control mechanisms increases management's ability to measure output.*

In sum, the reviewed literature suggests that the impact of IT on organizational control design affects especially situations with high ability to measure output and perfect knowledge of the transformation process. IT allows new controls through its ability to create transparency and process mass data. In the following, we will provide empirical evidence, revealing the need to extend the existing organizational control decision framework (Figure 9).

5.5 Research Methodology

For scrutinizing the theoretical foundation of IT-enabled controls, a multiple case study was chosen (Yin 2009). This approach seemed appropriate to understand how GRC IS influences control design and its impacts on control efficiency. We conducted qualitative data analysis (Strauss/Corbin 1998) on 14 expert interviews.

We derived hypotheses from literature before analyzing the case data, not to imitate quantitative research, but to test these hypotheses from various perspectives on the topic of GRC. This approach allows theory building (sampling logic) and model development (generalization) (Yin 2009). To develop the model we built on existing research on organizational control and derived additional influencing factors.

Since this case builds upon existing theory, the focus of selecting comparison groups for theory building was on maximizing diversity (Glaser/Strauss 2001). Maximizing diversity increases the possibility of finding different and varying data belonging to one sample. The differences support category building and summing up the data.

Sampling and Data Collection

To achieve highest diversity, a broad view on GRC was chosen, including all perspectives that relate to IT-enabled controls within organizations (Table 12). The professions and disciplines relevant for this research included audit, consulting, governance, compliance, risk management, IT, and users in terms of GRC IS.

Perspective	Expert ID	Language	Length	Background	Experience
Audit	Auditor 1	German	1 h 04 min	Business	8 years
Audit	Auditor 2	German	1 h 04 min	Accounting	4 years
Consulting	Consultant 1	English	1 h 25 min	Business	10 years
Consulting	Consultant 2	German	0 h 59 min	Audit	23 years
Governance	Governance expert 1	English	1 h 02 min	Audit	16 years
Governance	Governance expert 2	English	1 h 15 min	Compliance	10 years
Usage	Company expert 1	German	0 h 51 min	Computer Science	6 years
Usage	Company expert 2	German	1 h 13 min	Computer Science	12 years
Compliance	Compliance expert 1	English	1 h 07 min	Finance	16 years
Compliance	Compliance expert 2	German	1 h 49 min	Finance	22 years
Software	IT professional 1	German	1 h 22 min	Accounting	17 years
Software	IT professional 2	German	1 h 59 min	Computer Science	11 years
Risk	Risk manager 1	German	1 h 04 min	IS	14 years
Risk	Risk manager 2	English	1 h 02 min	Risk Management	3 years

Table 12: Perspectives on GRC Controls and Interviewees.
Source: Own research.

Since the different perspectives on GRC provide different focal points, we interviewed two experts from each perspective using convenience sampling. We met experts on GRC workshops in Germany and used professional discussion groups and blogs to identify potential respondents. All experts had between 3 and 23 years of experience in their profession; the average experience was more than 12 years. Although having different backgrounds, we grouped the expert's perspective according to their current job description (Table 12). We conducted the interviews using guidelines with semi-structured questions, including questions about GRC systems as well as questions regarding the developed IT-enabled controls. We tailored the interview guidelines to the hypotheses on the impact of IT control design. The interviews were open-ended phone interviews, the interview with compliance expert 2 was held face-to-face. We conducted nine interviews in German. The interviews with the governance and risk experts, compliance expert 1, and consultant 1 were held in English.

Data Analysis Procedure

We tape-recorded, transcribed, and anonymized all interviews. We integrated the transcripts from the 14 interviews into a hermeneutic unit comprising 67,761 words and 58 pages of text using the software ATLAS.ti. The coding procedure was conducted following Glaser and Strauss' (2001) guidelines. First, the first author read and coded the interview transcripts line by line, using phrases from the transcripts that describe the phenomenon (open coding). Similar he tagged phenomena with the same phrase. This resulted in a list of 129 codings and 563 phrases. Following the coding by the first author, the second author likewise coded the transcripts independently. We discussed and agreed on the differing codes. In the next iteration (axial coding), we grouped the developed phrases to concepts. We put the derived concepts in coherence and then aggregated them regarding their effect on control.

5.6 Results

Controls in the context of GRC range from segregation of duty to policies and code of conduct. Prominent controls include behavior control mechanisms, referred to as process control. This incorporates the automation of internal control management for SOX-compliance as well as similar requirements and integration with risk management solutions. GRC incorporates further behavior control to monitor certain organizational risks with the integration of various participants and stakeholders. Experts gave several examples ranging from the energy sector to risk management solutions for IT companies, providing automated testing of controls. Further, ethical guidelines and codes of conduct exist and provide examples of social control mechanisms. In terms of output control, existing quality assurance solutions were integrated in the organization's GRC portfolio. Such controls are often implemented too late in the value creation process and therefore meet only regulatory compliance aspects. In the context of ERP solutions, the most prominent control is segregation of duty, called access control. Access control includes automation of end-to-end access and authorization management with strong integration within the access control solutions. Such controls can be implemented early in the organizational value creation process and provide first insights on fraud or other undesirable behavior. Controls like access control are enabled by IT, making it possible to process masses of data in real time.

> *"With GRC concepts, companies can implement controls which […] support the early processing of information and providing information on possible company risks which might be blurred, but if ignored might result in serious to the organization." (Governance expert 1)*

The Role of IT in Increasing Knowledge of the Transformation Process

An aspect which persistently appeared in the study was the ability to create transparency through ubiquitous controls, which run in background of existing IS. The different GRC perspectives reveal certain reasons for creating transparency. From an audit and compliance perspective, transparency accelerates audits and therefore reduces costs. Practitioners actually operating GRC solutions use transparency for decision support and compliance reasons. From the IT-perspective, the main reason was for decision support. The functional units report on their situation and management uses this information as basis for their decisions. Therefore, this information needs to be reliable. Before the development of IT-enabled controls, management had to rely on their input and social control mechanisms, not guaranteeing reliable results. With the development of IT-enabled controls, management is able to verify the given information and to equally compare different reports. Consistent with hypothesis 1, interviewees argued that with IT-enabled controls, management can enhance knowledge of the transformation process:

> *"Management had to rely [on] reports and estimations with different quality and hierarchical level from various functions across the organization. At the end of the day, they had to decide […] based on this information. The new approach enables management to have transparency through reporting structures and work tasks. I am convinced that it creates transparency and better knowledge of the employee's tasks." (IT professional 2)*

From management perspective, this issue becomes even clearer. Before the implementation of IT-enabled control, management had to rely on their employee's engagement. Organizations were not able to know about all tasks performed on each hierarchical level. Therefore, they had to trust their employees and could only monitor the results at a reasonable level of costs. Automated, IT-enabled control mechanisms are able to process high amounts of data and provide information in real time. This enables management to get information on certain, maybe critical processes with reasonable efforts and supports hypothesis 1.

> *"As a manager, you should know how your company works. […] He has to know which tasks have to be performed to create a certain value. The implementation of GRC systems helps him to gain this knowledge context-specific […] and gain information [to] found his decisions on." (Company expert 2)*

From governance perspective, governmental regulations and the eager to found decisions on good data motivate management to define certain rules and procedures to provide this information. Management requests real time information on the risks, the organization is currently facing. This knowledge is gained from risk management at the operational level of the organization. Therefore the organization needs transparency from a top-down perspective. Especially for performance based controls it is important to develop integrated controls with similar measures.

Extending the process oriented value creation perspective, GRC enables optimization of the companies value creation tasks. Consultant 1, an interviewee with more than 20 years of experience in the field of IT consulting, argues that GRC is the natural successor of process management. Historically, IS design moved from mainframe to functional computing. Following that, the integrated process perspective, BPR and business process management (BPM) arose, enabling more control for management. The last years revealed serious shortcomings in this process oriented ERP based solution. SOX and other regulatory guidelines demanded formal aspects, sometimes questioning the usefulness of compliance rules and organizational benefit. The expert argues that GRC enables a new focus on business process optimization from a control perspective. The new trend of GRC controls helps companies meet this new type of requirements and increases management's knowledge of their value creation processes. Other experts confirm this argument, claiming that process control increase transparency and therefore increase the knowledge of the transformation process.

> *"Beyond governance and legal issues, [with the rise of GRC] there is a trend towards process optimization. It enables companies to directly optimize their portfolio and their internal structures." (Consultant 2)*

> *"Process control applications optimize […] business operations and help ensure compliance and mitigate risk by centrally monitoring key controls for business processes and cross-enterprise IT systems." (Risk expert 2)*

Overall, the study illustrates the hypothesis that IT-enabled controls increase the knowledge of the transformation process. There are various reasons for creating transparency, but they all

lead to the aim that the principal enhances his knowledge on the tasks performed by the agent and therefore the knowledge on the transformation process.

The Role of IT in Enhancing Management's Ability to Measure Output

Regarding hypothesis 2, the study results revealed clear evidence that IT-enabled controls increase the ability to integrate weak signals. In organizations, there are often enough warnings that, if correctly interpreted, could prevent certain negative outcomes from happening. To understand why these warnings are often ignored, the existing control mechanisms give an understanding of this shortcoming (Figure 10). Input and social controls do not provide reliability on certain happenings. Output control provides this reliability, but too late to implement correcting measures on this specific output to prevent the negative outcome. In a setting of outcome certainty, where all outcome-influencing factors are known and determinable, process control enables reliability on the desired outcome.

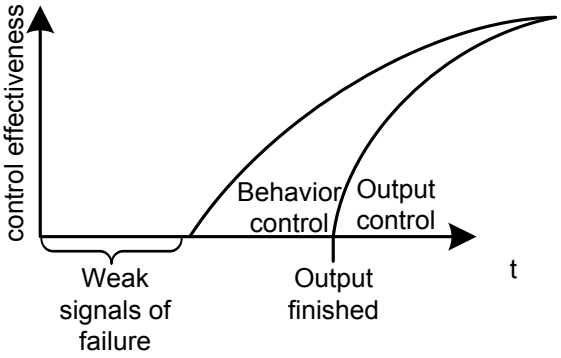

Figure 10: Temporal Perspective on Control Mechanisms.
Source: Own research.

However, today's organizational settings become more complex and intricate and it is often impossible to monitor all influencing factors and control the necessary tasks. Although there has always been early information on possible negative outcomes, there was hardly any possibility to examine all indicators and derive preventing measures. The implementation of IT-based controls enables management to continuously monitor and rate weak signals that possibly lead to negative outcomes. Automation helps both, mass data processing and reduction of reaction time.

> *"[…], whistle blower mechanism can be automated, in addition to improving the amount of data processed within GRC solutions." (Compliance expert 1)*

> *„So, companies would surely not document [transparency] with such detail and rigor, if there were no governmental regulations, forcing them to provide evidence." (Auditor 1)*

This indication for the second hypothesis is further supported by arguments from the interviewees. Although there are various control mechanisms, the interviewees implicitly ranked their examples according to certain criteria. The experts claimed that control quality depends on control effectiveness. Deepening this argumentation, the study reveals that control effectiveness depends on two factors: point in time and certainty. Ideal controls would be applied early in the organizations value creation process and the effects of the controls would

be entirely clear. Since there are no such controls, the experts stated that the tradeoff is either late usage or high uncertainty. In some cases (by the experts referred to as process control), the certainty is relatively high and it can be done early in the value creation process. As soon as there is higher uncertainty, the controls can either just be at the final product or service (quality management) or early with high effort and some uncertainty on the effects of the situation and possible controls (e.g. access control).

> *„You generally develop various controls. […] Firstly, access controls (technically, reporting tools) which give an overview on the situation. Secondly, you develop guidelines for your employees and monitor that. Thirdly, you have to measure your results." (Consultant 2)*

5.7 Discussion

This study was motivated by the need to improve the understanding of the value proposition of IT-enabled control on organizational control design. We used the prominent example of GRC IS to show that IT-enabled control reveals new perspectives on organizational control design.

Based on the study results, we propose a new control mechanism to support an early anticipation of potential future happenings that endanger the outcome of the value creation process. It enables fast reactions to early warnings that threaten organizational success, the reduction of trust within control relationships and in combination with legal regulations improves the outcome certainty of the value chain.

IT enables Organizational Controls

The results confirm the assumption that in today's heterogeneous organizational environment a combination of various control mechanisms is necessary (Orlikowski 1991; Meiselman 2007). Especially auditors and consultants confirm that there are different GRC IS application contexts. These different goals imply different expectations and results. Management can decide between various controls, depending on the underlying organizational situation (Liu et al. 2010). The results furthermore reveal that management increasingly relies on IT-enabled controls.

As presumed above, the found IT-enabled controls do not fit in the described classifications in literature (Table 13). As behavior and output control can only implemented within the value creation process, IT-enabled controls are implemented without clear connection to these pure functional process but rather with an object oriented perspective. Since input and social control do focus on the organizational unit but are informal, the found IT-enabled controls cannot be classified within the existing frameworks.

control mechanism	type	organizational integration	strengths	weaknesses	necessary conditions
input control	in-formal	organizational unit	- low supervision costs - reliability due to goal congruence	- high level of trust necessary - highly qualified agents necessary	- availability of qualified agents - low turnover
social control	in-formal	organizational unit	- low setup costs - no supervision costs - suits unknown situations	- high level of trust necessary - hard to evaluate - unreliable effects	- ongoing trainings necessary - continuity - low turnover
output control	formal	functional process	- low costs of supervision - unambiguousness - clear scale of measurement	- requires full know-ledge on process output - point in time of measurement might be too late	- concrete definition of value creation - ability to measure output
behavior control	formal	functional process	- possibility to change direction during the process - monitor agent's task performance	- high supervision costs - reduces task performance - no clear measurement scale	- transformation process must be known - behavior needs to be measureable
risk control (IT-eabled)	formal	organizational unit	- early warning of success threats - interpreting weak signals	- high degree of interpretation - mass of information - high costs	- business intelligence - mass data processing

Table 13: Classification of Control Types with New Type Risk Controls.
Source: Own research.

Introducing an IT-enabled Control Mechanism: Risk Control

The results reveal that IT enables new and fundamental controls within organizational control design. Since these controls combine characteristics that cannot be found in literature, we propose a new control mechanism called risk control. The controls introduced by the GRC experts, e.g. information systems for access control and risk management, are characterized by their focus on organizational unit rather than functional processes and allow implementing early warning systems to interpret ex-ante signal before incidents occur. Due to integration of IT, risk controls can process a high amount of data from various sources within the organization.

Risk control refers to the principal's early understanding of the uncertain, surprising, or non-assessable future happenings that endanger the outcome of the value creation process. As seen in the current approaches in practice, organizations use risk management to gain transparency, interpret early warnings and hence provide decision support. Using IT-enabled risk management, principals can control situations with high knowledge of the transformation process and high ability to measure output.

Risk control implies the tedious collection of high amounts of data and the careful analysis of this data with respect to signals of organizational failure. It is useful in vital and complex environments. It enables organizations to react early and possibly prevent major negative

consequences at an early stage of the process (Ansoff 1975). It turns organizational control from reactive to proactive actions. Risk control allows performance-steadiness through ubiquitous monitoring of agents. It is based on effective risk management and IT support. Risk management allows the prediction of strategic surprises and threats to value creation processes (Ansoff 1975). This is possible through the integration of IT in the organizational control design. IT enables data collection across various functions at a reasonable amount of time and costs. To create resilience and prevent negative surprises, risk control provides early help in uncertain environments. The study reveals several control mechanisms that can be applied in situations with low outcome certainty and high knowledge of the transformation process. Access control, information systems for risk management or whistle blowing are examples for risk control mechanisms.

Although risk controls create transparency about organizational units and allow ex-ante management of possible threats, they have the disadvantage of being cost intensive and interpretation dependent.

Placing Risk Control in the Organizational Control Framework

Existing literature on organizational controls does not provide decision support on control design for high knowledge of the transformation process and high ability to measure output (Ouchi 1979). The author uses additional indicators (costs) to suggest the most suitable control mechanism. The suggested control mechanism risk control uses IT to enable early information retrieval on a wide data basis but needs both, high ability to measure outputs and perfect knowledge of the transformation process (Figure 11). Within the suggested decision framework (Ouchi 1979), the suggested control fits in the upper left corner with perfect knowledge of the transformation process and high ability to measure output. Its characteristics of using automation and mass data processing allow handling high amounts of data at an early point in time. It is further characterized by processing not only process related data, as it was characteristic for formal controls before, but allows integrating data relating to specific organizational units. Hence, the suggested risk control is the most suitable control mechanism for organizational situations with perfect knowledge of the transformation process and high ability to measure output.

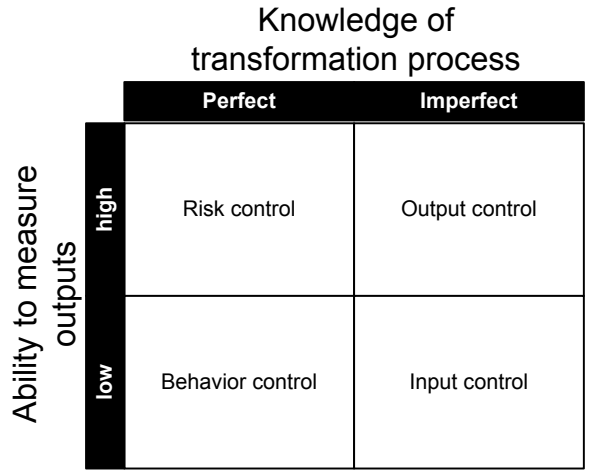

Figure 11: Adopted Organizational Control Framework.
Source: (Adopted from Ouchi 1979)

5.8 Implications and Limitations

This research contributes to organizational control theory by integrating the effect of IT-enabled controls on organizational control design. We explain the benefits from automation and transparency through implementing IT-enabled controls within GRC IS. We propose risk control as a new control mechanism, incorporating weak signals within organizational control. Based on the assumption of higher goal incongruence and performance ambiguity, we argue that risk control mechanisms help to identify weak signals and prevent future threats to the organization. The adopted organizational control framework gives additional decision support for designing organizational controls through being the optimal alternative for situations with high ability to measure output and perfect knowledge of the transformation process. Within GRC IS, risk control is frequently implemented, e.g. through information systems for access control and risk management.

However, there are several limitations to take into account. First, it should be conceded that this study is based on only 14 interviews. Although it's exploratory nature and the aim of maximizing diversity allows certain broadness at the expense of depth, selecting only two experts from each GRC perspective could bias the findings through their personal opinion or specific experience. Although we used a broad sample from various organizations, it might be possible that the suggested concept of risk control is not suitable in all organizational settings. Especially in settings of emerging organizations or loose structures (Cardinal et al. 2004), risk controls have to be explored. Furthermore, we might have overlooked additional GRC stakeholders and hence additional value propositions.

In addition, although being the most obvious, organizational control theory might not be the appropriate theoretical lens for researching GRC IS. As it is more output oriented, goal-setting theory might also be an alternative (Locke/Latham 2002). Instead of using theories from management and organizational science, we could also have used theories from computer science or IS which can be extended to accounting information systems as well. For example, the theory of technology dominance (Arnold/Sutton 1998) might also help in assessing the impact of IT on control especially in terms of decision support. We also focused

on exploiting existing control potentials. We focused on GRC solutions for control automation and coherence and hence lack a self-contained perspective on exploration.

5.9 Conclusion

In this paper, we ask the research question how IT changes organizational control design. We examined the prominent control trend GRC to answer the research question. We provided evidence that IT-enabled controls within GRC IS change organizational control design. We extend organizational control theory by proposing a new control mechanism called risk control. Risk control enables organizations to prevent possible major negative consequences at an early stage of the value creation process. It allows reduction in variance and performance-steadiness through ubiquitous monitoring of agents. Risk control allows managers to react early and possibly prevent major negative consequences at an early stage of the process. It helps managers to interpret weak signals but requires a high degree of interpretation and the ability to deal with high amounts of data.

6 Exploring the Contribution of Information Technology to Governance, Risk management, and Compliance (GRC) Initiatives

Title	Exploring the Contribution of Information Technology to Governance, Risk management, and Compliance (GRC) Initiatives
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Publication	19th European Conference on Information Systems (ECIS 2011)
Individual contribution	The author of this thesis participated in the study design, data collection, analysis and interpretation as well as in the conceptual development. He further significantly contributed to the creation of the manuscript.

Table 14: Bibliographic Details for Publication P3.

Abstract. Information technology (IT) has a tremendous impact on the discipline of accounting by introducing new ways of retrieving and processing information about performance deviations and control effectiveness. This paper explores the role of IT for managing organizational controls by analyzing value drivers for particular accounting information systems that commonly run under the label of Governance, Risk Management, and Compliance (GRC IS). We apply a grounded theory approach to structure the value drivers of GRC IS into a research framework. In order to understand the impact of IT, we relate the GRC IS value drivers to control theories. Practical implications include understanding GRC IS benefits beyond compliance and providing clear strategic reasoning for GRC IS depending on the individual company's situation. Research implications include the fact that integrating IT into the context of accounting leaves several unsolved yet promising issues in theory which future research might address. This paper is the first to use the lens of organizational control theories on Governance, Risk Management, and Compliance information systems and establishes a potentially fruitful research agenda for GRC IS as a highly relevant topic for information systems research.

6.1 Introduction

Information technology (IT) has a tremendous impact on the discipline of accounting. IT is seen as the catalyzing element of transforming the accounting discipline from pure information provision to a knowledge services profession (Sutton 2010). Especially the implementation of management controls has been changed fundamentally by IT. On the one hand, information systems such as Enterprise Resource Planning systems separate financial from non-financial data and therefore enable better financial accounting. On the other hand, they provide new potential for management control as "data become accurate, shareable, and available to many different parties but does hardly create the panoptic dream of visibility and action at a distance" (Dechow/Mouritsen 2005).

Nonetheless, management accounting literature lacks an integrated understanding of the impact of IT (Dechow et al. 2007; Woods 2009). Although studies report on the relevance and potential of IT (Chapman/Kihn 2009), there has hardly been any research on the impact of IT on accounting (Granlund 2009). A literature review by Efendi et al. (2006) within the top accounting journals provides evidence that confirms this statement. However, important claims in this regard are emerging from the practitioner literature. Practitioners argue that IT can help cope with accounting complexity (Fisher 2007). Organizations can use IT for cost minimization of accounting (Dittmar 2007), an integrated control overview (Chan 2002), control effectiveness (Ashbaugh-Skaife et al. 2008), and decision support (Beneish et al. 2008).

With the aim of understanding the impact of IT on accounting, this research focuses on empirical findings that support the understanding of information systems for Governance, Risk Management, and Compliance (GRC IS), which belong to the category of accounting systems, to collect and store data for processing into information used by decision makers (Hagerty/Kraus 2009). In this paper, we define GRC as the integrated governance, risk, and compliance perspective on management controls for accounting (Ashbaugh-Skaife et al. 2008). By controls, we understand interpersonal influence relations within organizations, enabling idiosyncratic behavior and compliance with the strategic plan and is therefore fundamental for any organization (Merchant/Otley 2006).

Since the purpose of this paper is to appraise the impact of IT on accounting by understanding value drivers of accounting information systems such as GRC IS, our research question is: *What are value drivers of GRC IS and how can they be structured?* We apply a grounded theory approach to identify and structure value drivers of GRC IS. With the intent to fully explain and predict the impact of IT, we develop a theoretical framework and relate our empirical findings to extant theories from management and organization science.

In the next section, we summarize practical and academic perspectives on accounting information systems. We then proceed by reporting on a grounded theory approach to reveal the value driver of GRC IS. In section 3, we give an overview over different perspectives on GRC IS in practice and what their value drivers are. In section 5, we discuss our findings, develop an integrated framework, and link it to existing theory. As a next step, we outline implications for research and practice. In section 6, conclusions are drawn.

6.2 Background

Academic Perspective on Accounting Information Systems

From academic point of view, researchers discuss the integration of accounting and IT in case studies (e.g. Butler/McGovern 2009), solutions for IT departments (Bonazzi et al. 2010) and regulations (Volonino et al. 2004). Although there is extant research on the business value of IT from accounting perspective, literature rarely discusses the value driver of IT on management control (Chapman/Kihn 2009). To the best of the authors' knowledge, academic literature lacks the integration of theory concerning both IT and management accounting (Efendi et al. 2006; Sutton 2010), with the notable exception of Woods (2009). Woods builds theory from case studies by revealing the "critical role played by good information systems as tools to support the control process itself" (Woods 2009, 18), but further pointing out that "there is still a lot of research to be done on risk management systems and the interface between risk management, internal control and governance" (Woods 2009, 19).

Even though there is an extant body of knowledge on controls in accounting (Merchant/Otley 2006), there is hardly any theoretical research on IT value drivers on management control (Granlund 2009). Although literature criticizes failing internal control systems (ICS) (Jensen 1993) and demonstrates awareness of the impact of IT on accounting (Sutton 2010; Rom 2008), effects of IT on developing better controls have not been investigated yet. This is speculated to be due to the vicissitude of developments of IT and a lack of interest in both disciplines for the respective other (Dechow et al. 2007).

Current State of GRC IS in Practice

The Sarbanes-Oxley Act (SOX) in 2002 caused the development of new accounting information systems which can be found under the label of GRC IS, which today are certainly prominent in practice (Hagerty/Kraus 2009; Volonino et al. 2004). Although there have been efforts to formulate a standard definition (Racz et al. 2010), there is still no common understanding of GRC (Mitchell/Switzer 2009). Various concepts, models, and frameworks for GRC exist, whose structure depends on the author's perspective on this broad topic (Racz et al. 2010; Hagerty/Kraus 2009). Based on the different understandings of GRC, GRC IS differ in terms of results and impact. GRC IS provide a variety of control mechanisms ranging from segregation of duties and process monitoring to risk management (Teubner/Feller 2008; Wiesche et al. 2011b).

Practitioners report different underpinning strategic reasoning and subsequently different value drivers for introducing particular features of GRC IS: Auditors and consultants focus on control deficiencies and the effects on the financial outcome (Ashbaugh-Skaife et al. 2008). Governance experts include the IT-business alignment and adequate and efficient coordination of tasks (Chan 2002). Compliance experts concentrate on effective controls, cost reduction, and the integrity of IT (Ramakrishnan 2008). Software vendors focus on segregation of duty and process control (Hagerty/Kraus 2009). IT practitioners focus on frameworks for the design of GRC IS (Beneish et al. 2008).

6.3 Research Methodology

With the intent of scrutinizing the impact of IT on accounting, we conducted an exploratory study on GRC IS using the methodology of grounded theory as proposed by Glaser and Strauss (2001). According to this research methodology allows building theories of "process, sequence, and change pertaining to organizations, positions, and social interaction" (Glaser/Strauss 2001, 114). It is an inductive and theory building methodology, which ensures grounding the theory in empirical observations or data. This approach can be considered particularly appropriate, since there has been hardly any research on GRC IS as the integration of management controls and IT (Efendi et al. 2006).

Since this research builds upon practitioners' broad understanding of GRC IS value drivers, the focus of the selection of comparison groups for theory building was on maximizing diversity (Glaser/Strauss 2001). Maximizing diversity increases the possibility of finding different and varying data belonging to one sample. The differences support category building and summing up the data. This research shares GRC IS as a common unit of analysis, but uses different organizational settings as contexts. We conducted qualitative data analysis (Glaser/Strauss 2001) on 14 expert interviews.

Sampling and Data Collection

In order to achieve the highest diversity possible, we chose a broad view on GRC, including all perspectives that relate to IT-enabled controls within organizations (Table 15). The professions and disciplines relevant for this research included audit, consulting, governance, compliance, risk management, IT, and managers in terms of GRC IS (cf. Section 6.2 for further details).

Perspective	Expert ID	Language	Length	Background	Experience
Audit	Auditor 1	German	1 h 04 min	Business	8 years
Audit	Auditor 2	German	1 h 04 min	Accounting	4 years
Consulting	Consultant 1	English	1 h 25 min	Business	10 years
Consulting	Consultant 2	German	0 h 59 min	Audit	23 years
Governance	Governance expert 1	English	1 h 02 min	Audit	16 years
Governance	Governance expert 2	English	1 h 15 min	Compliance	10 years
Usage	Company expert 1	German	0 h 51 min	Computer Science	6 years
Usage	Company expert 2	German	1 h 13 min	Computer Science	12 years
Compliance	Compliance expert 1	English	1 h 07 min	Finance	16 years
Compliance	Compliance expert 2	German	1 h 49 min	Finance	22 years
Software	IT professional 1	German	1 h 22 min	Accounting	17 years
Software	IT professional 2	German	1 h 59 min	Computer Science	11 years
Risk	Risk manager 1	German	1 h 04 min	Information Systems	14 years
Risk	Risk manager 2	English	1 h 02 min	Risk Management	3 years

Table 15: Perspectives on GRC IS and Interviewees.
Source: Own research.

Since the different perspectives on GRC provide different focal points, we interviewed two experts from each perspective using convenience sampling. We met experts on GRC workshops in Germany and used professional discussion groups and blogs to identify potential respondents. All experts had between 3 and 23 years of experience in their profession; the average experience was more than 12 years. Although the experts all had different backgrounds, we grouped their perspectives according to their current job

description. We conducted the interviews using guidelines with semi-structured questions, including questions about the experts' GRC understanding, the integration of the three G, R & C silos, GRC systems, and potentials of GRC systems as well as questions regarding the developed influencing factors on GRC. We tailored the interview guidelines to understand the potential of GRC IS and continuously substantiated the questions using the material from former interviewees.

Data Analysis Procedure

We tape-recorded, transcribed, and anonymized all interviews. We integrated the transcripts from the 14 interviews into a hermeneutic unit, comprising 67,761 words and 58 pages of text using the software ATLAS.ti. The coding procedure was conducted following Glaser and Strauss' (2001) guidelines. Firstly, the first author read and coded the interview transcripts line-by-line, using phrases from the transcripts that describe the phenomenon (open coding), and tagging similar phenomena with the same phrase. Following that, the second author likewise coded the transcripts independently. This resulted in a list of 129 codings and 563 phrases. We discussed and agreed on the differing codes. Furthermore, we conducted a second open coding step to consolidate the established categories. We put the derived concepts in coherence and then aggregated them into value driver categories.

6.4 Results

A first look at the interview data revealed high diversity regarding the elements of GRC IS. The interviewees stated various understandings ranging from IT products to management philosophy. A detailed look at the background and the GRC perspective helped classify the elements depending on the underlying value drivers. We asked the interviewees to explain why s/he would implement GRC IS, what the underpinning goals and the impacts of the implementation were, how technology serves these goals, and who is involved in GRC IS concerning responsibility, accountability, consulting and being informed. As stated in section 0, we followed the fundamental analytical process by braking down the described phenomena. We compared them to others to reveal similarities and differences and started to conceptually label and develop the categories. In the next steps, we built and tested the relationships between the categories, finding that each category was related to an IT value driver (Table 16). We identified more statements relating to the developed categories and grouped them into an overall core category, the underlying motivation to introduce and operate GRC IS, which in the following is referred to as value driver. We derived the following four value drivers as unique to the GRC IS discussion since they require an integrated perspective of GRC and require the introduction of information systems. In the following, we will describe the discovered value drivers.

Selected phenomena (total 129)	Concept (total 9)	Category (total 4)
report control liability & effectiveness	Meet required regulations	Control performance
ensure that controls are in place and up-to-date		
automate processes to collect audit data		
find disconnected, fragmented information		
integrated, global segregation of duties	SOX compliance	
allows effective fraud detection		
recognize undesirable behaviour		
use IT to accelerate audits	Enhance control effectiveness	Control coherence
management can observe organizational units		
process high amounts of control data		
provide real-time information		
reduces manual oversights	Continuous monitoring of existing internal controls	
allows automated control testing		
avoid fragmentation	Comparability	
standardized workflows and reports for risks		
see whether certain countries or units are compliant		
build effective internal control system	Prevent future incidents ahead of time	Risk responsiveness
create organizational resilience		
recognize anomalies early	Avoid negative outcomes	
find early risks, blurry but indicator		
understand which loss indicators are right		
use positive incidents to drive innovation	See opportunities	
reduce reduction time for market trends		
use risk management to process abstract innovation		
use functional unit's reports to make decisions	Prepare decision support	Management resilience
provide more information for management		
increase reliability of internal controls		

Table 16: Selected Phenomena, Derived Concepts, and Corresponding Categories.
Source: Own research.

Control Performance

In all interviews, experts stated meeting regulations as value driver of GRC IS. SOX and other regulations require organizations to report on the reliability and effectiveness of internal controls. Especially in global, networked and complex organizations, it is impossible to meet the plethora of regulations without the support of IT. GRC IS support meeting these regulations through using manual and automated processes to collect and document relevant information. GRC IS help provide evidence to auditors that certain controls were implemented and are working properly. They contribute to the early recognition of certain risks and to the implementation of adequate mitigation strategies.

> *"Companies need to document that they have implemented monitoring and controls and prove to auditors that they are effective. Such requests are prominent in all regulations such as SOX and GRC systems help achieving these requests." (Auditor 1)*

Automated internal controls in the context of GRC range from segregation of duty to policies and code of conduct. In the context of Enterprise Resource Planning (ERP) systems, the most prominent control is segregation of duty, called access control. Access control is a control mechanism, which is characterized by high process knowledge and tasks complexity. It includes automation of end-to-end access and authorization management with strong integration within the access control solutions. Such controls can be implemented early in the organizational value creation process and provide first insights on fraud or other undesirable

behavior. Such controls can only be implemented with IT, enabling the processing of masses of data in real time and allow compliance with e.g. SOX:

> *"Without automation, GRC activities are disconnected and fragmented across the organization. The inefficient and manual processes leads to duplication of efforts, higher operational and manpower costs, loss of opportunities, revenue and competitive advantage. [.,,] The integration of backend ERP systems with GRC application[s] enables automated controls." (Governance expert 2)*

Control Coherence

An aspect, which persistently appeared in the study, was the ability to create transparency over internal controls, which are performed in the background of existing information systems. The different GRC perspectives reveal certain reasons for creating transparency. From an audit and compliance perspective, transparency accelerates audits and therefore reduces costs. Similarly, before the implementation of IT-enabled control, management had to rely on their employee's engagement. Organizations were not able to know about all tasks performed on each hierarchical level. Therefore, they had to trust their employees and could only monitor the results at a reasonable level of costs. Automated controls are able to process high amounts of data and provide information in real time. This allows satisfying management's need to get structured, real-time, and comparable information:

> *"It is important to ensure GRC convergence. The function of monitoring […] is very important throughout the organization. I have seen it a few times now and I can say you that the average company has […] different risk management functions. All risks seem different and similarities can easily be overlooked. So management doesn't have a good view of the whole company. They can't see the total risks." (Governance expert 1)*

Experts gave several examples ranging from the energy sector to risk management solutions for IT companies, providing automated testing of controls. A prominent example for controls, which provides transparency and contributes to comparability, is called process control. Process control serves as control for continuously monitoring existing internal controls. It further ensures a standardized workflow and reporting. Hence, process control spares cost-intensive manual oversight and provides a real time integrated perspective.

> *"To ensure e.g. access control performance, the systems have to be integrated with process controls. Such controls allow testing the effectiveness of internal controls." (Governance expert 2)*

Risk Responsiveness

The study results revealed clear evidence that automated internal controls within GRC IS increase the ability to build effective ICS, which prevent future incidents early in time. In organizations, there are often enough warnings, which, if correctly interpreted, could prevent certain negative outcomes from happening. The case of one interviewee's organization, Alpha, may serve as a good example to understand why these warnings often perish. Having several hundred thousand employees in more than 70 other countries, Alpha operates more than 100

different IS for procurement alone. Regarding the SOX-required segregation of duties, management is not able to oversee all these systems. Even when aggregating less than 100 standard rules and introducing automated access control monitoring, internal audit detected several ten thousand violations when going live. This illustrates the extensive effort, necessary to fulfill regulations, and reveals that implementing internal control today is not possible without support of IS. They ensure the processing of the high amounts of data. Alpha plans to further implement GRC functionality, providing Meta control for automated internal control monitoring which provides additional data for companywide risk management.

> *"With GRC concepts, companies can implement controls which [...] support the early processing of information and providing information on possible company risks which might be blurred, but if ignored might result in serious harm to the organization." (Governance expert 1)*

Today's organizational settings become more complex and intricate, and it is often impossible to monitor and control all contributing factors. Although there has always been early information on possible negative outcomes, there was hardly any possibility to examine all indicators and derive preventing measures. IT-enabled control allows management to monitor continuously and rate weak signals in anomalies that possibly lead to both, negative and positive outcomes. Management has to find countermeasures for negative incidents, but can use positive incidents to drive innovation. Automation supports this argument, as it enables mass data processing and reduces reaction time.

> *"Risk management is a way to process abstract innovation. It is based on data which is won e.g. through access control and which is aggregated for representation to management. " (Consultant 2)*

Management Resilience

Practitioners operating GRC solutions request decision support from the gathered GRC information. The functional units report on their situation and management use this information as basis for their decisions. Therefore, this information needs to be reliable. Before the development of solutions based on automated controls, management had to rely on informal control mechanisms like guidelines and codes of conduct, both not guaranteeing reliable results. With the development of GRC IS, management is able to verify the given information and to compare different reports.

> *"Management had to rely [on] reports and estimations with different quality and hierarchical level from various functions across the organization. At the end of the day, they had to decide [...] based on this information. The new approach [GRC IS] enables management to have transparency through reporting structures and tasks. I am convinced that it creates transparency and better knowledge of the employee's tasks." (IT professional 2)*

Building upon data from GRC IS, enough information for management has been aggregated and selected to provide management resilience. Using the data provided by GRC IS, management can chose countermeasures for mitigation or seize the chance of positive

variation to innovate and enhance organizational performance. Management can use the GRC IS to examine additional and more detailed information, if necessary for this specific decision.

> *"You ha[ve] a risk management officer and you ha[ve] risk intelligence, but judgment [is] not being applied. This is a big failure because risk was not given that attention that it has needed. When you are thinking about having effective governance, it includes the situation of risk. You cannot have effective governance and strategies if you do not understand risks. So management has to take risk into account." (Governance expert 2)*

6.5 Discussion

A Framework for GRC IS Value Drivers

The different examples and underlying perspectives on GRC IS reveal that practitioners differ in terms of their GRC IS value drivers. As an initial step, GRC initiatives (1) aim at fulfilling regulatory requirements through implementing risk management systems and effective controls. Initially, organizations can implement controls without standard software or specific GRC solutions. Spreadsheets and paper-based reporting fulfill fundamental requirements at low implementation costs. Having implemented such procedures, companies quickly demand (2) more effective, automated systems that allow monitoring control effectiveness and reduce audit costs. Therefore, systems that provide Meta controls are implemented. Such Meta controls monitor control effectiveness and provide internal audit with an overall picture of existing controls and their coherence. To understand the organizational situation, the gathered control data has to be interpreted (3). Interpreting the data helps identifying risks and potentials for the organization. Finally, the control results, especially violations (4), ensure management resilience. Automated control systems allow control preprocessing, enabling managers to focus on variance and the interpretation of this anomaly. The variance from standard procedures does not always allude to risks and dangers but can be seen as a chance for innovation within the company. Consultant 1, an interviewee with more than 20 years of experience in the field of IT consulting, summarizes the differences in value driver as follows:

> *"Although initially triggered by providing evidence for implementing risk management and internal control systems, companies want GRC systems to go beyond these narrow solutions. […] In a recent project, we create process transparency, leading to the ability to evaluate control effectiveness. […] Finally, this data has to be summarized and thinned out. Only then, management is able to know how the company is doing and what decisions it has to make to correct possible errors." (Consultant 1)*

Using the prominent example of GRC IS, we identified several contributions of IT on accounting (Table 17). IT enables exploitation and exploration of controls in accounting. On the one hand, IT has impact on the efficiency and effectiveness of controls (see line 1 and 2 in Table 17), on the other hand, it allows new potentials in developing effective control systems and provide additional decision support for management resilience (see line 3 and 4 in Table 17). When designing internal controls, IT ensures control standardization and therefore audit efficiency through automation. Auditors are able to get an integrated picture of the complex control implementation. Similarly, IT ensures control coherence as automation and mass data

processing enable monitoring the effectiveness of controls and therefore choosing the right control composition. Furthermore, IT enhances accounting toward knowledge service providers as it allows interpretation of weak signals and providing decision support. Aiming at implementing more effective ICS, IT creates transparency through ubiquity of information and therefore enhances management's absorptive capacity. This strengthens management's ability to interpret weak signals. Similarly, IT allows suggesting measures and actions for mitigation more efficiently. Instead of just preparing information on (non-) compliance, accounting can actually use intelligence and benchmarks to provide decision alternatives to management.

	Objective	Contribution of IT	Impact	Organization-al level	Theory
1 Control performance	Efficiency of auditing	Control automation & digitalization	Ensure proper control implementation	Auditor	(Ouchi 1979)
2 Control coherence	Effective controls	Control integration	Monitor control effectiveness	Internal audit	(Turner/Makhija 2006)
3 Risk responsiveness	Interpret weak signals	Transparency, Business Intelligence	Enhances management's absorptive capacity	Management	(Ansoff 1975)
4 Management resilience	Rationales for actions	Patterns, Benchmarks	Provide backing for actions	Senior management	(Sitkin/Pablo 1992)

Table 17: Characteristics of found value drivers of GRC IS.
Source: Own research.

Linking the Value Drivers to Existing Theory

The interviews revealed four value drivers of GRC IS, which we integrated into a framework (Table 17). Having this deeper empirical understanding of the underlying value drivers of GRC IS, in the following we try to generalize these empirical findings (Eisenhardt/Graebner 2007). Furthermore, we attempt to spot overlaps and connections of existing theory to our findings. Using existing theory to explain the found phenomena would contribute by supporting both, explanation of existing and prediction of future phenomena (Eisenhardt/Graebner 2007). Since the disciplines of IS and accounting lack explaining theories (Sutton 2010; Dechow et al. 2007), we identified theories from management and organization science as closely related to both, economics of IS and accounting. The following linkage to theory reveals that existing theories lack the integration of the impact of IT and would highly benefit by integrating research from an IS perspective.

The first value driver, control performance, can be explained through organizational control theory (OCT). Organizational control describes the interpersonal influence relations within organizations, which can be seen as arrangements of individual human interactions (Ouchi 1979). Control enables idiosyncratic behavior and compliance with the strategic plan and is therefore fundamental for any organization (Lange 2008). Several control mechanisms exist to control relations within organizations (Lange 2008). All control mechanisms are based on two underlying control strategies (Ouchi 1979). The first, formal control strategy forces coercion and manipulates rewards and sanctions (Lange 2008). This control strategy requires explicit, formal rules, procedures, and policies to both monitor and reward organizational performance. The second, informal control strategy aims at minimizing the divergence of

personal and company goals. Since GRC IS implements only formal control strategies, in the following, the two control mechanisms will be introduced, which implement formal control strategy: When implementing output control mechanisms, the principal monitors the agent's achievements at the end of the given tasks. The monitoring of the value creation process implements formal control through analyzing the output of the performed tasks. Executing output control requires a clear understanding of the results of the value creation process and the ability to evaluate the outcome. Behavior control implements control mechanisms that help the principal evaluate the agent's behavior. It enforces the formal control strategy through evaluating the tasks that the employee performs on appropriateness and alignment with the overall strategy. Behavior control requires knowledge of the transformation process and understanding of the involved resources (Ouchi 1979).

Reflecting the extant body of knowledge on OCT reveals several unsolved issues concerning GRC IS. Although the concept of GRC IS is broad and comprehensive, the only implemented control type is output control. Segregation of duties, identity management, whistle blowing, business activity monitoring, or global trade compliance all evaluate and control work and process results. Although we do not have any clear explanations, we assume that this phenomenon might have the following two reasons: One alternative would be that GRC IS are not developed enough to implement other control mechanisms. This seems unusual, since on the one hand, it is easier to implement behavior control and on the other hand, the experts revealed visions of GRC IS value drivers that do not exist in existing solutions but could be implemented in the future. Another reason, which seems more realistic, might be that behavior control becomes obsolete through the usage of IT.

Literature also discusses the second value driver, control coherence, in the context of OCT. Although research emphasizes the need for control combination (Turner/Makhija 2006), rather few discuss the effective selection and combination from a Meta perspective. As a first step toward control coherence, research highlights the differing effect of different combinations of control types on performance, but suggests the changing of the underlying situational condition for long term control success (Liu et al. 2010). Similarly Alles et al. (2008) point out the value of IT in auditing by control automation, but the authors also emphasize that practice still lacks adoption especially for continuous data assurance similar to the case of company expert 1. They provide a typology of audit automation efforts and conjecture that certain controls can be subject of automation but others not.

The concept of the third value driver, risk responsiveness, has been discussed in the context of interpreting early warnings (Ansoff 1975). Research in early warnings tries to identify weak signals as early as possible in the organizational context (Weick/Sutcliffe 2007). With the help of automation and mass data processing, IT could enable new forms of interpretation of early warnings, which further enhance accounting toward a knowledge services profession (Sutton 2010).

Management literature discusses risk based decision-making (RBDM) as the underlying theoretical lens for the fourth value driver, management resilience (Sitkin/Pablo 1992; March/Shapira 1987). Management literature identifies various factors influencing RBDM, which are all based on the perception of risk and situation. The representation of risk, situation, and possible mitigation alternatives highly influences the overall decision

(Sitkin/Pablo 1992). GRC IS enable new forms of management resilience by providing extant information about the organizational context of the decision with a specific focus on risks and opportunities.

Need for Further Research

Conducting exploratory research, our aim in this paper is not to exhaustively list all feasible impacts of IT on accounting in which IS academics have an edge, but rather, to illustrate the utility of IT in helping enhance the accounting discipline. We deem several aspects worth highlighting. First, it could be beneficial of future research to focus on the impact of IT on control coherence. Further explanation from a Meta perspective is needed on how organizations can effectively select and combine controls. Future research should address the selection and evaluation of implemented controls and consider the requests for identifying successful controls and preparing decision-making. As suggested by Alles et al. (2008), further research could provide decision support for selecting controls that are suitable for automation. Additional research on control coherence would provide an additional part of the necessary overall theory of organizations as demanded by Jensen (1993) by providing effective ICS.

Another promising direction for future research would be to examine how IT affects theory of controls. Existing IS initiatives including process management and ERP systems had influence on the underlying control situation. Since processes became more standardized and steeped in IT, further research should address the impact on the underlying information for control design in terms of transformation process and output measurability. This comes along with the dominance of output control as control type. Using the theoretical lens of OCT, we had expected that GRC IS incorporates both output and behavior control. Further research might find that IT influences control performance by turning behavior into output controls at an early point in time and therefore facilitates resilient ICS.

Implications and Limitations

Theses value drivers of GRC IS have practical implications not only for understanding GRC IS benefits beyond compliance, but they also provide practitioners with an overview of existing value drivers of GRC IS. Hence, this research gives clear strategic reasoning for GRC IS depending on the individual company's situation and suggests how organizations can benefit from it.

This paper is the first to use the theoretical lens of OCT on IT and accounting. It contributes by combining the two disciplines by showing the potential of accounting information systems. We identify IT as having exploiting and exploring impact on accounting through control automation, control coherence, early warnings, and management resilience. The developed theoretical framework reveals the potential of IT to provide value to accounting and therefore provides a research agenda for further IS research. The linkage to theory reveals that integrating IT into the context of accounting leaves several unsolved yet promising issues in theory which future research might address.

However, there are several limitations to take into account. First, it should be conceded that this grounded theory approach is based on only 14 interviews, which were chosen by convenience sampling. Although the exploratory nature and the aim of maximizing diversity allows certain broadness at the expense of depth, selecting only two experts from each GRC perspective could bias the findings through their personal opinion or specific experience and limits potentials for generalization on the total population. Since the scope of this research was to explore value drivers, further research needs to address a deeper empirical validation. In addition, although being the most obvious, OCT might not be the appropriate theoretical lens for researching GRC IS. Goal-setting theory might also be an alternative, as it is more output oriented (Locke/Latham 2002). Instead of using theories from management and organization science, we could also have used theories from computer science or IS which can be extended to accounting information systems as well. For example, the theory of technology dominance (Arnold/Sutton 1998) might also help assessing the impact of IT on accounting especially in terms of management resilience. We also focused on exploiting existing accounting potentials. We examinated control automation and coherence, but did not consider a self-contained perspective on exploration. Finally, the level of detail on the combination and interdependencies of the found value drivers is limited.

6.6 Conclusion

In this paper, we try to understand the impact of IT on accounting using the prominent example of GRC IS as accounting information system. We first applied a grounded theory approach to structure the value drivers of GRC IS. We identified control performance, control coherence, risk responsiveness and management resilience as fundamental value drivers. In order to increase the understanding of the impact of IT on accounting, we suggested a theoretical framework to relate the GRC value driver to extant theories, including organizational control theory, weak signals, and risk based decision-making. Due to the potential of influence exploitation of controls and exploration of new potentials of accounting as knowledge provider, IT can contribute to accounting by providing a foundation for implementing more effective control systems. Based on the discrepancies between study results and theory, we highlighted the profound but yet unexamined impact of IT on theory for further research.

7 The Role of Information Systems in Supporting Exploitative and Exploratory Management Control Activities

Title	The Role of Information Systems in Supporting Exploitative and Exploratory Management Control Activities[7]
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Table 18: Bibliographic Details for Publication P4.

Abstract. The goal of this research was to investigate the role of information systems (IS) in helping organizations to address the challenge of achieving a trade-off between exploitative and exploratory management control activities. The relationship between IS and management control activities is complex and stems from different theoretical backgrounds. We adopted a grounded theory approach to offer an integrative lens on this multi-facetted issue. Through the study of information systems for governance, risk management, and compliance (GRC IS) as a recent practice-driven initiative to establish the means for balancing exploitative and exploratory management control activities, we developed a grounded model of the relationship between IS and management control activities. Our model highlights the ways in which GRC IS serve as a catalyzer for establishing balanced management control systems that enable managers to simultaneously exploit and explore richer management control information.

7.1 Introduction

A central issue in management research is finding and maintaining a balance between exploitative and exploratory activities (March 1991). Exploitative activities focus on efficiency and reducing deviations in performance and include standardization, refinement, and establishment of routines. Exploratory activities focus on innovation and include experimentation, risk taking, and search. While organizations that solely focus on exploitation may have difficulty developing new competitive advantages, organizations that solely focus on exploration may have difficulty transforming their innovative ideas into competitive advantages. Hence, the challenge to management is to achieve maintainable trade-offs to resolve the tension between exploitative and exploratory activities as they "are essential for organizations, but [..] compete for scarce resources. As a result, organizations make explicit and implicit choices between the two." (March 1991, 71).

In management control research, this tension has been explored in relation to Simons (Simons 1995) levers of control framework. Adopting quantitative and qualitative approaches, a number of studies have explicitly investigated how management controls entail balancing and trade-offs (e. g., Henri 2006; Mundy 2010; Widener 2007). An important aspect of management control activities is the nature of the information systems that support them, and so the goal of this research was to investigate the role of information systems (IS) in helping organizations address the challenge of achieving a trade-off between exploitative and exploratory management control activities (Simons 2010).

A complex relationship between IS and management control has been presented in the literature. Information systems help to reduce the effort required to acquiring, analyzing, integrating and reporting information on organizational behavior and outcomes (Chapman/Kihn 2009; Dittmar 2007; Fisher 2007). In doing so, IS establish an integrated control overview (Chan 2002), enable organizations to measure control effectiveness (Ashbaugh-Skaife et al. 2008), and help to support decision-making (Beneish et al. 2008). Further, IS provide new capabilities for management control as "data become accurate, shareable, and available to different parties without creating the panoptic dream of visibility and action at a distance" (Dechow/Mouritsen 2005, 729).

Because the literature around this important topic is found in multiple disciplines with different theoretical backgrounds and concepts, we seek to offer an integrative perspective that draws together these diffuse insights. To help us develop such a perspective, we investigated the recent practitioner-driven phenomenon of information systems for governance, risk management, and compliance (GRC IS). Originally, GRC IS were developed as IT-enabled management control systems to respond to tightened regulatory requirements (e.g., the Sarbanes-Oxley-Act). Thus, GRC IS support exploitative management control activities through the "automation of the management, measurement, remediation, and reporting of controls and risks against objectives in accordance with rules, regulations, standards, policies, and business decisions" (Caldwell et al. 2011, 3). More recently, however, organizations introduce GRC IS, without actual regulatory need, to support exploratory management control activities through establishing transparency and traceability in decision-making and new business analytics capabilities (Caldwell et al. 2011).

We adopted a grounded theory approach to investigate the role of IS in supporting exploitative and exploratory management control activities (Suddaby 2006; Glaser/Strauss 2001). In particular, we were interested in the rationale for introducing and using GRC IS by stakeholders such as executives, compliance officers, and administrative staff. The grounded theory approach seemed appropriate to integrate the diverse theories and concepts on the role of IS in supporting management control activities "as a stimulus [and] initial direction in developing relevant categories and properties and in choosing possible modes of" integrating extant literature (Glaser/Strauss 2001, 79). Thus, in terms of our research, grounded theory provides the methodological guidelines to study GRC IS as a practice-driven initiative. Using the principle of constant comparison (Glaser/Strauss 2001), we analyzed the responses from semi-structured interviews with 21 practitioners on the rationale and benefits of GRC IS. We did rounds of open coding using theoretical sampling for diversity. The resulting preliminary model was reviewed and discussed (Wiesche et al. 2011b) which yielded further dimensions for coding. Based on the principles of theoretical sampling, we then conducted a second round of interviews, which led to theoretical saturation.

Our grounded model indicates that GRC IS serve as a catalyst for establishing balanced management control systems that enable managers to use controls to engage simultaneously in exploitative and exploratory activities. IT-enabled management control systems such as GRC IS facilitate an overview of the current state of an organization's management controls and offer opportunities for refinement and automatic execution of management controls. For exploitative purposes, GRC IS assist in assessing the effectiveness and efficiency of management controls. Simultaneously, GRC IS provide an information platform that offers richer and more timely data about performance deviations and emergent chances and risks. Managers can interact with GRC IS to develop and explore scenarios and experiment with exploratory and exploitative control information. Our model structures the catalyzing effects and relates these to different theoretical backgrounds of exploitative and exploratory management control activities. Thus we have integrated disparate views from the literature on the role of information systems in supporting management control activities.

The remainder of this paper is structured as follows. First, we describe the theoretical foundation for studying our research question. We then explain our inductive research strategy, outline our core analytic tenets, and present our approach to generate key conceptual categories. In the analysis section, we report on the development of our final understanding of GRC IS. In the results section, we explain the rationale and benefits of information systems for supporting exploitative and exploratory management control activities. In the implications section of the paper we describe our grounded model and discuss its implications for theory and practice. We conclude the paper by highlighting its key results.

7.2 Theoretical Background

For this study we adopted March's (1991) distinction between exploitative and exploratory management activities as a theoretical framework for achieving trade-offs in organizations. Exploitative activities focus on efficiency and reducing deviations in performance and include standardization, refinement, and establishment of routines. Exploratory activities focus on innovation and include experimentation, risk taking, and search. March's central argument is that organizations need to balance exploitative and exploratory activities to be successful.

Exploitative and exploratory activities "compete for scarce resources. As a result, organizations make explicit and implicit choices between the two" (March 1991, 71). Hence, the challenge to organizations is to achieve and maintain trade-offs between exploitative and exploratory activities. The application of this argument has been useful in management research and organizational science (Kane/Alavi 2007; Gupta et al. 2006). By introducing March's argument to the management control literature, we follow Merchant and Otley's (2006) call for work contributing to an integrated theoretical body of management control.

In management control research, a number of studies have explicitly investigated how management controls entail balancing and trade-offs (e. g., Henri 2006; Mundy 2010; Widener 2007). The economics of management control is instrumental in achieving trade-offs. Here, the effort of acquiring and analyzing information about organizational behavior is weighed against the risk sharing agreements of principal and agent (Eisenhardt 1985). With regard to providing a rationale for management control design, the literature indicates that a trade-off between behavior and output controls is essential (Ouchi 1979). Mundy (2010), furthermore, suggests that a trade-off between a controlling and enabling use of control systems is required. Speklé (2001) discusses control archetypes that managers need to choose from when implementing management control systems.

The literature shows that information systems alleviate trade-offs between conflicting perspectives on management control activities; but the literature also presents a complex relationship between IS and management control (Chapman/Kihn 2009). Research results on the effect of IS on management control suggest that several factors change the use of management controls, underlying control modes, and the control systems' effectiveness (Granlund 2009). We see four major effects of IS on management control systems (Table 19).

Control issue	Source	Trade-off	Effects of IS
Economics of Control	(Eisenhardt 1985)	Cost of measuring behavior vs. transferring risk to agent and measuring output	IS reduce the costs of collecting control data, which leads to a more transparent agency relationship.
Rationales for Control Design	(Ouchi 1979)	Behavior vs. output control	IS enhance measurability of outcomes and increase the knowledge of the transformation process.
Use of Control Systems	(Mundy 2010)	Controlling vs. enabling use	IS reduce barriers to an integrated use of management control systems.
Result of Control Mechanism	(Speklé 2001)	Mechanic vs. exploratory control	IS allow the convergence of insights from the organization to be used in decision-making.

Table 19: Effects of IS on Management Control.
Source: Own research.

The first effect is a reduced cost of collecting control data that leads to a more transparent agency relationship (Ansoff 1975). By enabling automated control, such as access control systems and document management systems for compliance, IS provide an opportunity for preventive controls (Rikhardsson et al. 2005). With regard to SOX 404 compliance management, effective IT-enabled control helps to reduce audit costs (Canada et al. 2009). Thus, IS reduce the need for a "trade-off between the cost of measuring behavior and the cost of measuring outcomes and transferring risk to the agent" (Eisenhardt 1985, 135).

The second effect of IS on management control systems is an enhancement of measurability of outcomes and an increasing ability to acquire "knowledge of the transformation processes" (Ouchi 1979). IS, such as ERP systems, identity management systems and customer relationship management systems provide the ability to gather and share more detailed information about the behavior of the organization and outcomes (Sia et al. 2002). IS for business process management and workflow management help to increase knowledge of the transformation process by standardizing procedures, routines, and task descriptions thereby increasing transparency on variations (Tang et al. 2000; Lucas Jr/Olson 1994; Le Grand 1997). Mass data analysis, pattern matching, and machine learning enable organizations to examine transformation processes for criminal activities (Debreceny/Gray 2010; Jans et al. 2010, 2007). Thus, IS blur the previously distinctive dimensions of measurability of outcomes and knowledge of the transformation process for designing effective management controls (Ouchi 1979).

Thirdly, IS enable an integrated and interactive use of management control systems by providing integrated access and analytics on previously separated data sources within the organization, e. g., accounting, operations, or marketing (Chapman 1997). Research results suggest that control effectiveness is a function of the level of IS integration (Woods 2009). Integrated IS enable managers to discard 'scattered business silos' (Volonino et al. 2004) by formalizing control routines across business processes and organizational areas (Volonino et al. 2004). The effect of IS for management control, however, depends on the use of control systems. For instance, researchers have shown that vertical IS strengthen existing formalized control structures resulting in a more coercive management control system (Den Hertog/Wielinga 1992). Integrative IS equip organizational members with internal and global transparency and allow greater degrees of flexibility and self-empowerment (Adler/Borys 1996; Chapman/Kihn 2009). Thus, barriers to an interactive use of management control systems are reduced with integrated IS (Mundy 2010; Bisbe/Otley 2004).

Lastly, IS allow insights from the organization to converge, accumulate, and facilitate the transfer of these insights in a timely manner to decision makers. Dechow and Mouritsen (2005) argue that IS are configured with certain control strategies in mind and are therefore limited in their capability to gather new information (Dechow/Mouritsen 2005). Newer IS, such as GRC IS, enable managers to establish controls for situations in which processes and procedures are vague (Wiesche et al. 2012a). Hence, IS allow managers to establish exploratory controls to identify weak signals (Speklé 2001; Ansoff 1975).

Table 19 structures the complex relationship between IS and management control as presented in the literature. We are aware that the four presented effects do not offer an exhaustive overview of the complex relationship between IS and management control activities. We rather use the four effects as starting points for investigating IS for governance, risk management, and compliance. These four effects guided the development of questions for our interviews.

7.3 Research Method

Research strategy

Our study was designed to explore GRC IS as a means by which organizations resolve the challenge of achieving a trade-off between exploitative and exploratory controls. We interviewed 21 practitioners responsible for GRC IS initiatives and asked them to describe and discuss their rationale and motives for introducing and using GRC IS. Our access to operational GRC IS allowed us to compare and validate responses from the practitioners. In particular, we were interested in the role of GRC IS in resolving issues regarding the objective, scope and design of management control activities (see Appendix 1). We considered this inductive approach appropriate to answer our research questions (Henri 2006). As recommended by Suddaby (2006) we followed the methodological guidance of Isabella (1990) for conducting and presenting our research.

Sample

Our study sample was chosen to maximize diversity and increase the possibility of finding different and varying data belonging to one sample. Our first step was to interview administrative staff responsible for management control systems. In the course of our interviews, we added the perspectives of other practitioners including: auditors, consultants, executive managers, compliance officers, software architects, and risk managers (Table 20).

Perspective category	**Expert ID**	**Language**[8]	**Educational background**	**Length of work experience**
Audit	Auditor 1	German	Business	8 years
Audit	Auditor 2	German	Accounting	4 years
Audit	Auditor 3	German	IT	10 years
Consulting	Consultant 1	English	Business	10 years
Consulting	Consultant 2	German	Audit	23 years
Consulting	Consultant 3	German	Management	25 years
Governance	Executive manager 1	English	Audit	16 years
Governance	Executive manager 2	English	Compliance	10 years
Governance	Executive manager 3	German	Accounting	6 years
User	Administrative staff 1	German	IT	6 years
User	Administrative staff 2	German	IT	12 years
User	Administrative staff 3	German	Accounting	9 years
Compliance	Compliance officer 1	English	Finance	16 years
Compliance	Compliance officer 2	German	Finance	22 years
Compliance	Compliance officer 3	German	Law	12 years
Software	Software architect 1	German	Accounting	17 years
Software	Software architect 2	German	IT	11 years
Software	Software architect 3	German	IT	7 years
Risk	Risk manager 1	German	IT	14 years
Risk	Risk manager 2	English	Risk Management	3 years
Risk	Risk manager 3	German	Banking	10 years

Table 20: Characteristics of Interviewed Practitioners.
Source: Own research.

[8] German quotations were translated into English by the authors.

Because each perspective on GRC IS provides a distinct focal point on the topic, over the course of our study we interviewed two practitioners from each perspective and added an additional interview for each perspective later on to check for theoretical saturation. We met these practitioners at GRC workshops in Germany and used professional discussion groups and blogs to identify potential respondents. The interviews varied in length between 1 and 1.5 hours. All practitioners had between 3 and 25 years of experience in their profession; the average experience was more than 11 years. Although the backgrounds of the practitioners were diverse, their perspectives were grouped according to their job description at the time of our study.

After interviewing and analyzing two practitioners for each perspective, we conducted a second cycle of interviews for each perspective with an additional practitioner to substantiate theoretical saturation (Lee et al. 2006). We specifically selected these additional practitioners because they were responsible for GRC IS initiatives in organizations, which had recently been involved in public compliance or fraud scandals.

Identification of Rationales for Using GRC IS

The strategy we used in our research allowed the practitioners to describe and discuss their rationale for using GRC IS to support management control activities. We asked the practitioners to explain why they would implement GRC IS, what were the underpinning rationale and implications for its implementation, how does technology support these objectives, and who in their organization was involved in determining the scope and objective of GRC IS initiatives.

We structured the interviews along four themes to understand GRC IS as an initiative driven by practitioners. First, we asked the practitioners to explain the triggers that started the discussion about GRC initiatives and the introduction of GRC IS at their organization. We considered this important since the practical discussion on GRC IS is usually motivated by increased regulatory pressure. For instance, the Sarbanes-Oxley Act in 2002 (SOX) is considered a major trigger for creating the market for GRC IS (Volonino et al. 2004; Hagerty/Kraus 2009).

We also asked the practitioners to describe their interpretation and understanding of GRC IS. Although there have been efforts to formulate a common definition (Racz et al. 2010), there is still no shared understanding of GRC IS. From a practitioners' perspective, GRC IS are very broadly defined as the "system of people, processes, and technology that enables an organization to understand and prioritize stakeholder expectations, set business objectives that are congruent with values and risks, achieve objectives while optimizing risk profile and protecting value, operate within legal, contractual, internal, social, and ethical boundaries, provide relevant, reliable, and timely information to appropriate stakeholders, and enable the measurement of the performance and effectiveness of the system." (Mitchell/Switzer 2009). GRC IS provide a variety of control mechanisms ranging from segregation of duties and process monitoring to risk management (Teubner/Feller 2008). In light of this broad definition, we considered the specific concepts, models, and frameworks for GRC IS advanced by the interviewed practitioners. Based on the different understandings of GRC IS

we assumed these concepts, models, and frameworks would differ in terms of results and impact (Racz et al. 2010; Hagerty/Kraus 2009).

Third, we asked the practitioners to explain the different strategic motivations for introducing GRC IS within their organization. We assumed that practitioners would bring forward various strategic motives and rationales for seeking approval for an investment in GRC IS and that there would be differences in these reasons depending on the position of the interviewee in the organization. Literature sources suggest that auditors and consultants would focus on control deficiencies and the effects on the financial outcome (Ashbaugh-Skaife et al. 2008). Executive managers would focus on the IS-business alignment and adequate and efficient coordination of tasks (Chan 2002) whereas compliance and risk managers would concentrate on effective controls, cost reduction, and the integrity of IS (Ramakrishnan 2008). Software architects would focus on segregation of duty and process control (Hagerty/Kraus 2009) and administrative staff responsible for management control systems would focus on evaluating and selecting appropriate frameworks for GRC IS (Beneish et al. 2008).

We next asked the practitioners to describe the impact of GRC IS on their organization and to describe their efforts in tailoring GRC IS to their particular situation. Research results suggest that integrated IS would reduce the effort of acquiring and analyzing information on organizational behavior and outcomes (Eisenhardt 1985). Software vendors provide GRC IS as a portfolio to accommodate different requirements, standards, and regulations (Hagerty/Kraus 2009). The most common platforms include BWise, focusing on quantitative and qualitative risk and compliance management, SAP GRC, providing an integrated platform for role management, process control, and risk management, and Thompson Reuter's eGRC, providing advanced audit services such as regulatory content services, change and policy management, and regulatory tracking services.

At the end of each interview, we asked the practitioners to provide any additional information relevant for our research. The interviews were tape-recorded and then transcribed. Data were collected anonymously. We incrementally developed the set of questions for each interview based on our experience from prior interviews. While each interview covered the four themes, the incremental development of questions allowed us to explore new topics during interviews. This procedure follows methodological guidelines established in prior research (Lee et al. 2006; Suddaby 2006; Isabella 1990).

Analysis

We used grounded theory to analyze our data (Suddaby 2006; Glaser/Strauss 2001; Lee et al. 2006) and used previous work on the impact of IS on management control activities to support our reflection of the data and guide data analysis (Dechow/Mouritsen 2005; Chapman/Kihn 2009). This allowed us to substantiate our preliminary theoretical understanding using the most recently collected data and, at the same time, apply theories in an effort to interpret the collected data. This procedure took place in a cyclical manner; each cycle of interpretation produced an adapted interview plan and a new set of questions. After interviewing and analyzing two practitioners from each perspective, we condensed our results into preliminary coding categories and presented them at a conference (Wiesche et al. 2011b).

As a result of discussing our preliminary coding categories with academics, we added seven interviews with practitioners responsible for GRC IS initiatives in organizations that had recently experienced public compliance or fraud scandals in Germany. We expected that these practitioners had experienced the economic and public ramifications of insufficient management control systems and would therefore provide a different perspective on the scope and importance of GRC IS. This additional data led to a re-analysis of data and a second round of data analysis (Glaser/Strauss 2001). While this round of analysis substantiated our preliminary theoretical understanding, we discovered and consequently resolved an important conflict in our interpretation and subsequently created an additional conceptual category. We considered this repetition of information and confirmation of our existing conceptual categories as a signal of theoretical saturation (Glaser/Strauss 2001; Suddaby 2006).

We integrated our transcripts into one hermeneutic unit comprising 84,461 words and 74 pages of text using the software ATLAS.ti. The coding procedure was conducted following Glaser and Strauss' (2001) guidelines. First, the second author read and coded the interview transcripts line-by-line using phrases from the transcripts that described the phenomenon (open coding), and tagging similar phenomena with the same phrase. The first author similarly coded the transcripts independently. This resulted in a list of 139 codes and 687 phrases. We discussed and agreed on the differing codes. We then conducted a second open coding step to consolidate the established conceptual categories. The conceptual categories and their interdependencies were examined for patterns and themes that might explain the tension between exploitative and exploratory management control activities. Table 21 outlines the selected phenomena, derived concepts, and conceptual categories.

Selected Codes (total 139)	Concept (total 11)	Category (total 5)
Ease of collecting control information	Automation of collecting control information	Control measurability
Reuse data from ERP system		
Automatically generate control reports		
Less interruption of day-to-day work		
Continuous control monitoring	Continuous control	
Data collection in real-time		
Report control liability and effectiveness	Meet required regulations	Control performance
Ensure that controls are in place and up-to-date		
Automate processes to collect audit data		
Find disconnected, fragmented information		
Integrated, global segregation of duties	SOX compliance	
Allows effective fraud detection		
Recognize undesirable behavior		
Use IS to accelerate audits	Enhance control effectiveness	Control coherence
Management can observe organizational units		
Process large amounts of control data		
Provide real-time information		
Reduce manual oversights	Continuous monitoring of existing internal controls	
Allow automated control testing		
Avoid fragmentation	Comparability	
Standardized workflow and risk reports		
Check compliance in countries or units		
Build effective internal control system	Prevent future incidents ahead of time	Risk responsiveness
Create organizational resilience		
Early recognition of anomalies	Avoid negative outcomes	
Find early risks, blurry but indicator		
Understand which loss indicators are correct		
Use positive incidents to drive innovation	See opportunities	
Reduce reduction time for market trends		
Use risk management to process abstract innovation		
Use functional units reports to make decisions	Prepare decision support	Management resilience
Provide more information for management		
Increase reliability of internal controls		

Table 21: Selected Codes, derived Concepts, and Conceptual Categories.
Source: Own research.

7.4 Results

Rationale for using GRC IS

The interviewed practitioners provided very heterogeneous rationales for introducing and using GRC IS. Initially, organizations can conduct management control activities without standard software or specific GRC solutions. Spreadsheets and paper-based reporting fulfill fundamental requirements at low implementation costs. After the implementation of these procedures, companies quickly demand more effective, automated systems that allow monitoring control effectiveness and a reduction in audit costs. This led us to the categorization of various arguments for using GRC IS into four distinct rationales (see Table 22).

A first objective of GRC IS initiatives is to collect data for control purposes. GRC IS facilitate centralization and continuous measurement in order to reduce the effort of collecting data while increasing the breadth and depth of collected data. We call this rationale ‘control

measurability'. The next objective focuses on the confirmation of reliable controls. GRC IS facilitate automation and digitalization of controls to ensure continuous monitoring and examination. We call this audit-driven rationale 'control performance'. A third objective of GRC IS is to enable managers to identify and mitigate risks. GRC IS help to establish transparency through technologies such as data mining and business intelligence thus enhancing a manager's absorptive capacity (Cohen/Levinthal 1990). We call this rationale 'risk responsiveness'. Finally, the objective of GRC IS from the perspective of executive management is to support decision-making. GRC IS provide pattern analysis, benchmarking, and scenario analysis to aid in the assessment of outcomes of alternative management decisions. We call this rationale 'management resilience'.

Rationale	**Control measurability**	**Control performance**	**Risk responsiveness**	**Management resilience**
Task	Collect data for control purposes	Confirm control reliability	Identify and mitigate risks	Decision-making
Technology	Centralization, continuous measurement	Control automation, digitalization	Data mining, Business Intelligence	Pattern analysis, benchmarking, scenario analysis
Role	Employee	Audit	Management	Executive management
Impact	Completeness of data collection at reduced effort	Continuous monitoring and examination	Enhances absorptive capacity	Provide support for actions

Table 22: Rationale for Introducing and Using Information Systems for Governance, Risk Management, and Compliance (GRC IS).
Source: Own research.

In the following sections, we present each rationale in detail. Our identified rationales are structured according to the perspectives of the interviewed practitioners in order to reveal the divergent benefits that stakeholders harness from GRC IS. We identify areas of shared interest and particular concerns, specific to groups of stakeholders by contrasting the perspectives to facilitate constant comparison (Suddaby 2006).

Control Measurability

According to our analysis, one of the most central arguments for implementing GRC IS was the capability of GRC IS to automate the collection and aggregation of information for management control purposes. Consider the example of the implementation of an access control system for assuring segregation of duties. This type of system supports data collection by predicatively analyzing ERP roles and aligning user rights with the organizational structure. Hence, control data are easily collected because they are automatically documented within an information system and can be collected remotely without interrupting the operational tasks of the employee. The interviewed practitioners reported that dedicated IS would resolve trouble and avoid rush on regular and unheralded audits. When in place, the additional work of collecting the necessary data is taken over by GRC IS. Table 23 provides example quotes on control measurability from the interviewed practitioners.

Concept\Role	Administrative staff	Auditors	Consultants	Executive management	Software architects
Automation of collecting control information	We now have all data in a central system and we are able to gain additional information on certain risks without interacting with a particular division or country.	"If we had a compliance problem in Russia, I needed to find out first why it occurred. I used several manually started programs and then we analyzed the results. We approached the regional executives and told them that in this context an additional financial control and one more oversight control were required. That means that every time someone made a printout, he had to have it reviewed and signed by his supervisor . It was then filed in the archive for control purposes. With GRC systems, everything is connected."	"Auditors examine our books once or twice a year. A tool does this continuously and is working twenty-four-seven."	"Being the boss, I need to know that all our internal controls are [...] in place. They need to be monitored continuously, not just occasionally; GRC systems can do this."	"We collect tons of data and every step in the collection process is properly documented within SAP [ERP]. The amount of data is too great to analyze by hand. We need professional systems such as GRC to handle this huge amount of data. GRC can help me track processes: I need to know who created the purchase order, who examined it, who approved it, how it was used in production, and who took care of the invoice."
Continuous control	"The verification of invoices is based on the implemented inspection of the purchase requisition within our systems. It works only when the accounting department can access the data; that means that this information is in the system and can be checked. If volume or price of the purchase requisition and the final invoice differ, the invoice cannot be released for payment. This process is 100% automated. However, we still need to intervene if any anomaly should occur."		"As soon as the system runs properly, monitoring can be done in real-time. […] I instantly see what has happened and no one has to try to figure out what happened two weeks ago."		

Table 23: Exemplary Quotes for Control Measurability by Organizational Roles.
Source: Own research.

Using GRC IS for data collection is a first step toward continuous control monitoring; by using continuous control monitoring, organizations ensure that their controls are in place and effective. Existing controls must be integrated within GRC IS to allow the automatic

determination of control effectiveness. Such systems enable organizations to see in real time whether their control system is properly working. Instead of focusing on automating detective controls, GRC IS establish a preventive control set and ensure continuous monitoring of its effectiveness.

Control Performance

All practitioners we interviewed identified meeting compliance regulations as another dominant rationale for implementing GRC IS. Governmental regulations, e.g., SOX or Basel II, require organizations to report on the reliability and effectiveness of internal controls. In global, networked, and complex organizations, all practitioners reported that it is impossible to meet the plethora of regulations without the support of IS. The use of GRC IS help to comply with regulations through offering semi-automated and automated processes to collect and document relevant compliance information. GRC IS provide evidence that required controls have been implemented and are working properly. Further, GRC IS contribute to the early recognition of risks and to the implementation of adequate mitigation strategies. Table 24 provides example quotes on control performance from our data.

Concept\Role	Administrative staff	Executive managers	Compliance officers	Risk managers
Meet required regulations	“People used to blame IS for not supporting segregation of duties. Having this system, we can guarantee compliant provisioning since everything is automated and in real-time. Users can gain further system access if approved by management..”	“We put most of our control services within [the GRC system]. Control owners conduct self-assessments that are documented and then sent to relevant stakeholders. This is done within the system. I get a report and with my auditors’ oversight controls, I know that everything works out fine.”		“Consider the example that the user in the procurement system has one ID and another ID for using other systems . If those systems are not connected within our GRC tool, I cannot check in which system the user was active. Especially in regard to purchase orders within the FI/CO system, numerous documents from other systems merge and generate FI bookings, general ledgers, sub-ledgers, accounts, and payments to customers and suppliers. Of course, we could arrange that all users have the same ID in every system. It is almost impossible to update this arrangement and it requires too much coordination. If a user changes department or leaves the company, then I can delete this user with one button from all systems using the access control system.”
SOX compliance	“Today, our [access control] system permanently logs every access issue in every country. If we need to update roles or permissions, the system automatically validates this with the current role and permission matrix. If conflicts are discovered, the system will not allow the change. […] [We] implemented something like a compliance cockpit. The system generates reports about the situation of certain permissions in specific countries on a regular basis and sends the reports to the responsible executive. We are now able to meet every audit request at any given point in time and we can now provide absolutely clear information.”	“Fraud happens often because of bad provisioning. Users get too many rights, spread across several systems and nobody is able to monitor by hand what is going on. Given that situation, employees start abusing the system. They may pilfer goods and mark the missing goods as not delivered, use fictitious vendors, or change customer bank account information within our system. Having a global access control system limits these opportunities significantly.”	„We need documented processes. When there is no documentation, we just monitor single steps. If we know the workflow within the processes, we can use mining techniques to interpret the collected data. That’s not the full truth, but at least it provides indicators.”	

Table 24: Exemplary Quotes for Control Performance by Organizational Roles.
Source: Own research.

Automated internal controls in the context of GRC range from the segregation of duty to policies and codes of conduct. In the context of Enterprise Resource Planning (ERP) systems, consider again the example of access control. Access control is characterized by high-level process knowledge and task complexity. It includes automation of end-to-end access and

authorization management with strong integration within the controlled IS. Access control can be implemented along the organizational value creation process and records and prevents access violations. This provides initial insights on fraud or other undesirable behavior. However, access control can only be implemented using IS, which enables the processing of mass amounts of data in real time. Access control helps to address and support compliance with regulations such as SOX.

Risk Responsiveness

Our study results revealed clear evidence that the automated internal controls within GRC IS increase the ability to build effective management control systems by collecting early warnings. If interpreted correctly, early warnings can prevent negative outcomes in organizations. A situation relayed by one of the interviewed practitioners provides a good example of what can happen in the absence of GRC IS data control. The organization, "Alpha", has several hundred thousand employees in more than 70 countries and operates more than 100 different enterprise information systems for procurement alone. Despite SOX-required segregation of duties, management at Alpha is unable to oversee all systems. In the process of formulating less than 100 rules for segregation of duty and introducing automated access control monitoring, an internal audit detected several thousand violations during going operative with GRC IS. This example illustrates the extensive effort that is necessary to effectively meet regulations and shows that implementing management controls is no longer feasible without IS to support the processing of mass amounts of data. Although all of the violations were intercepted by the automated access control, Alpha investigated the most risky violations (e.g. access to top security information), which led to adapted business processes and tighter security measures. Table 25 provides example quotes on risk responsiveness from our interviews.

Concept\Role	Executive managers	Software architects	Risk managers
Prevent future incidents ahead of time	“Systems such as GRC IS create a new kind of transparency demanded by stakeholders. These systems help me guarantee that the company will still exist in five years; they please our customers, satisfy our employees, and create a positive image for in the general public. To convey this impression, we need data. And because of the large size of our organization, we need systems to collect this data.”		“In contrast to our internal control system, GRC information systems have a different value proposition. Instead of only occasionally taking random samples, our system comprises 170-200 controls, which are implemented in our ERP and continuously monitor our processes. Hence, we have a forecasting system which signals everything is working properly and according to schedule.”
Avoid negative outcomes	“The events of the past years show that things are not as unrealistic as expected. In collaboration with the executive committee, we had to decide whether we use IT-enabled risk management to reduce compliance costs or to recognize unsatisfactory events early enough to develop countermeasures. […] Therefore, we invested in software for GRC and are currently developing controls and KPIs, which will be integrated within our daily business to recognize risks earlier.”	“From my personal prospective, I have been most interested in the problem of assessing risk levels. Usually you have very little data on which to base your assessment. […] But it's not so easy to estimate how likely it is that an incident will occur and how bad the reaction will be if it occurs . […] You always have limited resources for doing the risk analysis. So you could of course spend weeks and months just coming up with a lot of strange incidents that may potentially happen but you need to limit your analysis so that you are actually able to deal with the situation in the time frame that you have. So this dilemma between identifying all risks that may be relevant and at the same time being able to perform the risk analysis within a realistic time frame is a big challenge.”	Find early risks; unclear but nevertheless an indicator.
See opportunities	“I can conduct real time monitoring. That means that I can see something happen as soon as it occurs so I don’t have to reconstruct the event afterwards. This is of course covers a lot more information – though still not complete – than a certain excerpt that I request afterwards. This is the difference -- and it is automated. No one is sitting for two weeks analyzing stuff that happened months ago.”	Reduce reduction time for market trends.	“If you implement GRC for automatically managing controls within your organization, you can collect risk information to ensure business continuity. We consolidate information on risks and chances and aggregate this information for management. I am currently working on our operational risk report. In the IT department of our group, CIOs are narrow-minded and build their own platforms. We use enterprise architecture data to understand the developments and provide risk information to management regarding the heterogeneity of our systems and the need for transparency and cost allocation. Management has now decided to build a central IT platform.”

Table 25: Exemplary Quotes for Risk Responsiveness by Organizational Roles.
Source: Own research.

Organizational settings have become more complex and intricate and it is often impossible to manually monitor and investigate all factors indicating potential organizational misconduct. IT-enabled control allows management to continuously monitor and identify weak signals in anomalies and to develop a response to such weak signals in a timely manner. Management can develop countermeasures for negative incidents and use positive incidents to drive innovation. Automation can support this situation by enabling the processing of large amounts of data and reducing reaction time to incidents.

Management Resilience

Practitioners seek to support management decisions with data gathered from GRC IS. Because functional units report their situation to management and management uses this information as a basis for decision-making, the relayed information must be reliable: using GRC IS, management can easily and quickly verify the information.

Concept\Role	Executive managers	Compliance officers	Risk managers
Prepare decision support	"I am responsible for making decisions. […] Therefore, I need lots of data to make these decisions. The data need to be comprehensive and reliable. I always ask for more data and receive long lists, which I have to search for the details I want. This sometimes takes hours. People need to collect details on the employee level and the system needs to aggregate it for me, but leaving open the option to play with the data."	"The most interesting problem is assessing risk levels. Usually you have a few data points on which you can base your assessment. However, you need information about how high or low the severity of a certain risk is and - you need to decide whether it is worth the cost to do something about it. […] It is very easy to come up with potential incidents that could harm you in some way. Nevertheless, it is difficult to estimate how likely it is that those incidents will occur and their level of severity. You want to be able to identify as many potential incidents as possible. So this dilemma -- finding the right tradeoff between identifying all risks that may be relevant and at the same time being able to perform the risk analysis in the given time frame -- is a huge challenge."	"What happens if big companies do not have controls implemented? They don't have a chance to get competitive advantages, do not know what their employees do, and don't know anything about their value creation. However, they remain liable for work conducted in their organization. In large companies, such monitoring can only be done with information systems. Take for example access rights. In our purchasing department, we have several hundred thousand violations within one process – occurring all over the world."

Table 26: Exemplary Quotes for Management Resilience by Organizational Roles.
Source: Own research.

Data generated from GRC IS help management to choose and compare appropriate measures for risk mitigation or to inform decision-making on innovations to enhance organizational performance. Further, GRC IS foster an interactive use of control data as the basis for informed decision-making. Example quotes on management resilience from our interviews are provided in Table 26.

How do GRC IS Resolve the Tension between Exploitative and Exploratory Management Control Activities?

IS Facilitate new Conditions for Management Controls: Synchronicity and Certainty of Actions

We found that GRC IS alter the conditions for designing management controls. GRC IS enable managers to exploit task conditions as output and behavior become more measurable (Ouchi 1979). With regard to the exploratory use of management control systems, GRC IS synchronize control events and control reports and enable managers to respond adequately based on the extensiveness of available control information (Ansoff 1975; Eisenhardt 1985).

Regarding the exploitation of task conditions, management can implement control systems depending on the conditions of the task. Ouchi (1979) argues that designing control systems depends on the task condition 'ability to measure output' and the task condition 'knowledge of the transformation process'. For example, implementing output control systems requires a clear understanding of the results of the value creation process and the ability to evaluate the outcome (ability to measure output). Behavior control, on the other hand, requires knowledge of the transformation process and understanding of the involved resources (Ouchi 1979).

Our results showed that information systems change the underlying task conditions for control purposes. As reflected in the rationale 'control measurability', IT-enabled management control systems enhance management's knowledge of the transformation process through precisely defined, documented, and enforced process descriptions (Hammer/Champy 1993; Davenport 1993). Centralized processes, continuous result documentation, and workflow management enable transparency of organizational operations. Using again the example of Alpha, after implementing global access control through their GRC IS, Alpha was able to control employee behavior and automatically prohibit system access as necessary.

As reflected in the rationale 'control performance', our results showed that GRC IS allow early collection of control information at reasonable costs (Speklé 2001; Canada et al. 2009). Systems can collect control information automatically, allowing auditors to get a complete picture of organization behavior and outcomes (Rikhardsson et al. 2005). Using another example from our interviews illustrates management's ability to easily control outcomes with GRC IS. Internal regulations for procurement at "Beta" include a purchasing limit for purchasing agents. If the value of goods exceeds a certain amount, management must approve the purchase. However, purchase agents could split orders into smaller purchases where each purchase does not exceed the purchasing limit. Despite the risk of splitting purchases being well known, auditors seldom caught these splits. At Beta, the GRC IS comprised process controls that identified split purchases by monitoring all purchase orders to identify similar transaction entries without interfering with legitimate purchasing. In this instance, GRC IS enhance management's ability to measure output by providing details on every split purchase immediately before the purchase order was issued.

The rationale of 'risk responsiveness' relates to the delay between an incident and the point of time when control data about this incident are available for management. GRC IS enhance the timeliness of control information by providing real-time progressing and analysis of control

information for use by management (Mundy 2010; Granlund 2009; Plattner/Zeier 2011). Consider again the example of Beta. The auditors in Beta's accounting department are responsible for ensuring that the implemented controls are in place and functioning. An internal audit was conducted every quarter. Auditors found instances of fraud committed several weeks past by employees of Beta. GRC IS in combination with new data-base technology provides Beta's internal auditors with real-time data on incidents and enables Beta to analyze suspicious transactions speedily and terminate them before fraudulent activities could get through.

GRC IS also increase the range of management decisions by visualizing, restructuring, and aggregating complex control information to foster solution development for multifaceted problems. GRC IS allow benchmarking, scenario planning, and pattern analysis for better decision-making by the executive management (Sia et al. 2002; Debreceny/Gray 2010). Consider the case of "Gamma": Gamma originally implemented a GRC IS to better meet compliance regulations. Later, Gamma implemented data mining techniques to analyze data on business process deviations, which enabled management to identify non-compliant transactions. Gamma's management used these insights to improve the business processes.

Control Coherence as Antecedent for Simultaneously Exploitative and Exploratory Management Control Activities

Consistently across all interviews, practitioners reported on the benefits of integrated IS. As other researchers have shown for the domain of ERP systems, integrated IS approaches provide a common database that allows generating and manipulating "comprehensive virtual perspectives on the nature and flow of operations and resources" (Chapman/Kihn 2009, 151). GRC IS transfer this functionality of integrated record keeping to the domain of management control systems: previously separated control data can be integrated and analyzed to gain deeper insights on the state of the management control system.

The practitioners reported that continuous monitoring is one of the central benefits of GRC IS. GRC IS provide the functionality to reduce intervals between control reporting events from months to minutes. Instead of just examining samples, all control events are recorded and analyzed with GRC IS, which allows the detection of all control violations. The interviewed practitioners reported that prior triggers for investigation (e.g., deviations larger than USD 10,000) no longer apply as even minor violations could be investigated with little additional effort. On the other hand, data gathered during the course of continuous monitoring do not immediately raise suspicions about potential performance deviations or risks. While these cues are timely, their implications for decision-making are not always clear. Thus, continuous monitoring enables organizations to accrue signals -- albeit weak -- about organizational behavior and outcomes (Speklé 2001; Ansoff 1975).

The combination of a common database and continuous monitoring requires managers to deal with initially vague control information that may become more specific over time (Ansoff 1975). Managers can now experiment with this data set to develop grounds for decision-making (March 1991) and can develop temporary controls based on this experimentation to support or refute hypothesized implications and thus increase their knowledge of the transformation process. GRC IS support this process by providing the means to establish new

controls and to automatically create the legally required control documentation for internal and external auditing.

GRC IS provide a balancing perspective, often referred to as process control by practitioners, on various exploitative and exploratory management control activities that are part of the organizational transformation processes. This balancing perspective enables each process owner to establish an individual ‘dashboard’ that systematizes and organizes the users’ information needs, related management controls, conducted analyses, and reports. According to the interviewed practitioners, working with these dashboards helps to establish a coherent set of controls, which meets the information needs of the process owner. GRC IS establish a coherent set of effective controls on the process level and thus alleviate the trade-off between allocating resources to exploitative and exploratory management control activities.

Concept \Role	Control Measurability	Control Performance	Risk Responsiveness	Management Resilience
Enhance control effectiveness	”With GRC software, the data can be collected and presented easier: just connect it to your ERP and other systems and as soon as a value exceeds a certain limit, the person in charge is notified.”	” Every control was centralized, every piece of documentation crossed my desk. Today, we empower middle management within the department. They have access to the system and they have knowledge, which means they have the control. They collect all the data and send senior management a summarization of the data which they then can use for drilldown.”	“Risk responsiveness ensures, for example, that receivables do not unnecessarily increase and the company stops delivering goods. Auditors should check the routines but it is no longer necessary to check each transaction.”	“To ensure access control performance, the systems have to be integrated with process controls. Process controls allow the testing of the effectiveness of internal controls.”
Continuous monitoring of existing internal controls	„Most of our controls are so-called transaction level controls and are a part of day-to-day operational work. We are trying to build our ERP systems and control landscape in order to have as much automatic validation and process control as possible.”	We were recently working on currency controls which are now implemented within our GRC system and which our auditors now test only once a year. The auditors focus on the difficult currency control issues and our system ensures automated full control over less complicated issues.”	“Although initially triggered by providing evidence for implementing risk management and internal control systems, companies want GRC systems to go beyond these narrow solutions. […] In a recent project, we created process transparency leading to the ability to evaluate control effectiveness. […] Finally, data have to be summarized and trimmed. Only then will management be able to know how the company is doing and what decisions it has to make to correct possible errors.”	
Comparability		”If we had a compliance problem in Russia or England [...], I always had to find out first, why it occurred. I used several manually started programs and then analyzed the results. We approached the regional executives and told them that we needed an additional financial control and an additional oversight control for these problems. That means that every time someone made a printout, he had to get a signature from his boss that he reviewed the printout. The signed printout was stored in the archive for control purposes. With GRC systems, everything is connected.”		“It is important to ensure GRC convergence. The function of monitoring […] is very important throughout the organization. I can tell you that the average company has […] different risk management functions. All risks seem different and similarities can easily be overlooked. Therefore, management doesn’t necessarily have a good overview of the whole company -- they don’t often see the total risks.”

Table 27: Exemplary Quotes for Control Coherence within each Rationale.
Source: Own research.

By combining the common database and the balancing perspective of GRC IS, users can share definitions of particularly effective or highly critical controls. Thus, users not only

monitor existing controls but also begin to develop new controls. Controls can also be used to establish benchmarks across departments or subsidiaries of an organization. Exemplary quotes from our interviews are provided in Table 27.

A Grounded Model of the Effect of IS on Management Control

Our research established four rationales of using IS to support management control activities. In the following, we discuss a grounded model to provide help in understanding the rationales for using IT-enabled management control systems as identified through our interviews. This model is based on existing literature on management control systems and categorizes the identified rationales for using IS to support exploitative and exploratory management control activities. Figure 12 presents an overview of this model.

We found two underlying objectives for IT-enabled management control systems; one entails an exploitative approach to management control activities, the other entails exploratory management control activities. The objective of ensuring organizational performance focuses on exploiting the situational context and the conditions of the tasks under control. Ensuring organizational performance, therefore, requires control strategies that follow the rationales of control measurability and control performance. These rationales focus on exploitative management control activities that help to detect performance deviations exhaustively and in a timely manner. The objective of ensuring organizational integrity focuses on exploring the conditions of the implemented management controls to identify new threats to organizational integrity. Ensuring organizational integrity requires control strategies that follow the rationales of risk responsiveness and management resilience. These rationales focus on exploratory management control activities that help to identify prior unknown risks and to develop new management controls from initially vague control information. Our analysis suggests that IT-enabled management control systems foster a balance of these two objectives by providing an integrated database, continuous monitoring, and dashboards.

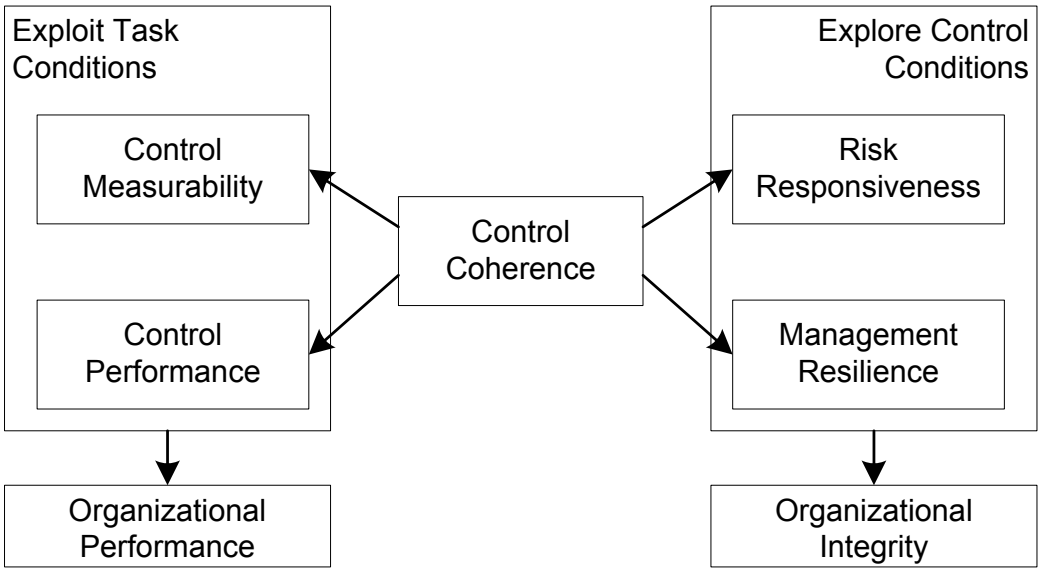

Figure 12: The Balancing Role of Information Systems in Supporting Exploitative and Exploratory Management Control Activities.
Source: Own research.

Management control systems have different underlying control objectives. On the one hand, managers use management control systems to align the goals and risk preferences of their employees with the organization (Cardinal et al. 2010; Merchant/Otley 2006). In this respect, control systems serve the purpose of ensuring organizational performance (Ouchi/Maguire 1975). This objective is driven from an internal perspective since managers need this information to run the organization (Merchant/Otley 2006). On the other hand, our data revealed that management also implements control systems to provide transparency of their activities to stakeholders (Lange 2008; Jensen 1993); these control systems afford organizational integrity (COSO 2004). Management can use the collected control data to produce reports for external stakeholders, to assess if organizational aims have been met, and to assess if the organization has been compliant with standards, rules, and guidelines (Volonino et al. 2004; Lange 2008; Fisher 2007). IT-enabled management control systems support managers in developing new ideas and initiatives (Marginson 2002; Widener 2007). This externally driven perspective is heavily influenced by compliance requirements (Volonino et al. 2004). IT-enabled management control systems balance this internal perspective of organizational performance control and the external perspective of organizational integrity.

IT-enabled management control systems allow managers to simultaneously pursue exploitative and exploratory objectives. The opposing objectives of exploit task conditions to ensure organizational performance and to explore control conditions to ensure organizational integrity have different impacts on designing management control systems. IT-enabled management control systems enable organizations to establish control coherence and, as a result, management is able to design management control systems that serve both purposes. This requires balancing performance-oriented controls and demonstrating the achievement of compliance through documenting organizational integrity (Speklé 2001; Chapman/Kihn 2009; Dechow/Mouritsen 2005). We found that IS provide a common database for both exploitive and exploratory activities. Hence, IS enhance the designing of control strategies through a balance of management control activities. In summary, IS reduce "the distance in time and space between activities […] and realization of returns" for exploratory management control activities (March 1991, 85).

7.6 Implications

We investigated the role of IS for designing and managing control systems within organizations. IT-enabled management control systems provide monitoring to prevent errors, which we call 'ensuring organizational performance', and to strengthen organizational resilience, which we call 'ensuring organizational integrity'. We identified the impact of IS on control design strategies comprising cost effectiveness, integrity, the measurement of control success, and mass data processing. When implemented, IT-enabled management control systems provide organizations with the capability to balance management controls for various purposes.

A first look at the data gleaned from the interviews revealed highly diverse interpretations of GRC IS among practitioners. The practitioners' understanding of GRC IS ranged from "it is an IT product" to "it is a management philosophy" and differed, as we expected, from one another according to the role of the practitioner in the organization. Practitioners used GRC IS

as an initiative for implementing systems for ensuring segregation of duties (software architects), or as a system used to document and report organizational controls (administrative staff), or as a means to align business processes and organizational controls (auditors). Practitioners defined GRC IS as an integration of operational and strategic risk management (compliance officers). Finally, the executives we interviewed described GRC IS as a management philosophy for situational awareness based on IT-enabled control data collection (consultants, executive managers).

Our grounded model indicated the opportunities for control design strategies through balancing the exploitation and exploration of data on performance deviations and emergent chances or risks. We showed that IS catalyze three important objectives of management control activities. First, control automation allows managers to exploit an ever-increasing amount of data for control purposes. Secondly, IT-enabled management control systems enable managers to explore control data to find new risks and new opportunities. Third, IT-enabled management control systems foster a coherent view on the rationales of using information systems to add value to management control. We integrated these catalyzing effects into a grounded model that positions IS in the context of management control literature.

The goal of this research was not to exhaustively list all feasible impacts of IS on management control, but rather, by conducting inductive research, to illustrate and categorize important rationales of using IS to support management through simultaneous exploitative and exploratory management control activities. There are several aspects of our research worth highlighting. First, it might be beneficial to focus on the impact of IS on control coherence in future research projects. Investigations as to how organizations can effectively select and orchestrate management controls would be worthwhile pursing. Future research might also address the mechanisms of selecting and evaluating management controls. As suggested by (Alles et al. 2008), further research could provide decision support for selecting management controls that are suitable for automation. Research on control coherence would certainly enhance what is currently known about the overall theory of organizations as advocated by Jensen (1993).

Our grounded model has practical implications as well. It provides structure to use GRC IS beyond purposes aimed at achieving compliance with regulatory guidelines. Further, the model provides practitioners with an overview of existing rationales for implementing GRC IS to tailor future GRC initiatives. Our research provides a starting point for strategic reasoning for initiating GRC IS in an organization.

We acknowledge that there are limitations to our study. The grounded theory approach was based on 21 interviews, which were chosen by theoretical sampling. Although the exploratory nature of the study and our aim of maximizing diversity allow certain broadness at the expense of depth, selecting only three experts from each GRC perspective could bias findings and limit the generalization of the results to a larger population. Since the scope of this research was to explore rationale for initiating GRC IS, further research should address a broader empirical validation. In addition, organizational control theory might not be the appropriate theoretical lens for conducting research on GRC IS; goal-setting theory, which is output oriented, might be a viable alternative (Locke and Latham 2002). Instead of using theories from management and organization science, we could have used computer science or

IS theories and related them to accounting information systems. For example, the theory of technology dominance (Arnold/Sutton 1998) might have provided insights into assessing the impact of IS on management control, especially in terms of management resilience. We also focused on exploiting existing control capabilities. Future research should address the issue of workarounds within IT-enabled management control systems and their effect on the discussed rationales (Ignatiadis/Nandhakumar 2009). Finally, most of the functionalities provided by GRC IS were newly introduced to the market by GRC IS providers at the time of the interviews. Hence, we could not account for long-term effects of GRC IS. Future research should investigate these long-term effects.

7.7 Conclusion

In this study we investigated the role of IS in helping organizations to address the challenge of achieving a trade-off between exploitative and exploratory management control activities. We adopted a grounded theory approach to seek an integrative perspective that draws together the different theoretical backgrounds on the complex relationship between IS and management control. We investigated IS for governance, risk management, and compliance (GRC IS) as recent practice-driven initiatives to establish the means to balance exploitative and exploratory management control activities. We conducted our study by comparing the responses from semi-structured interviews with 21 practitioners on the rationales and benefits of GRC IS. We conducted one round of open coding using theoretical sampling for diversity. A second round of interviews was conducted with practitioners who were responsible for GRC IS initiatives in organizations, which had recently experienced public compliance or fraud scandals. We developed a grounded model that showed that GRC IS serve as a catalyzer for establishing balanced management control systems that enable managers to simultaneously exploit and explore richer data on performance deviations and emergent chances and risks. We identified the exploitative rationales of control measurability and control performance as well as the exploratory rationales of risk responsiveness and management resilience as fundamental rationales for the implementation of GRC IS. Our analysis revealed that GRC IS further alleviate the trade-off between exploitation and exploration by providing the means to establish control coherence. The grounded model integrates previously disparate literature on the role of IS in supporting management control activities.

8 Antecedents of IT-enabled Organizational Control Mechanisms

Title	Antecedents of IT-enabled Organizational Control Mechanisms
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Individual contribution	The author of this thesis participated in the study design, data collection, analysis and interpretation as well as in the conceptual development. He further significantly contributed to the creation of the manuscript.

Table 28: Bibliographic Details for Publication P5.

Abstract. Organizational control is one of the fundamental management functions. Literature on control design suggests two underlying antecedents for designing organizational controls: 'knowledge of the transformation process' and 'ability to measure output'. We conducted an exploratory case study, drawing on archival data and interviews to test organizational control theory (OCT), taking into account the role of Information Technology (IT) in control design. We operationalized OCT as characterized by literature and classified 525 organizational controls. We found OCT correctly predicted the control type based on the antecedent conditions in approximately two out of three cases. We found the other third being influenced by automation, centralization, and mass data analysis. We argue that IT allows management to implement behavior controls in situations, where processes and procedures are unknown and therefore 'knowledge of the transformation process' is low. As contribution for theory, we reveal exploring capabilities of organizational control in addition to exploiting activities. As contribution for practice, we introduce new antecedents for designing organizational controls. This research is in line with others to test control theory, but it is the first to explain the catalyzing functions of IT on organizational control design within a case study.

8.1 Introduction

Organizational control is one of the fundamental management functions (Cardinal et al. 2010). Controls ensure that members of an organization act according to the organization's goals (Merchant/Otley 2006). Fast-pacing developments, globalization, and competition both exacerbate and require the implementation of proper organizational controls to ensure organizational performance. Compliance regulations and standards present the challenge to organizations to implement a plethora of organizational controls to meet these requirements. Organizations implement IT-supported control management systems to cope with the increasing numbers of requirements. These systems allow IT-enabled design and management of controls. One prominent example are so-called information systems for Governance, Risk, and Compliance (GRC IS), which allow organizational control management within an information system.

Although the particular design of organizational controls help managers to attain organizational goals the antecedents of effective design are still considered as an unsolved issue in management research (Jensen 1993; Cardinal et al. 2010). IT has been suggested as a promising research endeavor in this area (Rom 2008; Sutton 2010), the catalyzing function of IT in organizational control research has not yet been researched in depth (Granlund 2009). As recent literature (Wiesche et al. 2011b, Wiesche et al. 2012) suggests, IT catalyzes the exploiting capabilities of organizational controls, but also allows new capabilities for exploring organizational behavior and outcome. This research seeks to further explore the effect of IT on designing organizational controls. Therefore, we ask the research question of *how does information technology influence the design of organizational control mechanisms?* To answer this question, we conducted an exploratory single case study, using interviews and archival control data. We found that organizational control theory (OCT) correctly predicted the control type based on the antecedent conditions in approximately two out of three cases. We found the other third of the cases are being influenced by automation, centralization, and mass data analysis. We argue that IT allows management to implement behavior controls in situations, where processes and procedures are unknown and therefore 'knowledge of the transformation process' is low.

This paper is organized as follows: The next section outlines the theoretical background regarding organizational design recommendations and initial research on IT in organizational control design. The third section describes the methodology we followed in the course of our research. After documenting the operationalization of the considered framework, we present the results of our analysis. The fifth section discusses our results considering theoretical and practical implications and limitations. The last chapter summarizes our findings.

8.2 Background

Organizational Control Theory

The understanding of organizational control varies, depending on the different research streams followed in management, organizational, IS, and marketing literature (Cardinal et al. 2010; Merchant/Otley 2006). Three major perspectives can be distinguished: the cybernetic perspective, the management perspective, and the risk perspective. The cybernetic perspective

on control draws on the goals of achieving organizational objectives, adapting to environmental factors, collecting, processing, and reporting information, and influencing the behavior of organizational members (Ouchi 1979; Flamholtz et al. 1985). The management perspective focuses on a rather strategic perspective, focusing on organizational uncertainty and managerial requirements (Simons 1995). In contrast to the cybernetic perspective, the management perspective on control sees the scarcity of resources as drivers for managerial decision preparation instead of using the cost-analysis as suggested by the cybernetic perspective. Drawing on both, the cybernetic and management perspectives, the practice-driven risk perspective focuses on the exterior of the organization, by identifying potential threats that may affect the organization (COSO 2004).

For the purpose of this research, we understand organizational control as the interpersonal influence relations within organizations, which can be seen as arrangements of individual human interactions (Ouchi 1979). Control mechanisms are based on two underlying control strategies. Formal control strategies manipulate rewards and sanctions. This control strategy requires explicit, formal rules, procedures, and policies to both monitor and reward organizational performance. Informal control strategies aim at minimizing the divergence of personal and company goals (Cardinal et al. 2010). For the purpose of this research, we focus on formal control strategies. Therefore output and behavior control will be introduced in the following as the two control mechanisms implementing formal control.

When implementing output control mechanisms, the principal monitors the agent's achievements at the end of the given tasks. The monitoring of the output of the value creation process implements the formal control strategy through analyzing the output of the performed tasks. Executing output control requires understanding the results of the value creation process and the ability to evaluate the outcome (Ouchi 1979). Behavior control implements control mechanisms that help the principal evaluate the agent's behavior. It enforces the formal control strategy through evaluating the tasks that the employee performs on appropriateness and alignment with the overall strategy. Behavior control requires the knowledge of the transformation process and understanding of the involved resources (Ouchi 1979).

A Decision Model for Control Mechanisms

Literature suggests that the underlying element of a management's decision of how to control is inevitably linked to the feasibility of measuring the performance that ought to meet required standards (Ouchi 1979; Cardinal et al. 2010; Kirsch 1996; Snell 1992).

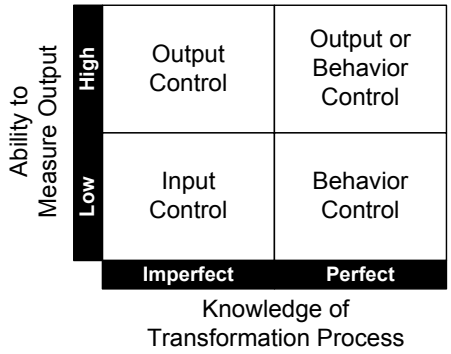

Figure 13: Framework of Control Antecedents.
Source: (Ouchi 1979).

Outcome measurability is thus seen as an antecedent condition that determines the mode of control that is implemented. In this paper, this dimension will be referred to as the ability to measure output (Ouchi 1979). The ability to measure output refers to task programmability – i.e. the agent's ability to determine the output of the value creation process. If output cannot be measured, another option to control if a task is satisfactorily performed, is surveillance. This dimension refers to the principal's knowledge of how the value creation tasks have to be performed by the agent (Ouchi 1979). If the principal knows exactly, which tasks the agent has to accomplish, the knowledge of the transformation process is high. When the principal does not know, which factors influence the value creation and therefore the tasks the agent has to perform, the knowledge of the transformation process is low.

It is indeed intuitively comprehensible that controls cannot be performed, unless there is adequate information at hand. Ouchi (1979) has depicted contingencies of the ability to measure either output or behavior with thee control mode in a matrix, which ought to serve as advice for the management (Figure 13).

Empirical Work on Ouchi's Framework

Empirical research has extended the framework of antecedents of control as predictors of the chosen control mode and tested it in real-life contexts, sometimes adapting the dimensions of the matrix to the setting of their study. For example, Snell (1992) tested correlations between the ability to measure output or behavior and the selected control mode of executives in bureaucratic control systems.

Kirsch et al. (2002) empirically investigated predictions on the chosen control mode from a client's point-of-view. Similarly to the above, findings suggest associations of outcome measurability with exercising output control in the context of client-company relations (Kirsch et al. 2002). The hypothesis on positive relations between behavior observability and the application of behavior control was also supported (Kirsch et al. 2002). In this context, behavior observability replaced the usual dimension of 'knowledge of the transformation process' proposed by Ouchi (1979), due to the fact that clients do not usually know processes.

The influences of 'knowledge of the transformation process' and ability to measure output were analyzed especially in the context of marketing (Jaworski/MacInnis 1989). Also

according to this study, tendencies to the performance of behavior or process controls correlate positively to a person's knowledge about the process (Jaworski/MacInnis 1989).

The Role of IT in Organizational Control Design

Previous research has thus suggested that Ouchi's framework (1979) adequately predicts or advises a certain type of control to be implemented. Studies report on the relevance and capabilities of IT in designing organizational controls (Wiesche et al. 2011a; Chapman/Kihn 2009).

Although study results indicate IT in organizational control design as an interesting métier (Rom 2008; Sutton 2010), the impact of IT on organizational control design has not been researched in detail (Granlund 2009). A literature review by Efendi et al. (2006) within the top accounting journals provides evidence that confirms these findings. Although an ongoing stream of research focuses on designing controls in IS projects (Conboy 2010; Kirsch 1997; Tiwana/Keil 2009), the research on the impact of information systems on organizational control systems is still fragmented (Rikhardsson et al. 2005). Little research exist on the explorative use of IT within control systems (Jans et al. 2010; Debreceny/Gray 2010) while IS research focuses on the impact of IT on clan control (Kohli/Kettinger 2004; Kuckein et al. 2010).

Information systems dedicated to plan, control, and report on the compliance with regulations create significant potentials for coping with regulations more effectively (Wiesche et al. 2011a). Commonly, features of such information systems are discussed under the label of GRC (governance, risk management, and compliance). Driven by regulatory compliance, companies established such GRC IS to prevent fines and penalties imposed by regulatory agencies. Today, companies focus on integrated solutions of GRC without a clear value proposition for their individual situation. Still, market research predicts that US-based companies spend almost $30B on GRC related technology and solutions and its perceived importance continues to grow (Hagerty/Kraus 2009). GRC IS provide a variety of controls ranging from procedures to monitor user access to information systems, to monitor process performance and provide enterprise-wide risk management (Wiesche et al. 2011a). Other than controls, GRC also implements mechanisms to report on compliance and to manage existing business processes. The most common platforms include BWise, focusing on quantitative and qualitative risk and compliance management, SAP GRC, providing an integrated platform for role management, process control, and risk management, and Thompson Reuter's eGRC, providing advanced audit services such as regulatory content services, change and policy management and regulatory tracking services.

Several value drivers for the potentials of IT were introduced in this context (Wiesche et al. 2011b). IT drives the exploitation as well as the exploration of organizational controls. This influence is made possible by IT's impact on data collection, efficiency and effectiveness of controls. Facilitation of new capabilities concerning the development of effective control systems and the provision of additional support for management resilience are two further important points. Audit efficiency can be further supported by IT when designing organizational controls, as it ensures control standardization. Moreover, IT ensures control coherence: Automation and mass data processing foster the monitoring of the controls'

effectiveness and therefore the pick for the right control arrangements. In addition, IT enables accounting toward knowledge service providers by allowing interpretation of weak signals and providing decision support,. IT creates transparency through ubiquity of information and therefore enhances management's absorptive capacity, directed towards more effective controls. Interpretation of weak signals from management can thus be improved. The suggestion of measures and actions for mitigation is facilitated by IT. IT enables decision makers within the organization to use decent and reliable information and benchmarks in order to provide decision alternatives to management, instead of the plain preparation of information concerning compliance.

8.3 Research Methodology

This paper reports on the results of a single case study. The method was selected in order to formulate answers to the research question as stated in the first section. A single case study is a research design, which makes it possible to gain qualitative and quantitative information on the application of a phenomenon in the setting in which it occurs (Yin 2009). An exploratory design that would combine interviews with the analysis of archive data was chosen to develop a profound understanding of the complex phenomenon of implemented controls within their original context (Yin 2009).

Case Selection and Data Collection

The case company - Beta - is Germany-based, of medium size and operates in the industrial and building sector. In 2008 the company implemented an IT-based control management system as a reaction to rising challenges in the business and due to its international activities. It is one of few of their size that have already implemented and gained experience with this method of meeting external and internal requirements, designing a GRC IS and implementing their organizational controls within. To assure actuality, Beta reviews existing controls on a regular basis. Controls which are marked as inefficient, e. g. because there have not been any incidents within a certain time period, are removed from the dataset. This ensures clarity and quality of the implemented controls.

Beta's board has decided to implement an IT-based control management system. This approach ought to provide the company with the possibility to supervise business processes and risks. In order to formulate controls, the company first determined and recorded the functional processes that tasks can be assigned to. All relevant processes were depicted as flowcharts and documented within the GRC IS. It collects data from various systems throughout the organization, including the global ERP system, a self develop tool for assessing control information, and other data sources. Beta implemented some of the predefined controls within their ERP system. In addition, Beta implemented operational controls with the tool for assessing control information meeting the requirements of their line of business and connected it to the GRC IS. Hence, IT is incorporated within Beta's management control system in two different ways: it manages existing controls and allows centralization, automation, and real-time monitoring. On the other hand, it uses mechanism for automatic evaluation of data and only reporting anomalies. Thus, it reduces control efforts.

We retrieved a subsidiary's full control set, comprising 525 controls ranging from strategic to financial, operational, and compliance controls. Each control is characterized along three main dimensions: a defined risk, an objective that should be reached and a control, in order to match the risk and the objective. Further information includes test instructions, character of control, corresponding, information system, and potential errors. This data set was analyzed as the central empirical evidence in this case. Interviews were held with co-workers of Beta who are involved in the control system process, in order to supplement missing information. These interviews lead to a more profound insight into the performed controls by providing additional insights and experience. Within the interviews, co-workers were encouraged to provide their own view of high importance information on this matter.

In order to test and extend existing theory with the control set at hand, we operationalized the framework introduced above using the items as introduced in the next chapter. The first author coded each control according to the criteria developed in the next chapter. To ensure impartiality, the second author likewise coded the controls independently. The two codings resulted in an average inter-coder reliability of 0.72.

Operationalizing the Control Design Framework

Previous research has designed empirical studies in order to test the control design framework. For the purpose of testing it in this context, we constructed criteria to measure Ouchi's (1979) dimensions, as well as the realization of controls in terms of their mechanism: output and behavior control. We will present literature in order to operationalize the dimensions of knowledge of the transformation process and ability to measure output. We will then present measurements of output and behavior control.

Measurement of the dimension of knowledge of the transformation process, was conducted with the construct behavior observability as a new contract to supplement knowledge of the transformation process as a predictor of behavior control (Kirsch 1996). The items of behavior observability consist of the controllers effort and time spent monitoring if goals were met, how often he participated in review of goal achievement meetings, how often the controller visited with the controlee, and how often the controller received written review documents (Kirsch 1996; Kirsch et al. 2002).

Using these items, we synthesized three criteria that would be determinable by the available data. First, a controller's knowledge of a task would be given if the task is formulated and documented. This would be the case for example, if a guideline for the underlying task exists. The second is based on the supposition, that knowledge about a task can be assumed if tasks are very simple. For instance, if a control consists of checking the stamp of a bill, the process of generating a stamp is probably comprehensible by the controller, as the task is very simple. The scale's third item is based on the understanding of the "bigger picture" that can be assumed for the controller. This is the case, if a control has been integrated in the depicted processes, the formulation of the control suggests a connection to other tasks, or the context of other tasks is easily comprehensible.

Furthermore, authors developed items for the dimension ability to measure outcome. Outcome measurability, in literature used as a synonym for Ouchi's (1979) term of ability to

measure output, is a construct of three items (Kirsch 1996). The first item is about whether the controller can determine if a project's goal was met. The second item as about whether to the controller it is possible for the controller to accurately and reliably assess to what extent a completed project meets the initially posed goal, while the third is based on how easily the extent of goal achievement is assessable (Snell 1992).

Again, we used these items to synthesize three criteria that can be determined by the available data. The first item is dedicated to whether a controller can state if the performance of a task sufficiently satisfies the companies need. This satisfaction does not have to be objectively assessable. For instance, this would apply to a control that requests to control the plausibility of data compared to previous months, or the plausibility of justifications given for deviations in performance. Second, higher ability to measure output is assumed, when objective indicators that suggest the objective-related successful performance of a task would exist. This is the case, for example, in the following control:

> *„Verify: if the Excel lists and all delivery notes were signed by the person in charge." (Archival Data)*

Third, quantifiable measures, depicting the extent to which set targets were achieved, form a criterion for the construct. This criterion is fulfilled, if data is compared and deviations are quantifiable, as can be seen in the following control:

> *„Verify: if booked values equal with the values reported in the change-report." (Archival Data)*

In order to test controls on their score for the dimensions of knowledge of the transformation and ability to measure output, measurement of output and behavior control is required. Measurement of the control mechanisms behavior and output control has been performed in the course of a plethora of studies in research (Cardinal et al. 2010; Snell 1992; Kirsch 1996).

First, the construct of output control is examined. Literature suggests items to measure output control as aiming at determining how strong the emphasis on output is regarding appraisal and rewards (Snell 1992). Similarly, other items stress the definition of antecedently specified goals and their linkage to reward as criteria for output control and how well they were communicated (Jaworski/MacInnis 1989; Kirsch 1996).

We summarize similar items in three criteria. The first criterion, goal specifity, refers to setting and communicating goals explicitly. The second criterion is the availability of quantifiable measures to determine the extent of goal completion. A third aspect in the context of the construct of output control is its link to rewards. Employees of Beta confirmed that no rewards for employees are linked to this control set. Rewards can only be linked to results, if these results are obtained at the end of a process. The third criterion used in the analysis is thus whether the control is directed to a final task at the end of a process.

Behavior control is the second control mechanism of interest regarding the analysis of the dataset. Jaworski and MacInnis (1989) evaluated behavior control with items based on the assessment of the controlee if immediate superiors can evaluate the extent to which the

controlee follows established procedures, if procedures are evaluated, if procedures are adapted when results do not meet expectations and if the controlee expects feedback from his superior (Jaworski/MacInnis 1989). Snell (1992) refers to behavior control as process control and analyzes the strength of emphasis in evaluations on behavior, the accountability of subordinates for actions, the interest of the controller in procedures and methods and the imposition of top-down performance programs (Snell 1992). Furthermore, the scale is based on the frequency of feedback given by the controller as well as frequency of meetings, and the existence of predefined performance goals (Snell 1992).

In conclusion, three main characteristics of behavior control appear. First, research states that performance of behavior control is indicated by formulated guidelines, which contain clear steps that have to be followed. Second, centralization, thus no or little delegation of decision-making to subordinates and centrally formulated policies and guidelines have been assumed to be characteristic for behavior or process control. The third characteristic is the frequency of performance control and appraisal, as well as of feedback given. In the considered data set, controls, which are performed at least daily, were considered to fulfill this criterion.

Rating of the control set was performed on every control as listed under test instructions of every of the 525 control under the label “verify”. Ratings on each item were conducted independently from each other. The score on the scale ranging from 0 to 3 resulted from the sum of appropriate criteria among the three defined. In the following, we report on the results of this rating. In order to fit within the framework, for each dimension, we assumed the scale of 0 and 1 as “low” and 2 and 3 as “high” regarding the dimension at hand.

8.4 Results

As outlined above, we classified the 525 controls, contained within the data set. Figure 14 presents an overview of the classification. In the following, we report on the classification in detail. First, results on the dimension of knowledge of the transformation process are listed. Measurement of knowledge of the transformation process consisted of three items, 1) formulization, 2) simplicity and 3) integration in process. 386 (73.52%) controls were directed to formulated tasks, while 139 (26.50%) were not. 212 (40.38%) underlying tasks were estimated to be so simple, control owners would have enough knowledge on their process. 313 (59.62%) of tasks controls are performed on are supposed to be not as easily comprehensible. 218 (41.52%) of controlled jobs could not be integrated into the context of their performance only by archival data information, while 301 (58.47%) were.

In sum, 53 (10.10%) underlying tasks of controls were rated with a 0 on the designed scale of knowledge of the transformation process; 168 (32.00%) were rated 1. In the matrix proposed by Ouchi (1979) both lower ratings result the label of “imperfect” for knowledge of the transformation process (Ouchi 1979). Thus, 221 (42.10%) tasks controls belong to are rated “imperfect”. 176 (33.52%) tasks controls are based on scored 2, and 128 (24.38%) controls scored 3 on the scale of knowledge of the transformation process. These ratings signify labeling of “perfect” knowledge of the transformation process. Ability to measure output was rated considering 1) determinability of satisfaction with performance outcome, 2) objective determinability of goal accomplishment and 3) quantifiable extent of goal accomplishment. For 462 (88.00%) tasks control is performed on, accomplishment of an objective to the

organizations satisfaction can be determined, for 63 (12.00%) it cannot precisely. In 333 (63.43%) of all tasks control refers to, it can be objectively determined whether a target is achieved, while in 192 (36.57%) of all tasks it cannot. The extent of accomplishment of 112 (21.33%) controlled tasks can be quantified. Accomplishment of 413 (78.67%) tasks was shown to not be accurately measurable. In sum, 27 (5.14%) of controlled tasks were graded 0, and 180 (34.29%) were graded 1 on the scale of ability to measure output. In summary, 207 (39.43%) of controls are labeled “low” concerning their ability to measure output. 227 (43.24%) of all tasks controlled are rated 2 on the scale, and 91 (17.33%) are rated 3. According to the scale, ratings of 2 and 3 result in a “high” ability to measure output. 318 (60.57%) of all assessed task consequently have a measurable output.

159 (30.29%) controls have scored “low” on ability to measure output and “imperfect” on knowledge of the transformation process. Performance outcome of 47 (8.95%) tasks can be measured, while knowledge of their transformation process is imperfect. Knowledge on 62 (11.81%) jobs is “perfect” whereas their output can explicitly be measured. For 257 (48.95%) jobs both knowledge of the transformation process and ability to measure their outputs is given.

As stated above, we also classified output and behavior controls. For the latter, 15 (2.86%) tasks were not centrally prescribed, 510 (97.14%) were centrally prescribed according to the control description. 503 (95.81%) of tasks were formalized, in parts within the description of the control itself, while 22 (4.19%) were not. Frequency resulted from the given classification in the provided control set. According to it, 93 (17.71%) of all controls were performed at least daily, while 432 (82.28%) were performed less frequently. On the 4 item scale, in sum 10 (1.9%) controls were rated 0 and 9 (1.71%) controls were rated 1, resulting in 19 (3.62%) of controls considered behavior control. 421 (80.19%) were graded with 2 and 85 (16.19%) were graded with 3. In sum, 506 (96.38) are considered behavior controls.

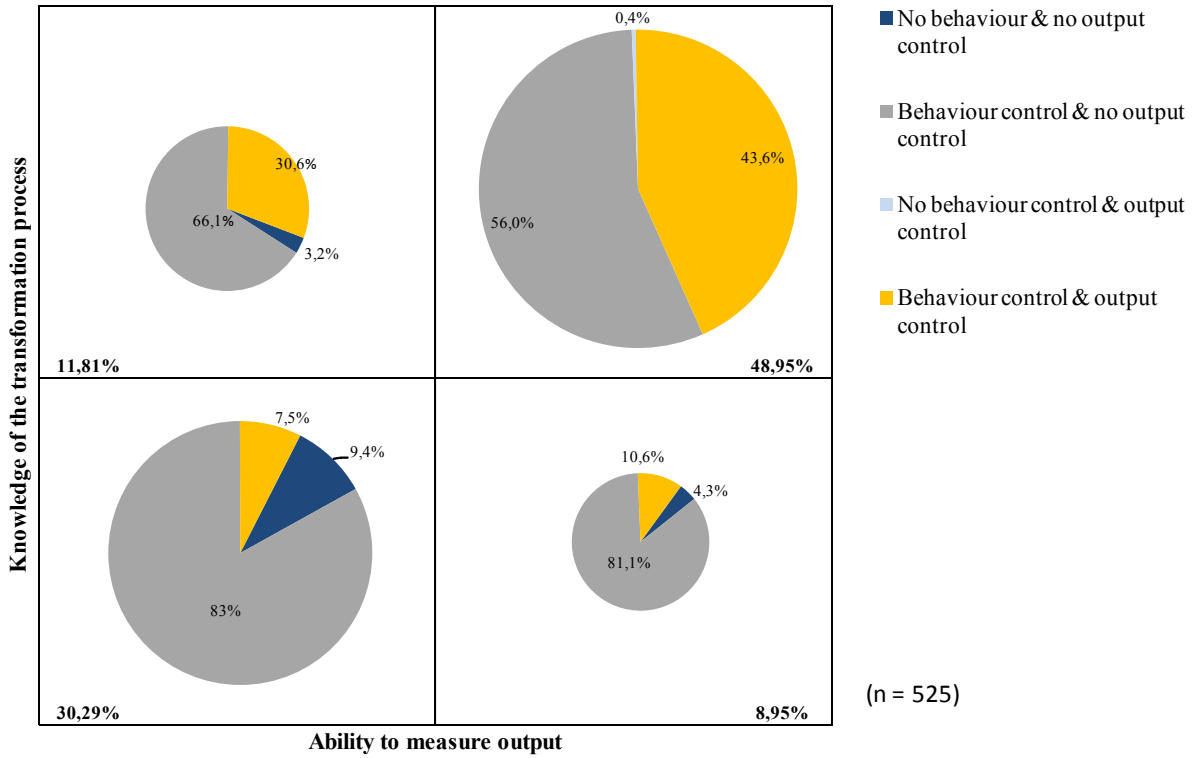

Figure 14: Classification of the Data Set within the Organizational Control Framework.
Source: Own research.

Considering output control, 381 (60.57%) of controls were found to be based on a specifiable outcome, while 207 (39.43%) were found not to be. 479 (91.23%) of controls are not dedicated to quantifiable extent of goal achievement, while 46 (8.76%) are. 164 (31.24%) of controls are directed to the end of a process and 361 (68.76%) are performed in a process's course. 176 (33.52%) of controls ended up with a grading of 0 and 199 (37.90%) with a grading of 1. 375 (71.42%) of controls are thus considered not to be output controls. 121 (23.05%) of controls scored 2 and 29 (5.52%) scored 3. 150 (28.57%) of controls are thus considered output controls. 17 control (3.24%) are low on both scales, knowledge of the transformation process and behavior control, while 301 (57.33%) are high on both scales. 318 (60.57%) match Ouchi's (1979) assumptions. For 3 (0.57%) controls the transformation process is known, but they score low on behavior control; and for 204 (38.89%) controls knowledge of the transformation process was rated low, while characteristics of behavior control are fulfilled. 207 (39.43%) of controls do not show predicted relations between these two constructs.

As literature suggests, the ability to measure output ought to predict usage of output control, the correspondence has to be assessed. 189 (36.00%) of tasks have no measurable output, and no output control is performed on them. 132 (25.14%) of do have measurable output, and output control is performed on them. 312 (61.14%) of all controls have been predicted accurately by their antecedent according to theory (Ouchi 1979). For 204 (38.86%) this is not the case, because antecedent and the implemented control mechanism do not match.

Results show, that 349 (66.48%) of all controls have been predicted accurately by their antecedents. 176 (33.52%) of controls have not been accurately predicted. Focusing on the latter reveals some interesting insights. Of these, 172 (97.73%) controls are behavior controls, which are implemented in a situation, where knowledge of the transformation process is low. Considering the theoretical assumptions on the catalyzing character of IT on organizational controls as discussed above, we reviewed additional information on these controls carefully. We found that of these 172 controls, 111 (64.53%) were of preventive character. Only 61 (35.46 %) were of detective character. Typical examples include using information systems to aggregate information for benchmark and tracking purposes. One financial control for example assesses ensuring that internal cost allocations are conducted correctly. The risk of wrong internal transfer pricing is assessed by aggregating transfer price calculations from each subsidiary on a regularly basis. Though from management's perspective, there is no transparency of internal price negotiations, figures can be aggregated and compared with e. g. the opposing subsidiary. In this case, the implementation of information systems eases executing the control regarding time and efforts. ERP systems serve as disintermediating catalysts by eliminating laborious tasks, which would make such controls uneconomic. Within the purchasing department, operational controls for incoming goods aim at preventing fraud. Within Beta, a matching between order and incoming goods is conducted using information systems, providing first indicators for fraud and error, if the deviation is of noticeable size. Similarly, other preventive controls are of ex ante character to identify potential error and fraud, before the incident occurs.

8.5 Discussion

The purpose of this study was to investigate the fit of an existing theory on organizational control design with modern IT-based management control systems. Our results suggest that the dimensions of 'knowledge of the transformation process' and 'ability to measure output' as antecedents for control design as proposed by Ouchi do not seem to explain design rationales in modern management control systems any longer. We find 'synchronicity' and 'certainty of actions' as promising indicators for control design. Although such concepts have been theoretically considered in research before (Ansoff 1975; Mundy 2010; Wiesche et al. 2012a), information systems enable organizations to explore these opportunities.

The data analysis disclosed four interesting observations, which we consider worthy of discussion. Two observations are related to the antecedents of organizational control design, two are related to the interpretation of control data and the usage within the management control system. Our observations and their discussion are summarized in Table 29.

First, we found that behavior controls preponderate output controls. Many of these controls are designed, considering the design rationales as suggested by literature. However, some violate the theoretical suggestions (Ouchi 1979). Analyzing the controls, which violate the cost-efficient design rationales, our results suggest that the importance of control costs decrease when companies that face stiff compliance regulations (Eisenhardt 1985; Jensen 1993). We argue that the analysis of the insignificance of control cost, caused by both IS and regulatory requirements, is an interesting endeavor for further research.

Second, our data suggest that behavior controls are implemented at different points in time. Behavior controls are implemented at an early stage of the process to collect information, which is not sufficient enough for decision-making (Ansoff 1975; Sia et al. 2002). Based on our analysis, we assume that IS reduce the costs of collecting control data, which leads to a more transparent agency relationship. We argue that the analysis of the effect of IS on the antecedents of organizational control design could be a stimulus for further research.

Third, our data reveal interesting combinations of organizational controls. Within Beta's control set, behavior controls are combined with input controls quite often. The gathered information helps using control information for rather exploratory control purposes (Speklé 2001). Our analysis suggests that IS allow converging insights that accrue from the organization and use these insights for decision-making. We consider the impact of IT on the design and usage of exploratory controls an interesting endeavor for further research.

Fourth, our case suggests the dynamic development of organizational controls. On a regular basis, Beta's develops new controls and reviews existing controls for effectiveness. Different controls are combined for exploratory purposes. The current state of the data set comprises various combinations of control types (Mundy 2010). We argue that IS reduce barriers to an integrated use of management control systems. We consider research on the impact of IS on the balance of organizational control systems as an interesting stimulus for further research.

Observation	Discussion	Stimulus for Research	Literature
Designing controls, which violate theoretical cost-efficient design rationales	The importance of control costs decrease when companies that face stiff compliance regulations.	Insignificance of control costs	(Jensen 1993; Eisenhardt 1985)
Behavior controls differ regarding of control point in time	IS reduce the costs of collecting control data, which leads to a more transparent agency relationship.	Antecedents of control design	(Ansoff 1975; Sia et al. 2002)
Exploratory combination of input and behavior control	IS allow converging insights that accrue from the organization and use these insights for decision-making.	Exploratory controls	(Speklé 2001)
Try different control types within process, remove inefficient ones	IS reduce barriers to an integrated use of management control systems.	Balance of control systems	(Mundy 2010)

Table 29: Observations, Suggestions, and Stimuli for Research in IT-enabled Organizational Control.
Source: Own research.

As implications for research, we provide empirical evidence that existing research explains today's organizational control systems only partly. We show that today's organizational requirements demand more controls than these, which are in line with existing theory. Although this exploitative usage of organizational controls is still prominent and hence relevant for organizational control research, our results reveal the need for further research on exploring organizational controls for ensuring organizational integrity (Wiesche et al. 2012b).

As challenges increase for companies to comply with legal as well as other regulations, questions arise on how to control compliance in this complex context. This research aids practitioners on deciding, what the most efficient and effective control type is. We provide evidence that automated controls are promising additions to organizational control systems.

For implementing IT-based organizational controls, we suggest criteria, which serve as antecedents of organizational control design.

However, there are several limitations that have to be taken into account. First, it should be conceded that this research is based on a single case study and therefore needs to be further evaluated in other contexts and broader samples. Especially the high degree of behavior control indicates an industry-specific phenomenon, which might limit the extent to which results can be generalized. In addition, although it is the most obvious, Ouchi's framework (Wiesche et al. 2011b) might not be the appropriate theoretical lens for researching this data set. Rather strategic theories for management control systems (Simons 1995) could provide further explanations and insights. From a methodological point of view, the independent classification of both, the control situation and the control type made an objective analysis possible. Using the developed independent classification criteria, we classified controls as both output and behavior control. However, this does not affect our findings since we did not consider existing measures of control efficiency. Nevertheless, the double classification leaves some open issues, which need to be resolved in further research.

8.6 Conclusion

To answer the research question, we reviewed existing literature on organizational control design in order to understand the catalyzing impact of IT on organizational control systems. In control theory, various characteristics have been investigated to predict the implemented control mechanisms. Ouchi (1979) suggested two dimensions as antecedents that would predict the control type most adequate for application. We operationalized the framework using existing items from literature. We show that only around 66% of controls implemented could be adequately predicted by determining the dimensions of knowledge of the transformation process and ability to measure output. In one third of the cases, theory could not reliably explain the implemented control. For the latter, exploratory analysis revealed synchronicity and certainty of actions as promising antecedents. Analyzing Beta's data set further indicates that controls, which were formerly implemented for different purposes can now be integrated to provide a more consistent picture of the organization, which needs to be controlled.

9 Why Do Organizations Prefer Exploitative IT-enabled Management Control Systems? An Exploratory Case Study

Title	Why Do Organizations Prefer Exploitative IT-enabled Management Control Systems? An Exploratory Case Study
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Publication	13th Annual Conference of the European Academy of Management (EURAM 2013)
Individual contribution	The author of this thesis participated in the study design, data collection, analysis and interpretation as well as in the conceptual development. He further significantly contributed to the creation of the manuscript.

Table 30: Bibliographic Details for Publication P6.

Abstract. Managers need to allocate scarce resources to either exploitative management control systems that refine organizational routines or to exploratory management control systems (MCS) that help to identify emerging threats and opportunities. In this paper, we use a case study with a financial service provider to understand how managers allocate information technology resources to exploitative and exploratory MCS. In contrast to established theory, we found that managers do not allocate IT resources equally but rather allocate IT predominantly to exploitative MCS. We drew from theory on creative processes to explain this behavior. That is, managers first use IT resources to master their exploitative management control systems through automation and digitization of routines and through establishing a common database for management control systems. This mastery of exploitative MCS serves as a catalyzer for allocating resources to exploratory MCS. Our study proposes new insights into the complex relationship between information technology and management control systems.

9.1 Introduction

Theory on organizational learning suggests that a balance of exploitative and exploratory management control systems is essential for effective management control (March 1991; Simons 2010). Exploitative management control systems help to align organizational behavior to the objectives of the organization's stakeholders ensuring short-term performance (Mundy 2010; Simons 1995). Exploratory management control systems provide measures "against undesirable surprises, capable of degenerating into catastrophes" (Fayol 1959, 109).

Literature suggests that IT-enabled management control systems allow managers to simultaneously pursue exploitative and exploratory objectives. Because IT-enabled management control systems enable organizations to establish coherent control, management can design management control systems that serve both, exploitative and exploratory purposes (Chapman/Kihn 2009; Dechow/Mouritsen 2005; Speklé 2001; Schermann et al. 2012). In practice, such systems are commonly discussed under the label of information systems for governance, risk management, and compliance (GRC IS) (Ashbaugh-Skaife et al. 2008; Racz et al. 2010; Mitchell/Switzer 2009; Hagerty/Kraus 2009). Automating elements of the control systems and the integration of control information create significant potential for coping with legal regulations more effectively (Fisher 2007; Volonino et al. 2004). In addition, GRC IS foster the interpretation of weak signals and provide rationales for action by using business intelligence techniques, patterns, and benchmarking (Chou et al. ; Hardy/Leonard ; Schermann et al. 2012).

While organizational learning theory postulates a balance of exploitative and exploratory management control activities, practice shows that organizations predominantly use GRC IS for exploitative use only (Caldwell et al. 2011). Applications include access rights, records management, and customs (Bamberger 2010). A seemingly obvious explanation for the predominance of the exploitative IT-enabled management control activities is the plethora of legal regulations and the effort required by organizations to report their compliance with these regulations (Parry 2004; Volonino et al. 2004; Ashbaugh-Skaife et al. 2008; Li et al. 2012; Karanja/Zaveri 2012). Yet practice shows that managers in charge of management control systems need exploratory capabilities such as fraud detection, data mining, process control, and continuous control monitoring in order to comply with legal regulations (Dooley ; McClean 2011; Jans et al. 2007; Caldwell et al. 2011; Jans et al. 2010; Debreceny/Gray 2010). Thus, we pose the research question: *How do organizations allocate IT resources to exploitative and exploratory management control activities?*

Because the interplay between the different constructs in management control systems is complex and requires understanding the phenomenon in its natural context, we conducted an exploratory case study using semi-structured interviews and company documentation to answer our research question (Siggelkow 2007; Benbasat et al. 1987; Yin 2009). In the context of our study we explored explanations for the predominance of exploitative IT-enabled management control systems. To provide a theoretical framework for our study we introduce GRC IS as an example of IT-enabled management control systems. We then analyze the impact of GRC IS on exploitative management control activities and lastly focus on the shift toward exploratory activities after mastering exploitative management control systems.

Following a description of the theoretical background for studying our research question, we explain our exploratory research strategy, outline our core analytic tenets, and present our analysis. After the presentation of our study results, we discuss our findings and outline their implications for theory and practice. Lastly, we provide a critique of the study's limitations, suggestions for further research and concluding statements.

9.2 Theoretical Background

Management control systems are understood as "formalized routines and procedures that use information to maintain or alter patterns in organizational activity" (Simons 1991). The importance of control systems for management decision-making was recognized as early as the late 1950's (Anthony 1965; Fayol 1959). Control systems are used to gather management information about the progress of implementing of rules, standards, and procedures and strongly drive organizational learning (Simons 1991; Henri 2006; Bisbe/Otley 2004; Adler et al. 2011). In the following sections we introduce literature on exploitative and exploratory management control activities, summarize the inconclusive role of IT in supporting these, and outline the gaps in research on the effect of IT on exploitative and exploratory management control activities.

Exploitative and Exploratory Management Control Systems

Typically, management control systems (MCS) are seen as tools for ensuring exploitation of existing resources. For example, top management uses MCS to communicate about intended strategies and plans to lower organizational levels and to gather information about progress in achieving intended strategies from lower organizational levels to top management. (Simons 1995). MCS are comprehensively discussed in diverse streams of literature such as accountability (e. g. Merchant/Otley 2006), performance management (e. g. Otley 1999), and budgeting (e. g. Flamholtz 1983).

Yet MCS are also used to support exploration and adoption. For example, top management uses MCS to communicate about the organization's strategic domain to lower organizational levels and gather information about emerging threats and opportunities from lower organizational levels (Mundy 2010; Simons 1995; Speklé 2001). MCS are used in a more active sense to achieve flexibility (Chenhall 2003; Ahrens/Chapman 2004), organizational change (Abernethy/Brownell 1999), and manage uncertainty (Ittner et al. 2003).

Extant literature discusses the use of management control systems for both exploitation and exploration. Literature on ambidexterity suggests combining exploitative and exploratory activities (Raisch/Birkinshaw 2008; Tushman/O'Reilly 1996). Empirical research on management control systems further suggests simultaneous balance of exploitative and exploratory management activities (Mundy 2010; Simons 1995; Simons 2010).

While various studies postulate the importance of achieving a balance of exploitative and exploratory management control activities (Mundy 2010; Simons 1995; Simons 2010; Tushman/O'Reilly 1996), strategies for achieving this balance have hardly been researched. A recent review points out the gaps of implementing ambidexterity and thus the development of exploitation and exploration (Raisch/Birkinshaw 2008). Recent empirical work outlines the

challenge of achieving balanced management control systems in organizations and calls for further research on achieving an optimal balance (Mundy 2010).

IT as Enabler for Achieving Exploitative and Exploratory Management Control Systems

The role of IT in supporting exploitative management control activities has been discussed controversially in the context of panopticism and workarounds (Kayas et al. 2008; Coombs et al. 1992; Ignatiadis/Nandhakumar 2009; Sia et al. 2002; Hanseth et al. 2001). While effects such as centralization and time reduction have been identified to enable decision support (Bruns/McFarlan 1987; Finnegan/Longaigh 2002), the increasing support for exploitation resulted in contradictory findings regarding the effect of IT. Empirical studies both confirm (Coombs et al. 1992) and dispel (Ignatiadis/Nandhakumar 2009) the idea that information systems foster management control systems.

Similarly, various effects of IT in supporting exploratory management control activities have been identified in the context of empowerment and enabling (Chapman/Kihn 2009; Dechow et al. 2006; Bloomfield/Coombs 1992; Sewell 1998). On an organizational level, integrated systems enable control (Chapman/Kihn 2009), allow the discovery of new control information (Dechow et al. 2006) and lead to the reinvention of new technologies (Boudreau/Robey 2005). On an individual level, collaboration and information processing allow self-management (Leifer/Mills 1996).

The above mentioned conflicting explanations on exploitation and exploration have been identified in the context of information systems and management control. While empirical research has shown that information systems support the simultaneous balance of exploration and exploitation (Schermann et al. 2012), other findings suggest an incremental approach (Marx et al. 2012).

Need for Understanding the Effect of IT on Exploitative and Exploratory Management Control Activities

The reason for exploring new aspects of exploitative and exploratory management control activities stems from a gap in the existing literature on strategies for balancing MCS in combination with the inconclusive IT effects on management control. Existing work on exploitative and exploratory management control systems grounds mainly in sectional analyses (Ahrens/Chapman 2004), thereby leaving the dynamics of balancing exploitative and exploratory MSC relatively unexplored. Understanding how organizations achieving a balance between exploitative and exploratory MCS has been established as an important challenge for management accounting research (Simons 1995; Simons 2010; Mundy 2010). Empirical research has shown that these two types of MCS are intertwined and hard to separate (Ahrens/Chapman 2004; Brown/Eisenhardt 1997). The role of IT in this context is controversial. While research has identified an integration of exploitative and exploratory management control activities as a major benefit for achieving flexibility and transparency (Schermann et al. 2012; Chapman/Kihn 2009), others found effects of IT such as the emergence of workarounds and loss of control (Leifer/Mills 1996; Ignatiadis/Nandhakumar 2009). This state of controversy indicates a need to understand the process of for balancing exploitative and exploratory MCS with the help of IT.

9.3 Research Method

Research Strategy

We conducted an exploratory case study using 13 semi-structured interviews and more than 180 pages of company documentation (Yin 2009; Eisenhardt/Graebner 2007). We followed the strategy of theoretical sampling for selecting interview partners, focusing on employees with IT-enabled management control experience (Siggelkow 2007; Yin 2009). In the following sections, we provide additional details on the practice driven phenomenon GRC IS, introduce our case company and data collection, and outline our strategy for data analysis.

GRC IS as a Form of IT-enabled Management Control Systems

The Sarbanes-Oxley Act (SOX) in 2002 spurred the development of IT-enabled management control systems as new form enterprise information systems, which can be categorized under the label GRC IS. These systems are used to support existing management control activities and have a prominent role in practice (Hagerty/Kraus 2009; Caldwell et al. 2011; Ashbaugh-Skaife et al. 2008; Mitchell/Switzer 2009). The most common platforms include: BWise, focusing on quantitative and qualitative risk and compliance management; SAP GRC, providing an integrated platform for role management, process control, and risk management; and Thompson Reuter's eGRC, providing advanced audit services such as regulatory content services, change and policy management, and regulatory tracking services. Although there have been efforts to formulate a standard definition (Racz et al. 2010), there is still no common understanding of GRC. A prominent definition by practitioners defines GRC as a "system of people, processes, and technology that enables an organization to understand and prioritize stakeholder expectations, set business objectives that are congruent with values and risks, achieve objectives while optimizing risk profile and protecting value, operate within legal, contractual, internal, social, and ethical boundaries, provide relevant, reliable, and timely information to appropriate stakeholders, and enable the measurement of the performance and effectiveness of the system." (Mitchell/Switzer 2009, 8). Various concepts, models, and frameworks for GRC, whose structure depends on the author's perspective on this broad topic, exist (Racz et al. 2010; Hagerty/Kraus 2009). GRC IS provide a variety of control mechanisms ranging from segregation of duties and process monitoring to risk management (Teubner/Feller 2008). For this research, we focused on functionalities of collecting control information (e. g. deficiencies), managing control workflows, control reporting, documenting and managing risks, policy management, fraud detection, and business continuity management.

Data Collection

Our case company Alpha is a large financial service provider based in Germany. Alpha employs more than 100,000 people in almost 70 countries, serving more than 50 million customers. Alpha serves as management holding to generate value through portfolio management, steering, and supporting operational excellence and synergies. Group business units include finance, operations, various regional units, and one unit in charge of control, risk, and reporting. Various national and international standards for operations, reporting, and transparency apply for Alpha.

We selected Alpha because it operates in a highly regulated and compliance-driven environment. Thus, established reporting procedures exist and employees focus on collecting and aggregating control information for management. We found Alpha particularly suitable because it has conducted several cost reduction programs, uses GRC IS within control processes, and is currently working on improving the IT support for management control activities. Before collecting primary data, we used existing company documentation and initial focus group discussions to understand the historical development of the departments and their control systems.

Department	Expert ID	Organizational level	Language	Length of interview	Professional experience
Operational risk	Risk expert 1	Operational	English	1 h 02 min	3 years
	Risk expert 2	Management	German	0 h 56 min	3 years
	Risk expert 3	Operational	English	0 h 37 min	2 years
	Risk expert 4	Operational	English	0 h 27 min	2 years
Compliance	Compliance expert 1	Operational	German	0 h 52 min	13 years
	Compliance expert 2	Management			5 years
Policy management	Operations expert 1	Operational	German	0 h 23 min	20 years
	Operations expert 2	Operational			15 years
Audit	Audit expert	Management	English	0 h 39 min	15 years
Business continuity	Corporate security expert 1	Operational	German	0 h 48 min	5 years
Psychical security	Corporate security expert 2	Operational	German	0 h 36 min	15 years
Corporate Security	Corporate security expert 3	Management	German	0 h 32 min	33 years
Information security	Information security expert 1	Operational	English	0 h 45 min	12 years
	Information security expert 2	Management	English	0 h 38 min	8 years
Investment operational risk	Investment expert 1	Operational	German	0 h 56 min	16 years
	Investment expert 2	Operational			12 years

Table 31: Characteristics of Interviewed Practitioners.
Source: Own research.

We then conducted 13 interviews with practitioners working on GRC in various organizational roles in order to achieve the highest diversity possible. Table 31 provides an overview of the interviewed employees, their department, experience, and level within the organization. We interviewed at least two practitioners from each unit with the exception of the audit department. The interviewees were practitioners on the operational as well as the management level. All practitioners had between 2 and 33 years of experience in their field, the average length of experience was more than 11 years. We conducted all interviews face-to-face in either German or English. Three interviews were conducted with two practitioners simultaneously, the others were conducted with one interviewee at a time. We used guidelines with semi-structured questions, including, but not limited to, questions about the way they handle their data, the information exchange with other GRC departments, the potentials of GRC systems, as well as the potentials for process synergies. At the end of each interview, we asked for any other details and pieces of information that the interviewees felt were relevant to the topic of our interview.

In the course of our research we also gathered unobtrusive data related to the implementation of IT-enabled management control systems (Yin 2009; Webb/Weick 1979). Our archival sources included minimum control standards, guidelines, trainings and conference materials.

We collected 183 pages of documentation across the departments. We observed the implemented GRC IS during daily work and conducted a focus group discussion on the advantages of a particular GRC IS. We continuously reflected on this information during our interviews and adapted the questions we posed as needed. We accompanied Alpha through implementing GRC IS and documented decisions and process steps. Figure 15 provides an overview of the final GRC IS landscape at Alpha.

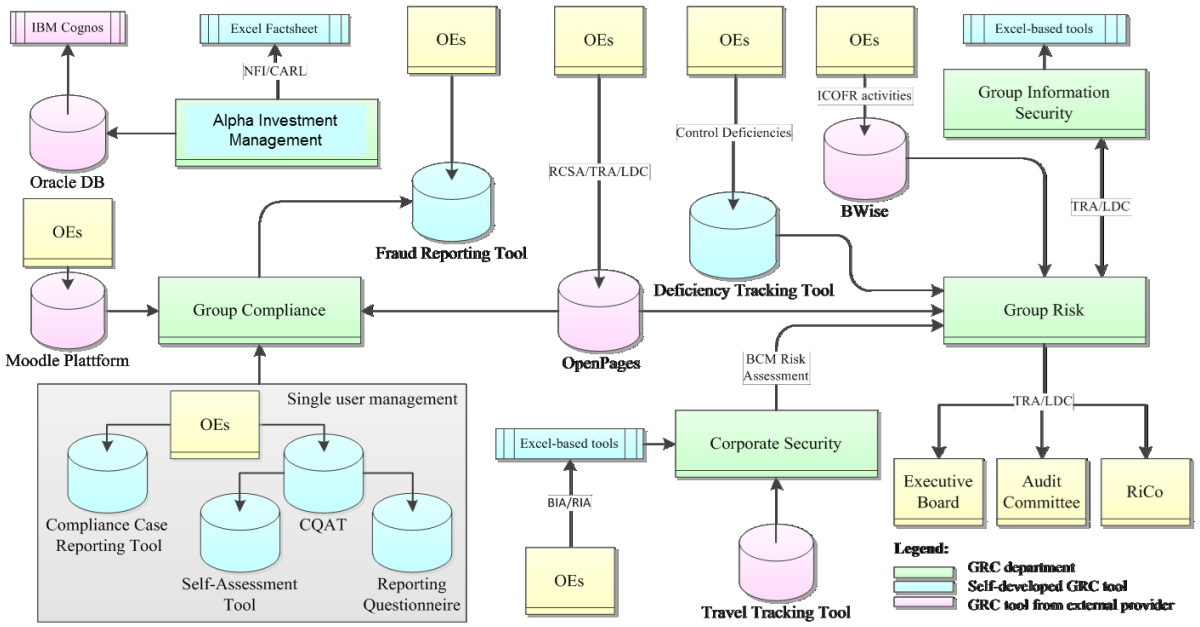

Figure 15: Overview of the Implemented GRC Information Systems at Alpha.
Source: Own research.

Data Analysis

We transcribed each interview and integrated the transcripts using the software ATLAS.ti into one hermeneutic unit comprising 52,578 words and 131 pages of text. We conducted the coding by employing qualitative content analysis (Krippendorff 2004). The quotations derived from the interviews reflect experiences, impressions, opinions, wishes, and assessments regarding the phenomenon under analysis.

We ensured external validity of our results using a consistency check of single quotations across units and through a comparison of results with archival data from the case and results from the literature review. We followed the recommendations of Yin (2009) for applying analytic generalization. Here, generalization is not – as in quantitative research - based on principles of statistical interference. The case exemplifies the gap in literature on strategies for achieving exploitative and exploratory management controls by illustrating the causal relationships and relating theoretical constructs close to practice-defined variables (Siggelkow 2007). Finally, to increase the reliability of the results, the interviews were coded independently by two people. First, the second author read and coded the interview transcripts line-by-line using the developed coding categories. The first author similarly coded the transcripts independently. Both authors then discussed and agreed on the differing codes. A comparison was then made of the codes with archival data and existing literature. This resulted in a final list of 57 codes and 273 quotations.

9.4 Results

Alpha conducted the introduction of GRC IS as IT-enabled management control system in different phases. As depicted in Figure 16, Alpha first focused on the improvement and standardization of existing processes. Those employees in charge of introducing GRC IS understood this as a necessary condition for the implementation. After implementing GRC IS, Alpha focused on transferring the information into the new system and ensuring data quality. Alpha is currently working on data transformation and quality issues and will start using the GRC IS for other purposes as soon as these phases are finished. Other purposes include exploratory data analysis and the combination of control information for management.

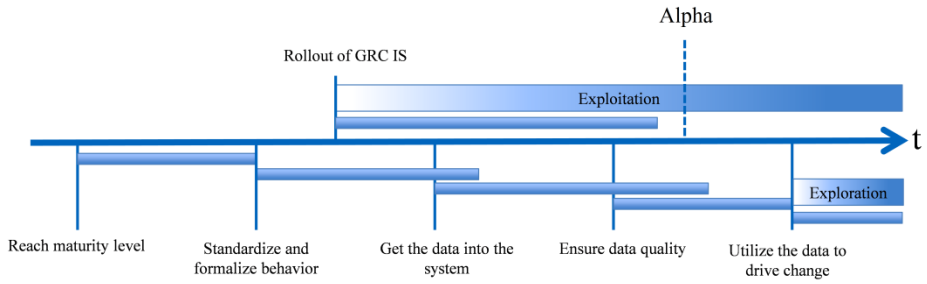

Figure 16: Overview of the Introduction of GRC IS at Alpha.
Source: Own research.

Predominance of Exploitative Management Control Activities

The interviewed employees of Alpha use GRC IS in different contexts and for different purposes. The interviewees provided arguments for regulatory obligations and external requirements, which necessitate mature control management: in this type of large and distributed organization, this is hardly possible without the support of integrated information systems such as GRC IS. From our data we identified four different dimensions of exploitative use of GRC IS: documentation efforts, work automation, process improvement, and integration. These dimensions are all defined by the employee's job description and comprise activities, which are conducted regularly to achieve a pre-defined goal. Thus, they are exploitative in nature. In the following we introduce each dimension and provide examples of it from the interviews.

Regarding the dimension of documentation, GRC IS allows central storage of the control data and provides standardized formats for documentation. This effect is particularly important since external auditors and legal regulations strictly require documentation of compliance related information. Having an integrated solution enables completeness of documentation, even in different locations.

> *"[GRC IS] support the documentation of SOX activities. It helps identify the key calcs, for example process risk controls. So, this application helps to document the business process, risks, and controls. Our risk managers can do risk assessments on their own spreadsheet and integrate this information in the GRC IS. We use regular tests and check for correctness and completeness. So it serves as a kind of workflow." (Risk expert 1)*

In addition, GRC IS support management control activities in terms of automation. Control execution can be automated and defined workflows allow control enforcement and assurance. Control data are provided almost in real-time. This is particularly useful for ad hoc reporting. In contrast to standard reports, management often requires certain control analysis as soon as possible. GRC IS support this by providing the relevant information and allowing flexibility for generating individual reports.

> *"We used to send out manual survey templates to all departments. To almost 100 people. Every three months we sent Word files and received printouts, scans, Word files, and excel spreadsheets. We had to manually evaluate the data and could hardly do any further analysis. Now they get their templates in [GRC IS], but can download Word files and excel spreadsheets and re-import them afterwards. Then we can draw various reports from the system." (Compliance expert 2)*

By allowing control workflow management and integration, GRC IS provide process improvement. Such systems reduce process throughput time and the number of unnecessary process steps. Of importance, efforts for printing and manually transferring control information back into information systems can be reduced. Helpful structures such as templates and pre-defined content within GRC IS not only reduce rework, but also reduce errors during daily business. As one of the most prominent problems in management accounting, GRC IS allow standardization of control information. Though it requires strong organizational structures and exact guidelines, GRC IS can help implement standard control processes and reporting.

> *"[GRC IS] advantages include standardization, but you have to do that before you get the tool. Then you have some constancy of managing certain security risks. For example, compliance reporting moments are horrible manual processes which take weeks. […]The key thing is that you can easily link policies to industry frameworks. [GRC IS] has a database built inside which I use. I link payment card policies to – let's say - ISO 27000 or COBIT. So if you have a policy change, you know what it will impact. As there are other industry standards we need to comply with, you have to have that data linked." (Information security expert 1)*

A fourth dimension of IT effects in GRC IS is providing an integrated perspective on control information throughout the organization. Pre-defined structures allow benchmarking between different strategic business units. Standardization and consistent risk assessment increase comparability of such solutions. In addition, an organization-wide solution for providing access to control information allows security and privacy requirements to be fulfilled.

> *"The systems help us to better compare units. […] For instance, there is no objective reason why two units of the same or similar size would have significant differences in the volume and number of losses that have been reported. If one unit such as France reports 200 losses in a year but a unit such as Spain hypothetically only 10, then that would tell me that France has better implemented [risk management] and not that Spain has less losses." (Risk expert 2)*

Our results indicate that the introduction of an IT-enabled management control system at Alpha predominantly supports exploitative management control activities. Alpha reports on various benefits of GRC IS to support management control activities. Efforts for documentation, automation, process improvement, and integration all have in common that they improve existing exploitative management control activities.

Exploitative IT-enabled Management Control Activities Increase Potential for Exploratory Activates

After providing evidence for the dominance of exploitative management control activities when introducing IT-enabled management control systems, we now focus on the effect of IT-enabled management control systems on exploratory activities. First, our data indicate that IT eases compliance-related management control activities.

> *"Our tools support documentation, reporting, aggregation of reporting and make it more efficient. For government and regulatory agencies who want certain information, we can provide that data. Take for example Solvency II, we can use the tools to support requirements from our regulators in terms of information requirements, documentation and reporting." (Risk expert 1)*

While we outlined the compliance-related control activities above, there are several interesting statements about the time gaining effect and thus the increase of capabilities for exploratory activities as well. Interviewees stated that they understand the need for and importance of their risk reporting, security monitoring or compliance integration functions in the organization. However, they seemed to be more focused on exploiting existing activities rather than developing new uses of the control information. Interestingly, they do not argue that it is not their task to innovate in control reporting, but that the current situation requires improving existing processes before initiating new ones.

> *"I have got 10 risks that are not of any use, getting a database to store them does not really help me. […] Once you have got a big and robust data set, managing it by spreadsheets is too much work […]. But if I have got 2,000 useful risks then a database will allow me to manipulate and report on it. So I am not saying do not use tools but you will have to do a lot of work to get any value out of them. Many organizations throw hundreds of thousands Euros in tools and then realize they have not actually generated any value, because they have not figured out what is broken in the first place before they buy the tool." (Information security expert 1)*

Across all departments, Alpha employees see the need for improving processes and reducing work by introducing software such as GRC IS. Yet, mature organizational processes are required to accomplish this. Instead of using GRC IS for improving existing processes, such systems reduce existing work and leave time for other tasks.

> *"We could use [GRC IS] to report our top risks to management. That would save so much time instead of manually collecting all the data. We gain time by using the software and not entering all the information over and over again. […] But we would therefore have to change our reporting structures. We need to model and define proper processes and then*

introduce the software. I do not want the software to introduce its own processes. That does not help at all." (Corporate security expert 1)

Similarly, other departments are currently working on improving processes, which could then be supported by IT. When asked for outlining the reasons the risk department should implement a GRC IS, the interviewees gave various reasons for exploiting existing functions. They did provide some innovative ideas, which necessitate the standardization of the risk department's processes.

"There are different reasons. One is efficiency. Clearly it is inefficient to have many fractured smaller processes and tools supporting those processes. It is much easier for management to interpret, act on that information if it is coming from a common language or a common methodology. […] The tools come after the methodology alignment. […] It makes it much easier to have a single tool." (Risk expert 4)

Our results indicate that exploitative IT-enabled management control activities free capacities for exploratory capabilities. We found that Alpha uses IT-enabled management control activities to master their exploitative management control activities, i.e., to cope with compliance requirements. Reducing throughput times, manual steps, and documentation efforts make exploitative management control activities more efficient. This means more time to spend on other tasks.

Focus on Exploratory Management Control Activities

Several departments at Alpha are currently working on mastering their exploitative management control activities. Some departments already have very mature processes and had implemented GRC IS in order to focus on exploratory management control activities. While control contexts and purposes differ in different units, employees across units see exploratory uses of IT-enabled control systems.

"This reporting is helpful. In the GRC solution, we can assemble a report for [top risk report at Alpha] automatically. So we can automate all these manual data collection tasks within the software. We save lots of time and it helps to think out of the box." (Operations expert 2)

"There are different ways that we can break the information down in the system. What we are still working on is to break them down by […] subfunctions and by Basel II operational risk categorizations. We can also break them down by units. We can say we want to look at the operational risk profile of units this size based on a range of revenues. […] That is something that we are still working on. […] The focus last year was getting the mechanics in place and helping the OEs to implement the process. Now, they have got the data in the system and once we exit this project stage, then we will work more on utilizing the data to drive change." (Corporate security expert 2)

„Consider our anti-fraud processes. We have a fraud reporting tool. At the same time we get some numbers from our [Operational risk], but they have different thresholds. […] Some fraud does not affect the organization, because sometimes we can get the money back. Then we do not get the operational risk reported. Yet, we want to see these cases as well. Those that

do not manifest financially as operational risk. We want an integrated perspective in order to report to management and audit committee. […] But that is not related to IT – it is matter of thinking." (Risk expert 2)

While the last statement clearly states that exploratory management control activities are not a matter of information systems such as GRC IS, we found that GRC IS directly eased Alphas exploitative capabilities and hence provided a focus on exploratory management control activities. Indeed, our findings showed that Alpha uses GRC IS to provide an integrated database for exploratory analysis of control information.

> *"I think that the tool has a lot of potential because it is very flexible. It is quite easily customizable. In terms of innovation it has a lot of future potential to continue the annual processes to that tool. Whether it is something that we want to do or not is another question, but it has that potential. You could probably find some innovative things in that area, but we have not thought about that yet." (Risk expert 4)*

Our results indicate that after mastering exploitative management control activities, Alpha starts exploratory management control activities. And, after implementing IT-enabled management control systems to master their exploitative management control activities, employees at Alpha can now focus on other tasks, such as innovative usage of the collected control information. In combination with the units' task of providing rich control information to prevent undesirable surprises, one can argue that after mastering exploitative management control activities, organizations can focus on exploratory management control activities.

9.5 Discussion

The case of Alpha illustrates that organizations use IT-enabled management control systems mainly to support exploitative control activities. Our results indicate that even in a highly regulated setting, the organization we examined pursued IT-enabled exploitative management control activities not only for compliance but for other reasons as well. While we found several motivating factors that stem from refining compliance, we also found that organizations acknowledge the benefit of using IT-enabled management control systems such as GRC IS for exploratory purposes. We conjecture that our case organization, Alpha, must first fully master their exploitative management control activities before they can focus on experimenting, risk taking, variation, discovery, and innovation.

While March (1991) advocates the balance between exploitative and exploratory organizational learning activities, Bradshaw, Langley, and Simon (Bradshaw et al. 1983) show that exploratory capabilities are a function of exploitative capabilities. Their results suggest that organizations need to master exploitative learning before engaging in exploration. The authors argue that "the less blind the search - that is, the more existing theoretical knowledge is available to guide it and turn it from unprofitable directions - the more readily and directly are the regularities hidden in empirical data discovered" (Bradshaw et al. 1983). Following this argument, organizations should first take care of their exploitive learning capabilities before they start exploratory activities (Simon 1985).

Reflecting on March's notion of balancing exploitative and exploratory organizational learning (March 1991), our results question the possibility of simultaneously enhancing exploitative and exploratory IT-enabled management control systems. Our study results indicate the need for mastering exploitation before focusing on exploration and are in line with Simon's results that successful innovation requires skills and knowledge (Simon 1985). Reflecting on ideas of mastering exploitation before initiating exploration proposed by Bradshaw, Langley, and Simon (Bradshaw et al. 1983), our empirical data confirms that organizations will first focus all of their limited resources on exploitative learning. After mastering exploitative learning activities, the absorptive capacity of the organization becomes available. Referring back to March's argument (March 1991), organizations in this situation will then have the resources to start exploratory learning activities. Hence, Simon's perspective on mastering exploitation before conducting exploration (Simon 1985) may serve as an explanation for implementing a balance between exploitative and exploratory management control activities.

Our study findings have implications for the management control literature. We suggest four distinct design recommendations for IT-enabled management control systems. (1) Management control systems have to be designed to serve multiple purposes. Control information, especially in the case of exploratory activities, has to be rich and easy to analyze. Thus, exploitative management controls could serve as a basis for exploration by providing information and structure. When management controls are implemented for exploitative purposes, they should simultaneously collect standardized information, which can be used for exploratory management control activities as well. This can be accomplished by using standardized information retrieval and continuous control monitoring. Integrated information systems such as GRC IS support the multipurpose use of management controls (Schermann et al. 2012). (2) In order to provide resilience against undesired outcomes, organizations should design coherent management control systems, consisting of both exploitative and exploratory elements. Similar to the strategic use of management control systems (Simons 1991; Henri 2006; Widener 2007), our data show that control mechanisms benefit from coherent design as well. We found that when implementing IT-enabled management control systems within organizations, it is important to (3) align the system with existing processes. As discussed in the IS adoption literature (Markus/Keil 1994), information systems must meet user requirements to support or fulfill certain tasks. This is particularly important in the case of IT-enabled management control systems designed to meet regulatory requirements. Compliance guidelines, control definitions, and reporting standards require particular attention and should be aligned with IT-enabled management control systems. Knowledge intensive processes such as management control fundamentally depend on the availability and quality of data. This means that existing control information has to be accessible and comparable. IT-enabled management control systems support this requirement by (4) providing an integrated database for control information. Similar to Enterprise Resource Planning (ERP) solutions on the operational level (Chapman/Kihn 2009; Dechow/Mouritsen 2005), GRC IS support activities at the managerial level by providing rich control information on a timely basis.

We found that in the context of management control activities, IT enhances an organizations exploratory management control activities (Speklé 2001). When IT reduces the amount of work required for exploiting activities, organizations free resources for exploration. Employees can use the resulting spare time to explore innovative controls and experiment

with control information. Thus, our data suggest aversion of stagnation in management control systems when IT is employed. While March argues that focusing first on exploitation will lead to a substitution of exploitation for exploration (March 1991), we argue that initiatives, which reduce effort, such as the introduction of IT-enabled management control systems, leads to a trend toward exploratory management control activities. Our data suggest that management control activities should first focus on exploitation, which then – through IT – frees up time for exploration. Trends in automation, such as mining for fraud patterns, will further reduce the effort of exploitative control activities and focus on exploratory control systems in order to guard "against undesirable surprises, capable of degenerating into catastrophes" (Fayol 1959, 109).

9.6 Limitations and Further Research

We acknowledge that there are limitations to our study. First, this was a single case study which limits the generalizability of our results (Mayring 2007). The selection of only 13 practitioners could bias findings and further limit the generalization of the results to a larger population. Although we included multiple sources of evidence, used theoretical sampling for interviewee and topic selection, and continuously compared our results with our theoretical assumptions (Krippendorff 2004), further research would surely benefit from using a larger sample and cross case analysis (Yin 2009). Alpha was selected because it is an organization operating in a highly regulated and compliance-driven environment. We selected largely independent departments with differing tasks and job descriptions in order to increase generalizability. The existence of both operational and management perspectives in each department interviewed helped us address differing types of work along with IT-enabled MCS.

Bradshaw, Langley, and Simon's perspective of mastering exploitative learning before engaging in exploration (Bradshaw et al. 1983) is based on findings at the individual level. Though similar concepts are applied in the context of absorptive capacity to organizational levels (Cohen/Levinthal 1990), knowledge of such effects in the domain of management controls is very limited.

Future research should address effects of IT-enabled management control systems such as workarounds (Ignatiadis 2007) or enabling controls (Adler/Borys 1996; Chapman/Kihn 2009). Finally, some of the functionalities of GRC IS were newly introduced to the market by GRC IS providers at the time of our study. Hence, it is difficult to account for or speculate about longer-term effects of GRC IS. Future research should investigate these longer-term effects especially in terms of exploratory management control activities.

9.7 Conclusion

Our research was guided by understanding how organizations allocate IT resources to exploitative and exploratory management control activities. We answered this research question by conducting a single organization case study: our results shed light on the introduction of GRC IS as an IT-enabled management control system. We found that our case organization shifted toward exploratory activities after mastering exploitative management control activities. Managers first use IT-enabled management control systems, such as GRC

IS to master their exploitative management control activities. This mastery of exploitative MCS serves as a catalyzer for allocating resources to exploratory MCS.

Part C

10 Summary of Results

The developed pattern catalogue (P1) provides an overview of control objectives that can be supported by GRC IS. It illustrates the challenge addressing a plethora of compliance requirements presented to organizations. We identified several overlaps between control requirements and found that many regulations can be integrated into similar control patterns. However, the relationships between these patterns remain, which increases complexity. The study provides a structure for analyzing functionalities of IT-enabled management control systems. The results suggest that current information systems support certain control activities and require additional functionality for supporting others. Other patterns require changes of organizational structures and stakeholder's values. Our results suggest that such control patterns can only be supported insignificantly by IT.

The second study (P2) explores the role of IT in changing the organizational control situation and suggests that through IT, the overall knowledge of the transformation process within an organization is enhanced. We argue that this development will turn former behavior controls into more granular output controls. Our results further suggest a risk-based perspective on control design decisions (Rikhardsson et al. 2005) as the cost-oriented criterion of organizational theorists (Eisenhardt 1985; Ouchi 1979) is diminished through the ubiquity of IT. This is particularly relevant in situations with high knowledge of the transformation process and high ability to measure output.

The third study (P3) structures reasons why organizations use GRC IS. We found these value drivers to be ensuring proper control implementation, monitoring control effectiveness, enhancing transparency and management's responsiveness, and backing for actions. We found that instead of only improving existing control functionalities through reducing reporting intervals and enabling investigations at reduced costs, GRC IS support organizations in exploratory analysis of control information and in orchestrating new controls as well. An additional round of data collection (P4) confirmed the found value drivers and highlighted the importance of a coherent design of the management control system. We synthesize organizational integrity as new control objective and suggest 'synchronicity' and 'certainty of actions' as new antecedents for control mechanism design.

A case study (P5) reviewed Ouchi's (1979) taxonomy and suggests limited usability of the taxonomy for predicting control design choices. The larger amounts of the analyzed controls violate the theoretical cost-efficient design rationales. Furthermore, different controls are combined for addressing similar purposes. We observe that GRC IS allow converging insights that accrue from the organization, behavior is observed at different points in time, and existing and new controls evolve over time. Finally, (P6) we accompanied the implementation of a GRC IS and found that organizations first master exploitative control activities through documentation efforts, work automation, process improvement, and integration of control information and then focus on allocating resource for exploratory control activities. Table 32 provides an overview of the findings in the embedded papers.

Paper	Finding
P1	F1: Overview of control objectives that can be addressed by GRC IS
	F1.1: Outline similarities, overlaps, and relationships between regulations
	F1.2: Provide indicators for assessing the maximum degree of IT support
	F2: Suggest structure for analyzing functionalities of GRC IS
P2	F3: Impact of IT on antecedents of control mechanisms design
	F3.1: Overall increase of 'knowledge of the transformation process'
	F3.2: Risk-based perspective on control design choices
	F4: IT allows transformation from behavior control mechanisms to output control mechanisms
P3	F5: Summarizes arguments why organizations implement GRC IS
	F5.1: Ensure proper control implementation through automation & digitalization
	F5.2: Integrate controls to monitor control effectiveness
	F5.3: Use Business Intelligence to enhance transparency and this management's responsiveness
	F5.4: Provide backing for actions by developing and documenting patterns and benchmarks
P4	F6: Provides understanding of the role of IT in supporting exploratory control activities
	F6.1: Integration reduces of costs of control data collection
	F6.2: Centralization provides more control information in a timely manner
	F6.3: Standardization eases comparability and understanding of control information
	F7: Coherence as a way to ease the balancing of exploration and exploitation
	F8: 'Synchronicity' and 'certainty of actions' as new antecedents for control mechanism design
P5	F9: Review of existing taxonomy using control set from case organization
	F9.1: Existing theory predicts 2/3 of existing control mechanisms
	F9.2: The predictive part of the framework covers only 20% of the control mechanisms of the case organization
	F10: Characteristics of the analyzed control mechanisms
	F10.1: Control mechanisms provide information early in time
	F10.2: Orchestration of several control mechanisms to fulfill similar purpose
	F10.3: Dynamic development of control mechanisms
P6	F11: Process for implementing GRC IS
	F11.1: Mastering exploitation serves as a catalyzer for allocating resources to exploration
	F12: Incorporating exploitative control mechanisms in GRC IS
	F12.1: Support documentation efforts
	F12.2: Work automation
	F12.3: Process improvement
	F12.4: Integration of control information

Table 32: Summary of Results.
Source: Own research.

11 Discussion

The six papers included in this thesis provide a more thorough understanding of the role of IT in management control systems. We contribute to addressing the aforementioned challenges in several ways. In the following, we discuss our finding across the publications and use quotes from the papers to illustrate our argument. Figure 17 links the findings from the embedded publications with the introduced challenges and introduces the following discussion points.

11.1 Questioning the Assumptions of Cost-Efficient Control Design Choices

This thesis strengthens the argument that IT improves existing control activities through centralization, integration, automation, and standardization (Quattrone/Hopper 2005; Dechow/Mouritsen 2005; Finnegan/Longaigh 2002; Coombs et al. 1992). The empirical results further suggest that IT reduces efforts for control information collection. In contrast to existing ERP solutions that do not have the capability to store all relevant management control information (Dechow/Mouritsen 2005), GRC IS provides organizations with an integrated and centralized control information storage (P3, P4). GRC IS thereby reduce data collection efforts. Standardized information requirements for control mechanisms (P2) ease usability of existing information that facilitates ongoing supervision without human intervention (Elmes et al. 2005; Sia et al. 2002; Kayas et al. 2008).

We observe several developments that question the existing assumptions of cost-efficiency in control design. In situations, where knowledge of the transformation process is low, we found several output controls (P2, P5). These output controls were spread across the value creation process and tightly combined. This suggests that former behavior controls are replaced with several output controls. IT supports the transformation from behavior to output control by providing timely, cheap, and exact information for benchmarking. This might explain why certain controls feature characteristics of output and behavior control and thereby violate existing theoretical cost-efficient design arguments (Eisenhardt 1985; Ouchi 1979). We further observe that organizations combine different control mechanisms for similar exploratory purposes (P5). We argue that GRC allow converging insights that accrue from the organization and use these insights for decision-making. This argument is strengthened by the continuous substitution and refinement of existing controls. As a senior manager illustrates:

> *"The events of the past years show that things are not as unrealistic as expected. In collaboration with the executive committee, we had to decide whether we use IT-enabled risk management to reduce compliance costs or to recognize unsatisfactory events early enough to develop countermeasures. […] Therefore, we invested in software for GRC and are currently developing controls and KPIs, which will be integrated within our daily business to recognize risks earlier."*

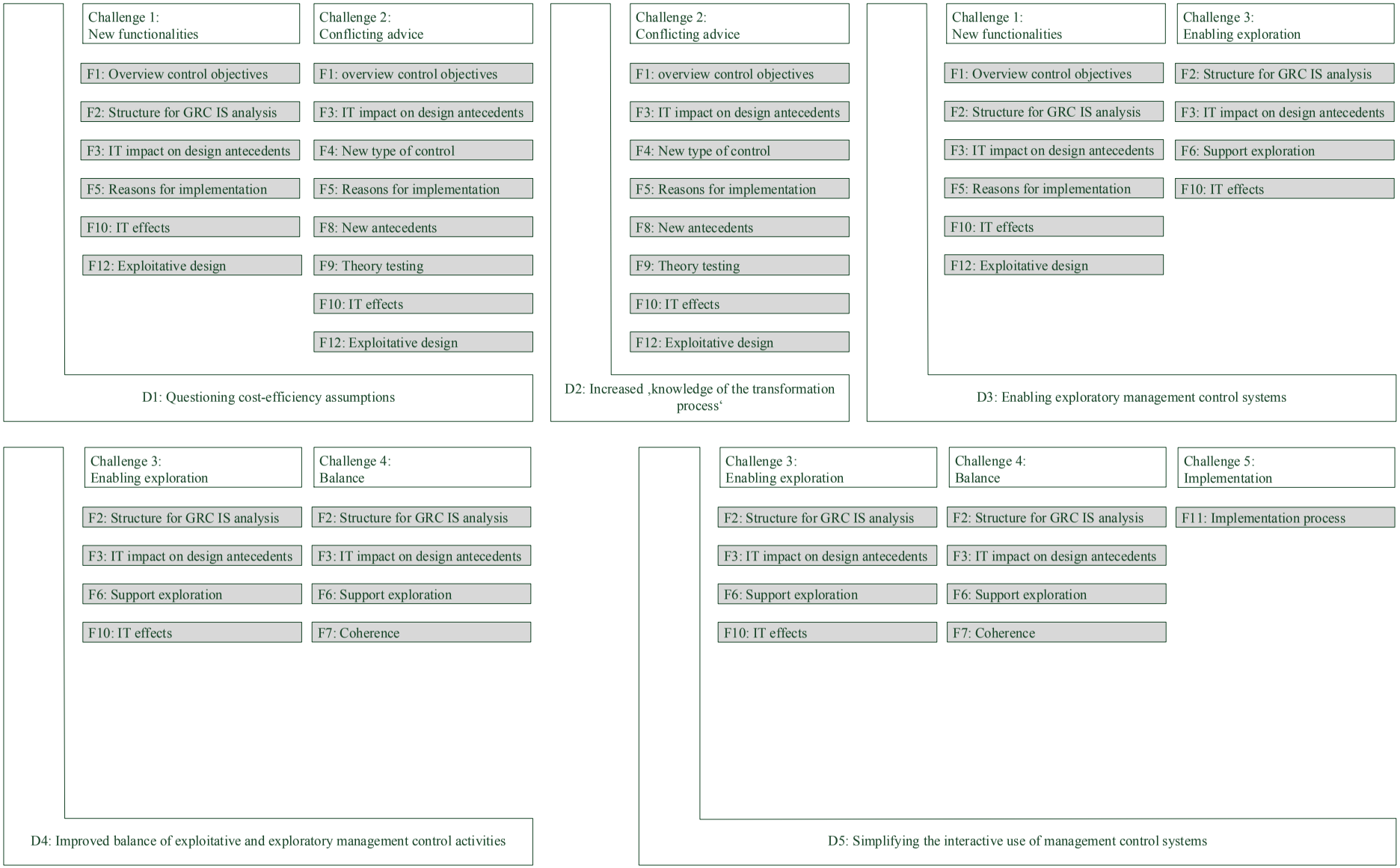

Figure 17: Linking the Addressed Challenges (C) with the Findings (F) to Introduce the Discussion (D).
Source: Own research.

Our analysis (P4) suggests that while the existing exploitative antecedents of 'ability to measure output' and 'knowledge of the transformation process' are still valid for detecting performance deviations exhaustively and in a timely manner, control design decisions for exploratory control activities are based on risk-oriented rationales. Based on our results, we propose 'synchronicity' - the point in time, where management is informed - and 'certainty of actions' for managerial decision-making as antecedents for exploratory control design choices. This reveals a transformation from a cost-oriented perspective on control design choices (Eisenhardt 1985; Ouchi 1979) to a risk-based perspective. Another senior manager argues:

> *"I can conduct real time monitoring. That means that I can see something happen as soon as it occurs so I don't have to reconstruct the event afterwards. This of course covers a lot more information – though still not complete – than a certain excerpt that I request afterwards. This is the difference -- and it is automated. No one is sitting for two weeks analyzing stuff that happened months ago."*

This may turn management control systems from reactive and random audits to holistic and proactive information sources that protect organizations "against undesirable surprises, capable of degenerating into catastrophes" (Fayol 1959, 109).

11.2 Increased 'Knowledge of the Transformation Process'

Ouchi's theory predicts different forms of control depending on the organizational antecedents 'ability to measure output' and 'knowledge of the transformation process'. Based on these antecedents, control mechanism design decisions are made. However, our results suggest that with information technology becoming ubiquitous these two antecedents are less relevant for control mechanism design decisions. We especially question the dimension 'knowledge of the transformation process' for three reasons: modern organizational processes are pervaded with IT that (1) enhances managerial transparency and oversight, (2) increases the reliability of control information through unambiguous measures, and (3) reduces the efforts for control information collection.

Our results confirm that with IT, managers gain transparency of organizational value creation processes. Since the development of the original control mechanism design framework in the 1970s, several IT developments fundamentally changed how organizations create value. The business process management paradigm (Davenport 1993), workflow management systems (Reijers/van der Aalst 2005), or ERP systems (Dechow/Mouritsen 2005) all provide a more structured perspective on organizational processes. ERP systems for example enforce organizational procedures that require greater conformity and discipline as they are embedded in software routines (Elmes et al. 2005, 3). Thus, IT-enabled management control systems help managers in using this information for control purposes (Sia et al. 2002). Deviations from pre-defined behavior guidelines are recognized automatically and reported instantly. Even for processes, where the steps for value creation are not fully clear, information can easily be gathered and as soon as enough information is available, control mechanisms can be designed to meet this uncertain situation. We argue that with IT, organizations are more often confronted with situations where knowledge of the transformation process is high rather than low. One participant of the study argued:

> *"Process control applications optimize […] business operations and help ensure compliance and mitigate risk by centrally monitoring key controls for business processes and cross-enterprise IT systems."*

IT-enabled management control systems increase the reliability of control information (P3, P4, P5). Organizations collect information on business processes in a standardized manner. Using information systems for data collection reduces the amounts of errors for collection and preparing information. Organizations may further limit the possible form the information is provided and thus increase comparability and non-ambiguity of control information.

Additionally, IT reduces the cost of data collection of control information (P2, P6). Integrated information systems such as ERP systems automatically collect a vast amount of information that can be used for control purposes (Dechow/Mouritsen 2005; Chapman/Kihn 2009). Management can acquire additional information at reasonable costs. New control mechanisms often only require additional software functionalities. These do not hinder the value creation process by requiring organizational members to spend time on data collection. Even complete management control systems can often be implemented using existing information or be integrated into existing information systems that can easily provide this information. Thereby, the completeness and accuracy of control information can be increased. After the implementation of a GRC IS, when asked about the benefits of the new solution, one risk manager confirmed:

> *"There are different reasons. One is efficiency. Clearly it is inefficient to have many fractured smaller processes and tools supporting those processes. It is much easier for management to interpret, act on that information if it is coming from a common language or a common methodology. […] The tools come after the methodology alignment. […] It makes it much easier to have a single tool."*

The high degree of knowledge of the transformation process throughout the organization has consequences for control mechanism design as well. The ability to gain information on almost any organizational activity at reasonable costs, leads organizations to choose different control mechanisms based on other decision criteria. Our theory of exploitative and exploratory management control activities (P4) suggests timeliness and certainty of actions as new antecedents. While there will always be situations like research and development labs where informal control mechanisms such as clan control may be the mechanism of choice, our study (P5) of Gamma, which is similar to Ouchi's tin can plant lets us assume that IT allows more situations with high clarity with which performance can be assessed. We argue that through the ubiquity of technology and the decrease in costs of data collection the importance of 'ability to measure output' and 'knowledge of the transformation process' as antecedents for control mechanism design is reduced.

11.3 Enabling Exploratory Management Control Systems

An important potential of IT-enabled management control systems is supporting organizations in implementing exploratory control. Exploratory control is exercised in situations with low ex-post information asymmetry, imperfect knowledge of the transformation process, and low ability to measure output. As exploratory control is characterized by a high autonomy for the

controlee, the controller requires information to see whether controlees are still on the right track and to predict long term performance. This is particularly challenging as control information come with a high degree of uncertainty and fragmentation. The right behavior and thus the accompanying controls emerge during the process. Yet, management has to judge controlees expertise and organizational learning during the process.

We found that GRC IS contribute to resolving these information asymmetries. GRC IS provide information to decision makers early on (P2). These systems accelerate the process of exploration through automating, centralizing, and standardizing the processing of control information. The drill-down functions within reports allow managers to quickly meet control information needs (P4). This helps decision makers in resolving potential challenges through early warnings sooner (Ansoff 1975). We found that GRC IS support management in achieving compliance with regulations. Our results (P1) suggest that GRC IS document the process of exploration and thereby guarantee traceability and accountability. Finally, the exploratory control perspective on organizational processes provides a coherent picture to management. Combining automated control mechanisms that do not hinder controlees' exploration with bottom-up process information and up-to-date risk information helps managers to assess, analyze, and strengthen the implementation of these insights in a timely manner (Lorange/Scott-Morton 1974). One software architect who participated in the implementation of a GRC IS argued:

> *"We collect tons of data and every step in the collection process is properly documented within SAP [ERP]. The amount of data is too great to analyze by hand. We need professional systems such as GRC to handle this huge amount of data. GRC can help me track processes: I need to know who created the purchase order, who examined it, who approved it, how it was used in production, and who took care of the invoice."*

In contrast to other IT-enabled management control systems such as ERP systems, GRC IS provide management with techniques for exploring control information. ERP systems are developed with certain control mechanisms in mind (Dechow/Mouritsen 2005). Therefore, the capabilities to develop new controls are limited. GRC IS combine the information on the value creation process with information on control mechanisms and control information requirements. Thereby, management is supported in analyzing existing control information in regard to new control purposes and ultimately exploring new control mechanisms. When asked about how the new systems change their daily business, one managers describes his process of gathering new information that has not been integrated in existing control mechanisms yet:

> *"I am responsible for making decisions. […] Therefore, I need lots of data to make these decisions. The data need to be comprehensive and reliable. I always ask for more data and receive long lists, which I have to search for the details I want. This sometimes takes hours. People need to collect details on the employee level and the system needs to aggregate it for me, but leaving open the option to play with the data."*

There is an interesting relationship between exploratory control and clan control. Similar to clan control, exploratory controls are not pre-set and emerge during the process. While both control mechanisms differ in terms of systemic form, degree of formality, control target, and

degree of formality, one can see that both mechanisms develop their measures during the activity that is controlled. While clan control's measures such as norms and beliefs focus on the transformation process, the emerging measure in exploratory control, the expected result, focuses on the output of the process. Information technology thus enhances the clarity with which performance can be assessed in situations with a high degree of uncertainty. However, our results suggest that the development of exploratory controls always requires a bottom-up approach based on the data that is available. Our results suggest that IT-enabled management controls not only provide the large amounts of data necessary for exploratory management control development, but also ensures continuity in reporting as one of the central characteristics of exploratory control. This may shift management control activities from formerly reactive evaluation to proactive corrections.

11.4 Improved Balance of Exploitative and Exploratory Management Control Activities

One of the central challenges for managers is allocating scarce resources to either exploitative management control activities that refine organizational routines or to exploratory management control activities that help to identify emerging threats and opportunities (March 1991). Speklé (2001) discusses control archetypes with different objectives that managers need to choose from when implementing management control systems. Taking a strategic perspective on management control systems reveals the challenges of on the one hand restricting behavior – e. g., through boundary systems – and on the other hand encouraging risk-taking – e. g., through interactive control systems (Simons 1995). Further research suggests that a trade-off between this restricting and encouraging use of management control systems is required (Simons 2010; Mundy 2010).

Research on temporary and emerging organizations has already suggested the notion of balance to resolve these challenges. The configurations of control types, control degree, and control style have to be periodically adjusted to meet the specific dynamic requirements of temporary organizations such as software development projects (Gregory et al. 2013). Similarly, Cardinal, Sitkin, and Long (2004) observed a harmonious use of multiple forms of control that relies on context and situation in developing organizations. These endeavors have primarily focused on balancing formal and informal control mechanisms. Balancing exploitative and exploratory controls becomes more challenging as it requires resolving contradictions and pursuing conflicting goals (Benner/Tushman 2003; Raisch/Birkinshaw 2008). Furthermore, the studies by Gregory, Beck, and Keil (2013) as well as Cardinal, Sitkin, and Long (2004) focus on software development projects and emerging organizations. Larger organizations whose structures evolved over time are challenged with a plethora of environmental dynamics, adoption, and resistance to change (Raisch/Birkinshaw 2008).

However, we see (P4) that IT-enabled management control systems can support the balance. While the advancements of IT may not support organizations in directly changing member's mindsets and values, it still provides a robust informational grounding on organizational processes, combined with documented control mechanisms and control information requirements. Thereby, IT supports the balance of IT-enabled management control systems in organizations. More precise, IT-enabled management control systems support organizations in (1) resolving the tension of differentiation and integration, (2) enhancing top-down

knowledge with bottom-up knowledge, (3) inform managers of control imbalance, and (4) continuously improving their control systems.

Our results suggest that GRC IS support organizations in resolving the tension of differentiation and integration management control activities by maintaining structural mechanisms that separate exploitative and exploratory organizational units but simultaneously ensures integration across these (Benner/Tushman 2003). The organizational structure can still be maintained by defining and implementing individual organizational processes, routines, and reports in different units that have different foci on exploitation and exploration (Adler et al. 1999). Nonetheless, GRC IS overcome this separation (Tushman/O'Reilly 1996) by creating comparability and standardization (P6). Senior management uses the standardized information to compare across units, while the old organizational structures remain. The integration of information sources within one information system and standardized controls such as unified control definitions, risk understanding, as well as pre-defined reports enable benchmarks and KPIs across organizational units. Even within one organizational unit, information from boundary or diagnostic control systems can be used for interactive control systems as well.

Our results suggest that GRC IS support managers in better understanding bottom up knowledge by including drill-down functions in control reports, new data-driven controls, and continuous controls monitoring. When pursuing ambidexterity, managers need to consider opposing knowledge flows for decision-making (Mom et al. 2009). Our results suggest (P3) that GRC IS integrate bottom up process information with top down controls and thus helps managers in balancing exploration and exploitation. The following quote illustrates that managers get information on organizational processes provided by GRC IS:

> *"What happens if big companies do not have controls implemented? They don't have a chance to get competitive advantages, do not know what their employees do, and don't know anything about their value creation. However, they remain liable for work conducted in their organization. In large companies, such monitoring can only be done with information systems. Take for example access rights. In our purchasing department, we have several hundred thousand violations within one process – occurring all over the world."*

We found that GRC IS inform decision makers of the balance or imbalance of the management control systems. One of the challenges in achieving balanced control systems is determining the status of balance, imbalance, and rebalance (Cardinal et al. 2004). Especially in the context of temporary organizations such as software development projects, there are distinct phases within the project that reveal different project needs and thereby trigger control refinement (Gregory et al. 2013). In large and established organizations, control systems have developed over time based on the organizational context and managerial preference. Thus, it is challenging to determine, whether the amount of exploitative and exploratory controls is balanced or needs corrective actions. We found that GRC IS combine strategic with operational control information by integrating bottom-up information such as upcoming risks with top-down structures such as control mechanisms and reports (P2, P3, P4). We argue that thereby existing control systems get questioned and are reviewed for capturing the intended behavior and outcomes more often. Control malfunction, transformation of organizational

processes, and changes in the organizational environment get evaluated for requiring rebalancing an imbalance control system. Decision-makers can define their own information requirements and explore the current value creation processes in detail:

> *"Management had to rely [on] reports and estimations with different quality and hierarchical level from various functions across the organization. At the end of the day, they had to decide […] based on this information. The new approach enables management to have transparency through reporting structures and work tasks. I am convinced that it creates transparency and better knowledge of the employee's tasks."*

We found that GRC IS support organizations in continuously improving their management control systems (Kirsch 2004; Choudhury/Sabherwal 2003). Literature observed five types of control change that ensured balanced control systems within organizations (Cardinal et al. 2004). Our results suggest that control change is supported through GRC IS in several ways: Organizations continuously develop new controls and extended the existing management control systems by monitoring control effectiveness (P4) and using new information provided by the information system (P2, P6). We found several controls (P5) with similar purposes. One could argue that the integrated system either supported managers in documenting, monitoring, and benchmarking competing controls for adapting existing control mechanisms or subtracting inefficient controls from the system.

11.5 Simplifying the Interactive Use of Management Control Systems

The findings from this thesis imply that IT-enabled management control systems support the interactive use of management control systems in organizations. Such interactive control systems establish information networks within the organizations to predict future developments and to suggest actions to cope with these developments. Interactive control systems are early warning systems that prepare organizations to cope with strategic uncertainties (Ansoff 1975). They thereby serve as catalyst for organizational learning by enabling the discussion of data, assumptions, and strategic plans. One example for an interactive control system is an intelligence system that gathers and disseminates information about social, political, and technical business developments that build on data such as industry reports, journals, and available information on competitors (Simons 1995). Table 33 compares a diagnostic control system to an interactive control system and highlights the importance of information on future developments and the consequences for action.

Our findings imply that IT-enabled management control systems support the interactive use of control systems in three ways: (1) They ease the use of interactive control systems by reducing the complexity of available information, (2) by linking risk-based information to control information and providing technologies for analysis, they support the analysis of information, and (3) by improving diagnostic control systems, they indirectly improve interactive control systems as well.

IT-enabled management control systems support interactive control systems by reducing the complexity of available information (P1, P3, P4, P5). Managers are confronted with information that is provided on a bottom-up basis and might be relevant for coping with strategic uncertainties, but has little structure or is completely unstructured. The

implementation of risk-based management control systems throughout the organization informs organizational members of management's interest in particular information on strategic uncertainties and thereby helps organizational members in prioritizing information that needs to be provided and discussed within interactive control systems. Benchmarks, recurring patterns, and data mining techniques further help reduce the amount of information provided to management by further substantiating management's control information requirements. One interviewee who was responsible for information security policy management illustrates how IT-enabled management control systems help reduce efforts in data collecting and processing:

> *"[GRC IS] advantages include standardization, but you have to do that before you get the tool. Then you have some constancy of managing certain security risks. For example, compliance reporting moments are horrible manual processes which take weeks. […]The key thing is that you can easily link policies to industry frameworks. [GRC IS] has a database built inside which I use. I link payment card policies to – let's say - ISO 27000 or COBIT. So if you have a policy change, you know what it will impact. As there are other industry standards we need to comply with, you have to have that data linked."*

	Diagnostic control systems	**Interactive control systems**
Focus	Critical performance variables	Strategic uncertainties
Purpose	Provide motivation and direction to achieve goals	Stimulate dialogue and organizational learning
Goal	No surprises	Creative search
Analytical reasoning	Deductive	Inductive
System complexity	Complex	Simple
Time frame	Past and present	Present and future
Targets	Fixed	Constantly reestimated
Feedback	Negative	Positive
Adjustment to	Inputs or process	Double loop learning
Communication	Eliminate need for talk	Provide common language
Staff role	Key gatekeepers	Facilitators

Table 33: Comparison of Diagnostic and Interactive Control Systems.
Source: (Simons 1995).

The risk-based perspective on control systems supports the analysis of information in interactive control systems as well (P2, P3, P4). Linking risk-based information requirements to control information helps organizational members and managers in understanding the consequences of certain developments. When a control report is linked to a risk, the organization is currently facing, it is easier to understand what may happen and what actions are reasonable to cope with these developments. Especially management benefits from

technological developments such as drill-down functionalities and data mining techniques to deepen their understanding of early warnings and thereby increases the information that managers use for decision-making. An example from a risk management department illustrates the ability to compare and question data across organization units:

> *"The systems help us to better compare units. [...] For instance, there is no objective reason why two units of the same or similar size would have significant differences in the volume and number of losses that have been reported. If one unit such as France reports 200 losses in a year but a unit such as Spain hypothetically only 10, then that would tell me that France has better implemented [risk management] and not that Spain has less losses."*

Finally, IT-enabled management control systems improve diagnostic control systems as well (P5, P6). Integration and centralization increase the availability and comparability of information in diagnostic control systems. Automation and standardization reduce the efforts of data collection and processing. All four effects thereby increase the quantity and quality of available information in diagnostic control systems. This improves management's knowledge of past and present target deviations. This information might in turn be relevant for interactive control systems in their understanding of new developments and derivation of necessary actions.

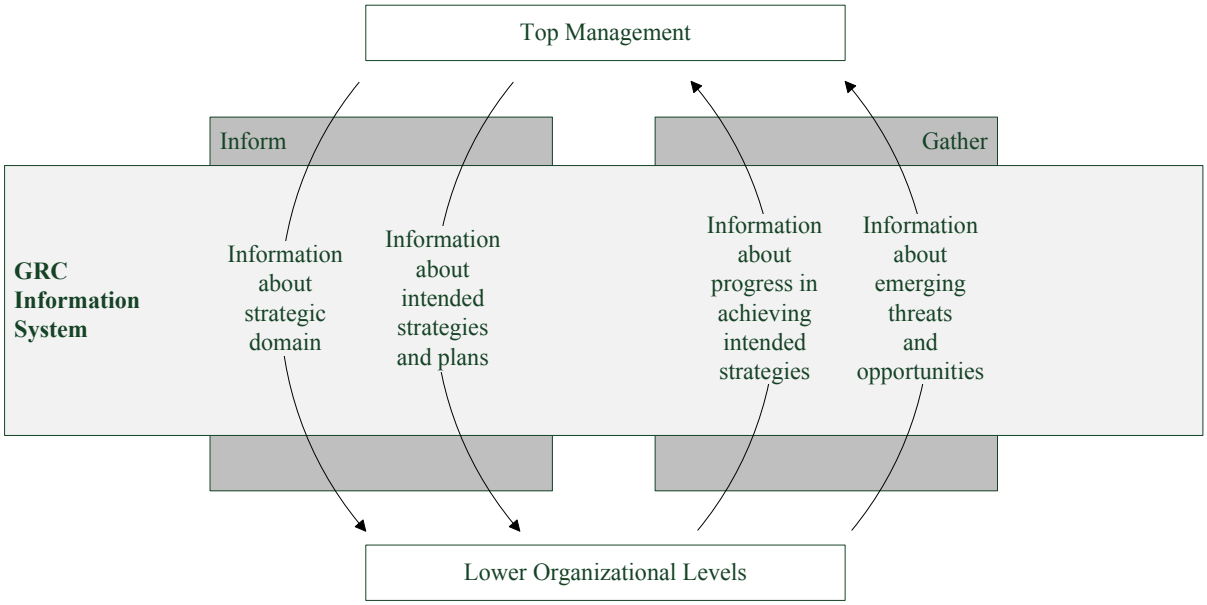

Figure 18: Role of GRC IS in Supporting Top Managers in Implementing Strategy.
Source: (Simons 1995).

While we agree with Simons that "strategic uncertainties are in a constant state of flux and, therefore, cannot be programmed" (1995, 94), we found several aspects of interactive control systems that benefit from IT-enabled management control systems. As summarized in Figure 18, IT-enabled management control systems support interactive control systems in distribution information throughout the organization in order to inform organizational members of the intended focus on control information and to collect information in order to support management in gathering this control information. Using Simons' (1995) breakdown of the conditions that are necessary for interactive control systems, we found that IT supports

four aspects: forecasting future developments, increase the simplicity of the information provided by the integrated control system, enforcing usage across all organizational levels, and relating strategic uncertainties to the organizational strategy. IT-enabled management control systems equip organizational members with internal and global transparency and allow greater degrees of flexibility and self-empowerment (Adler/Borys 1996; Chapman/Kihn 2009; Woods 2009). Thereby IT-enabled management control systems support organizational members in forecasting future developments. IT-enabled management control systems enhance management's understanding of interactive control systems information by providing techniques such as benchmarking, drill-down, and data mining that allow managers to acquire additional contextual information to help understand the control information at hand. Elaborate access control solutions and real-time availability of information across organizational functions and geographic boundaries supports organizational members on all organizations levels when using the control information. Finally, by applying a risk-based perspective on control information, organizational members understand consequences of certain developments in are thereby able to relate the developments to the current organizational strategy.

Analytical information systems such as GRC IS support the use of interactive management control systems. They help organizations in coping with complexity, linking information for control purposes and improving existing management control systems. While the technological developments enable new data analysis techniques, the challenge lies in designing organizational routines for data collection and for using the information.

12 Limitations

The choices made in the design of scientific research impose certain limitations on this study. While the design decisions made in this thesis were made to minimize potential problems, the findings have to be evaluated within the context of these limitations. The most important limitation lies in the fact that the papers included in this thesis have been written over a period of four years. During these four years, the concepts and thinking underlying this thesis have developed considerably. The concept of control has developed from a management and organizational theory perspective (P1, P2, P3) to a broader conceptualization including accounting and other disciplines (P4, P5, P6). The thinking evolved during the course of writing the papers and earlier analyses were re-visited (e. g., P3 and P4) and integrated in this thesis. Our thinking evolved over time to include a wider range of literature, different terminology, and a broader empirical foundation. The lacking conceptual consensus in control research resulted in the consideration of various concepts (P3) and the singularity in existing typologies motivated the examination of the dynamic development of an IT-enabled management control system.

This study is of an exploratory nature and thus develops new constructs to examine a new phenomenon. The data is limited to only a few organizations in a small number of industries (especially P5 und P6) and thus limited in generalizability (Yin 2009; Eisenhardt/Graebner 2007; Eisenhardt 1989). Yet, several methodological techniques were applied to increase validity and reliability to improve generalizability (Dyer Jr./Wilkins 1991; Lee/Baskerville 2003). We triangulated methods and data across the papers (Yin 2009). In the grounded theory study, we applied theoretical sampling in order to maximize diversity amongst interviewees and open coding to have our theory emerge from the data. We also applied selective and theoretical coding and constant comparison to consolidate our derived constructs and categories (Strauss/Corbin 1998; Suddaby 2006; Urquhart et al. 2010; Kelle 1996). In the case studies, we used different data sources and thereby provided richer empirical evidence (Yin 2009).

In the course of this thesis several data sources were analyzed, yet the predominant data source were interviews. These are subject to interviewee's subjectivity and researcher's individual judgment (Mayring 2002). The interviewees were asked to provide insights on the questions by explaining their thoughts and opinions and illustrating these with examples from their daily business. The analysis and interpretations of the data sources are idiosyncratic to the researcher who examined the data sources.We attempted to limit this weakness by re-analyzing parts of or the complete data set across all research methods in all papers. The co-authors re-coded interview transcripts, control descriptions, and reviewed additional documentation. We discussed our derived concepts and categories amongst the co-authors, within the research group, with practitioners, and in a conference (P3) and thereby refined our analysis and identified additional categories. Despite these methodological limitations, our results on the role of IT in management control systems may serve as an invitation for further work on the issue opened up by this study.

The current research was limited to certain aspects of control balancing. We focused on the balance of exploitative and exploratory management control activities (Simons 2010; March

1991) as a challenging aspect of pursuing new control possibilities and improving existing controls. We acknowledge that there are further interesting trade-offs that may be examined with regard to the role of IT. Yet, we argue that the exploitation exploration trade-off is particularly interesting in the context of IT-enabled management control systems for two reasons. First, information systems transfer control issues from an individual decision-making to an organizational design level. Up to now, only few individuals simultaneously executed exploitative and exploratory control activities (Raisch/Birkinshaw 2008). Today, using standardized, integrated, and centralized information combined with a risk-based control perspective and individual analysis for managerial information requirements allows individuals on various organizational levels to simultaneously execute exploitative and exploratory control activities. Second, the potential of IT in collecting and exploring large amounts of data at a reasonable price might serve as an enabler to resolve the predominance of exploitative control activities in research and practice. We therefore found the balance of exploitative and exploratory research as a particularly interesting perspective to examine IT-enabled management control systems.

Another limitation is the only short term examination of the phenomenon in its natural context. One could argue that while IT-enabled management control systems initially support the balance of exploitation and exploration, the achieved integration may exceed the differentiation. IT-enabled management control systems will thereby destroy the structural boundaries between exploitative and exploratory units and lead exploratory units to adopt the incremental mindset of exploitation (Raisch/Birkinshaw 2008). This would ultimately lead to imbalance of management control systems and require efforts of rebalancing (Gregory et al. 2013; Cardinal et al. 2004).

The current investigation was limited by scope and level of granularity of studying IT-enabled management control systems (Anthony/Young 1999). Regarding the scope, we focused in controlling organizational goals rather than judging the quality of the set goals. This study did not consider the improvement of goal setting (Locke/Latham 2002). Regarding the level of granularity, we predominantly examined specific control mechanisms rather than full control systems. Our goal was to examine different types of IT effects on control mechanisms across organizations and to identify these effects in full control systems in single organizations as well. By focusing on certain aspects of the initially derived value drivers in control systems, we were able to derive the concept of coherence for balancing exploitative and exploratory control activities. Examining the role of IT only in full control systems across organizations, however, would lead to an emphasis of organization specific aspects and hinder axial coding of empirical data and derived concepts as well as constant comparison (Strauss/Corbin 1998).

13 Implications

This section identifies contributions to theory by explaining the role of IT in management control systems.

13.1 Implications for Theory

Management control research: The motivation for this thesis implies that the potential of IT for supporting management control systems is not fully understood. Findings of this thesis suggest that IT supports management control systems beyond improving existing practices. IT-enabled management control systems also increase measurability of information for control purposes and mathematical techniques for analysis. IT allows completeness in control data collection, but also supports risk management, prepares decision-making, and allows a coherent management control system. In management control research, the concept of exploratory control mechanisms has been suggested (Speklé 2001). This thesis provides empirical evidence on exploratory control mechanisms. We found that IT supports organizations in developing exploratory control mechanisms. Our results suggest that IT supports exploratory control systems that help organizations control innovation and new developments. IT increases the vast amount of information and capabilities for analysis that is necessary to develop exploratory controls. Based on the emerging data, management can develop goals during the process and these goals can be used for future control mechanisms. However, this study did not find evidence that IT supports the focus on long-term performance in exploratory controls.

Further, the findings in this thesis enhance our understanding of the managerial challenge in balancing management control activities. We conceptualize a coherent management control system as one that has the appropriate balance of exploitative and exploratory management control activities for the current organizational situation. When talking about coherence, we refer to a reciprocate knowledge of control mechanisms and control information between exploitative and exploratory management control activities. This is achieved by a standardized and centralized information system that provides an integrated data-base, but does not affect the analysis of this information. A coherent management control system diminishes the challenge of balancing exploitative and exploratory management control activities. While IT cannot resolve the trade-offs between reducing deviations and fostering innovation, the integrated data-base provides transparency on control activities and re-usable control information. IT thereby turns the challenge from allocating scarce resources to interpreting existing information and revising control mechanisms. Further, the findings of this thesis shed light on the process of implementing an IT-enabled management control system independent of what purpose it is used for. It confirms the results of ERP implementation studies of standardizing and integrating information along the value creation processes for exploitative control activities. The case study analysis suggests that organizations first have to master their exploitative management control activities to prepare exploratory management control activities. Exploratory management control activities require a vast amount of information on the value creation process and therefore rely on the information provided by exploitative management control activities through e. g., thorough

control documentation, work automation, process improvement, and integration of control information.

Organizational control theory: The present study makes several noteworthy contributions to organizational control theory. This thesis questions the relevance of the prominent control design rationale of cost-efficiency for two reasons. Our findings (1) suggest that through the use of IT, the cost of data collection has tremendously decreased. Organizations can collect almost any information at a reasonable price if it is not collected already. Automation and standardization reduce the manual efforts and integrated data-bases provide information throughout the organization. We further found (2) that control design choices depend on different values as argued by organizational control theory. In situations where organizations are confronted with traceability and accountability, e. g., when organizations have to comply with external regulations, control design choices are based on how early control information is available and how certain derived activates are rather than information completeness and unambiguity. We suggest two antecedents: 'synchronicity' and 'certainty of actions' that influence control design choices in these situations. This argument is supported by the fact that we found several control mechanisms that served similar purposes. This combination and experimentation with controls suggests that instead of examining single control mechanisms, researchers should rather focus on the management control systems and interactions between related control mechanisms (Cardinal et al. 2010; Liu et al. 2010; Malmi/Brown 2008; Jaworski et al. 1993; Kirsch 1997).

The results of this study indicate an imbalance of the existing taxonomy of control design (Ouchi 1979). We found that through IT, the knowledge of the transformation process is high in almost every control situation. Organizations implement value creation processes in information systems and automatically monitor information on each process. In situations, where the exact steps of value creation are unclear (e. g., in projects or research & development departments), organizations are able to monitor the behavior in an exploratory manner and develop the controls during the process. The predominance of control situations with high knowledge of the transformation process reduces the predictive power of the taxonomy and requires further research on antecedents for today's situation.

IT-enabled management control systems: The current findings add substantially to our understanding of IT-enabled management control systems. This thesis focused on understanding how IT-enabled management control systems are used within organizations. We identified value drivers that provide insights on the reasons why such information systems are implemented to support management control systems. The review of control regulations, guidelines, standards, and frameworks from different sources synthesizes the requirements for control mechanisms that are supported by IT-enabled management control systems. The derived patterns summarize similarities across industries and organizational functions. The pattern catalogue serves as structure to evaluate IT-enabled management control system functionalities. The catalogue helps evaluate the usefulness of specific IT-enabled management control systems.

13.2 Implications for Practice

The findings suggest several courses of action for practice as well. Before applying the findings to practice, more research is needed to replicate and extend the current findings. Assuming that further research validates the value drivers and other findings there are several suggestions for (1) vendors of IT-enabled management control systems, (2) IT personnel in charge of adoption such systems, and (3) managers using the systems. Vendors may use the derived value drivers as suggestions for identifying and designing new functionalities that address these issues. The homogeneity of control aspects in the patterns and in the examined control set suggest that vendors could support their customers by providing an universal control set for basic processes within their information systems.

IT personnel in charge of the adoption of IT-enabled management control systems needs to carefully consider the functionalities offered by such systems. The developed pattern catalogue may help them in evaluating existing solutions, identify strengths, and detect shortcomings for further improvement. We further provide design guidelines for implementing IT-enabled management control systems. We suggest that such implementation projects should first fully integrate existing control activities before enhancing the management control system with new control mechanism. Further, our value drivers structure the potential business value of IT-enabled management control systems and thus enable IT personnel to gain funding for implementation projects.

Finally, managers benefit from the results of this thesis by gaining additional understanding the technological capabilities of IT-enabled management control systems. Managers may apply the developed value drivers on existing management control systems and thereby identify areas for improvement of existing systems. We suggest exploratory control mechanisms in situations with high uncertainty and provide additional antecedents for control design decisions.

Typically, managers balance exploitative and exploratory management control activities. This allocates scarce resources to either one alternative often without bearing in mind the other alternative. In contrast, using IT-enabled management control systems managers can a coherent control system as basis for exploitative and exploratory control activities. Thereby, control information can be gathered for exploitative purposes and simultaneously be used for exploratory analysis. This reduces overall efforts for management control activities.

14 Future Research

This thesis suggests several fruitful avenues for further research. First, future studies should address the limitations stated above. Complementing the current concepts with additional data and with quantitative research methods could address the existing threats to validity (Bhattacherjee 2012). In the following, future research regarding (1) the technology, (2) the used information, (3) the design of management control systems, and (4) the human factor in management control research is outlined.

Regarding the technological elements of IT-enabled management control systems, a deeper understanding of the dynamics of the technology behind IT-enabled management control systems would enhance the knowledge on this topic (Orlikowski/Iacono 2001). In addition to the context, the effects, and the capabilities, a conceptualization of the information system that supports management control systems would enhance our understanding of the phenomenon (Hardy/Leonard 2011; Racz et al. 2010; Vicente/da Silva 2011). It would be particularly interesting to focus on the impact of IT on measurement techniques for control activities (Lorange/Scott-Morton 1974). With the developed value drivers as lens for analysis, it may be fruitful to explore new techniques for mass data processing and data mining in their potential to support management control activities. On a broader technological level, the question arises if information systems that are strategic rather than operational support organizations in similar ways. For example, strategic enterprise management suits (SEM) that focus on strategic risk management could by analyzed (Granlund/Malmi 2002; Rom/Rohde 2007). Finally, further research could suggest concepts and architectures for developing inter-organizational control monitoring and sharing of organizational control information. Sharing information on incompliance, e. g., software malfunctions or workarounds would improve management control systems without revealing strategic advantages of the organization.

This thesis identified processing of information as the central strength of IT in management control systems. Therefore, it is highly recommended to further examine information-intensive controls such as risk management (Power 2004; Power 2005; Mikes 2011; Mikes 2009). The measuring and mathematical techniques as suggested by the framework of Lorange and Scott-Morton (1974) seem particularly promising in the context of risk management. IT's information processing capabilities may facilitate taking a risk-oriented perspective on control as suggested by Merchant and Otley (2006) and Collier (2008). Future research might also address the gap of research on using external information for control purposes. With the capabilities of processing vast amounts of data, external information on fraud cases, black-lists, and control-related developments could be easily integrated and analyzed for management control purposes.

Future research could provide further understanding of the role of IT in management control systems by examining the concept of coherence in more detail. By drawing on existing work on ambidexterity (Raisch/Birkinshaw 2008) and balance in contemporary and developing organizations (Cardinal et al. 2004; Gregory et al. 2013), the concept could be enhanced and validated in a large-scale survey. Therefore, the antecedents and goals for exploratory control mechanisms need to be examined in more detail. Further, the dynamics of developing exploratory controls and how they may turn into exploitative control mechanisms would

enhance the current understanding of coherence. There is still a conceptual gap on the dynamic interactions between exploratory and exploitative management control activities. The questions that could be addressed by further research include: What are factors that determine the balance of management control systems? What are indicators for an imbalanced system?

Finally, this thesis did not examine the human perspective on IT-enabled management control systems. This can be examined in two dimensions: the behavior of the manager as controller who uses information from IT-enabled management control systems and the behavior of organizations members as controlee, who experience IT-enabled controls in their daily business. Regarding the former, it would be interesting to examine how managers identify imbalance and which role information provided by IT plays in rebalancing the management control system. The questions that could be addressed by further research include: How do managers use information provided by IT-enabled management control systems? What effect do coherent management control systems have on middle managers that were traditionally in charge of providing information to senior management? On the operational level, it seems promising to reinvestigate the perception of modern IT-enabled management control systems (Sia et al. 2002; Kaghan 2005; Elmes et al. 2005). While IT eases efforts of control data collection for organizational members, IT-enabled management control systems might be perceived differently than laborious ERP systems (Adler/Borys 1996; Sewell 1998). It seems worthwhile examining whether exploratory control mechanisms, as enabled by IT-enabled management control systems, limit the development of workarounds in organizational information systems and thereby improve performance (Ignatiadis/Nandhakumar 2009; Ferneley/Sobreperez 2006).

15 Conclusion

This thesis examined the role of IT in management control systems. We provide a structure for analyzing the effects of IT on management control systems and suggest four value drivers using the example of GRC IS. IT propels management control systems but comprises more than improving existing control activities. IT supports management control systems with structures that facilitate (1) exploratory control activities, (2) the balance of exploitative and exploratory control activities, and (3) resolving the challenge of allocating scarce resources to exploitative and exploratory control activities. GRC IS enable exploratory analysis of control information. They also help in orchestrating new control mechanisms through reducing reporting intervals and investigations that cause little additional effort. GRC IS further integrate opposing knowledge flows for decision-making by allowing timely and complete reporting and drill-down functionalities for managers. Finally, GRC IS support managers in revising existing control systems and detecting inefficiencies and imbalance. We argue that with IT, more control mechanism design choices meet the criteria of cost-efficiency and thus new antecedents are necessary to cope with the rising uncertainty in today's organization. While the antecedents 'knowledge of the transformation process' and 'ability to measure output' are constituent factors in designing control mechanisms, the findings in this thesis indicate that additional antecedents may arise that focus on the quality and point in time auf availability of control information.

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Appendix

Appendix A: Interview Questions

First Interview	Last Interview
Current position • In which department do you work? • What is your position in the company? (How long have you been employed in this position?) • What are your duties and responsibilities? • What is your expertise with GRC IS?	**Current position** • Please briefly describe the activities and functions of your department. • What are your tasks and responsibilities? • What experience do you have in your GRC domain? • Please describe the most important processes in your GRC unit. • To whom do you report ?
Understanding of GRC IS • In your opinion, what are the basic elements of GRC IS? o What is GRC IS? o What is the most important element of GRC IS? o Which economic concepts does GRC IS include? o Which technical aspects does GRC IS include? • How does GRC IS influence your work? o What is GRC IS used for? o Who in your organization benefits from using GRC IS? o How can the value of GRC IS be measured? o Does GRC have an impact on the company's business value? • What information is necessary for GRC? o Where are these data gathered? o How are the data gathered? o Who decides what data are gathered?	**Tasks related to GRC IS** • Please describe how you collect/manage/visualize/monitor your data. • Do you share/exchange any data with other GRC domains? • Please describe how this is done. Can you give examples? • Why do you share/exchange this data? • With whom do you share/exchange the data? • How often do you share/exchange data? • Do you experience any problems with this process? If so, please describe them. • What do you gain by sharing/exchanging this information? • How could information systems support your tasks? • What kind of management controls are implemented within GRC IS? • What are the benefits of using GRC IS with automated controls? • What are the reasons for implementing non-automated controls? • Within your management control system, how much focus is placed on centralization and standardization?

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- Do you know GRC IS reporting structures?
  - How are data from GRC IS communicated?
- What GRC platforms do you know?
  - From your perspective, how do you rate the quality of [name of software]?
  - What are the strengths of this tool?
  - Which elements need to be improved?
  - Which elements are missing?
  - Why did you choose [name of software]?

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- How do you use guidelines within your organization?
- How do you ensure that guidelines are properly followed?
- To what extent are controls integrated within the business processes and do not require any additional employee efforts?

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Integrated perspective on GRC IS

- Why do you think governance, risk management, and compliance tasks are considered jointly?
  - Can you identify the value added by considering GRC jointly?
  - What would be missing if GRC were considered individually?
  - Which relationships would be ignored?
  - How does the integration of GRC create synergies?
  - Please name and explain dependencies between the corporate functions of governance, risk management, and compliance.

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Technological developments

- How does GRC IS support management control tasks?
  - How does GRC IS support the integrated perspective on risks within the company?
  - How can GRC IS be connected to existing company processes?
  - Which tasks could not be performed without GRC IS?

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Key performance indicators

- Have you defined any key performance indicators/key figures?
  - Are they clearly defined?
  - Are they effective?
  - Can they be realistically achieved?

Technological developments

- Which tasks do/could you manage with GRC software?
- Why do/would you do it?
- What is your goal?
- What is/could be the impact of a software solution?
- Have you experienced any difficulties with GRC software?
- How are tasks supported by the use of information systems?
- Which software solutions have you chosen

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• How are GRC-relevant data extracted from existing (ERP) systems? o Are there standards to support data exchange between GRC systems?	and why? • What are the advantages and disadvantages of these solutions? • Do you have any specific requirements for GRC IS? • Does your solution fulfill all your requirements?
Challenges • In your opinion, why does management need GRC IS? • What were the main challenges when you started your GRC initiative?	**Challenges** • If you had the chance to design your own GRC solution, what would it look like? • Please explain how you ensure effectiveness of your information systems. • Which challenges do/would you meet in your attempt to achieve effectiveness, transparency, and automation?