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The Regulatory Influence On Management Information Systems - A Contingency Perspective

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THE REGULATORY INFLUENCE ON MANAGEMENT INFORMATION SYSTEMS – A CONTINGENCY PERSPECTIVE

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Abstract

Reporting scandals and the financial crisis led to a massive increase of regulations. In particular financial institutions and governmental organizations are faced with a daunting number of regulatory requirements. So far, the influence of regulation on the organization and success of Management Information Systems (MIS) remains an open question. With this paper we provide a first insight into the organizational parameters that are affected by a volatile regulatory environment. Inspired by contingency theory and its application for MIS research, we first present an exploratory research model that explains the effects of regulation on the organization of MIS. Second, we evaluate the proposed research model by conducting an empirical study with 105 highly experienced respondents and apply a SEM-PLS approach. In summary, the results provide evidence that the degree of regulation is positively associated to both executive commitment to regulatory compliance and involvement of legal experts in IS compliance projects.

Keywords: Compliance, Contingency Theory, Law, MIS, Regulation.

1 Introduction

The Worldcom and Enron reporting scandals in 2002 and the financial crisis of 2008 were without doubt two of the most influential drivers for an extraordinary increase of regulation. The enactment of the Sarbanes-Oxley Act (SOX) and the revision of Basel II are just two direct consequences. Organizations react on a volatile regulatory environment by changing their Information Systems (IS) and business processes. In this paper we focus on IS which need to be changed or developed in order to comply with regulations.

To comply with regulatory requirements is a "conditio sine qua non", meaning it is essential to fulfill these regulations. Considering legal requirements in business processes and IS is a challenging task because of steady changing regulations, legislation weaknesses, inconsistencies, and overlapping regulations (Abdullah et al., 2010). Several organizational capabilities, such as executive commitment, expert involvement or the IS design process are affected by regulatory requirements. We summarize all organizational capabilities of the IS department by using the term Management Information Systems (MIS) and investigate how these capabilities are influenced by regulation.

In regulatory-driven IT projects, IS experts need to work together with legal experts who define system requirements. In such interdisciplinary teams, legal and IS experts are forced to communicate with each other in order to share knowledge. Based on different skills and professions, we assume a missing or inadequate common ground between all participants which causes communication problems (Clark & Brennan, 1996). Dissolving such communication problems is often depending on MIS organization variables, such as executive commitment to regulatory compliance, expert involvement and the usage of formalized design methods, whose effects will be analyzed in this paper.

From a contingency theory perspective (Galbraith, 1973, Lawrence & Lorsch, 1967) organization's success is depending on the ability to adapt to its environment. Inspired by the contingency theory and the work of Weill & Olson (1989), we perceive the regulatory environment of an organization as one factor that influences organization's success in general and MIS success in particular. By perceiving regulation as one part of organization's environment we utilize the framework of Weill and Olson (1989) who adapt the general contingency theory for MIS. Based on their defined contingency and MIS constructs we are interested in answering the following two questions:

- How does regulation influence the organization of MIS in terms of executive commitment, expert involvement, and the utilization of formalized IS design methods? (Q1)
- To which extent do these determinants influence MIS success in a regulatory environment? (Q2)

This paper aims to answer these questions by an exploratory study in different industries. Based on a theory-guided model, developed by Becker et al. (2011), we investigate the influence of regulation on MIS. The paper at hand provides two additional contributions. First, we evaluate the model by utilizing Structural Equation Modeling using Partial Least Squares. Second, the study results explain the extent to which MIS capabilities contribute to the success of MIS in a regulatory environment.

The paper is structured as follows. The next section provides the theoretical foundations of the contingency theory and its adaptation for MIS. Based on these foundations, we then present a theory-guided exploratory research model for the influence of regulation on MIS. In the following section, we describe our research design before we provide the results of our study. Afterwards, we briefly discuss the findings. The last section comprises a summary of the results, describes the research contribution, and gives an outlook about ongoing research and future work.

2 Theoretical Foundation

2.1 Contingency Theory

The basic rationale of this paper is the dependency of organization's performance on its ability to align its internal organization to the environmental situation. "The contingency approach attempts to understand the interrelationships within and among organizational subsystems as an entity and its environment" (Szilagyi & Wallace, 1980). The approach ranges back to initial works in the 1950s and 1960s. Contingency theorists tried to explore the main determinants assumed to influence performance (Donaldson, 2001, Scott, 2003). For instance, Woodward (1965) identified technology as a direct determinant of differences in organizational attributes. Important works by Lawrence and Lorsch (1967) and Galbraith (1973) have made contingency theory almost a standard thinking within organization theory (Drejer, 2002). Organizations that are in line with the contingencies will have higher performance than those in misfit. For this reason, organizations are motivated to avoid misfits in order to avoid loss of performance. Donaldson (2001) describes contingency as „any variable that moderates the effect of an organizational characteristic on organizational performance", whereas organizational effectiveness is the ability to attain self-defined goals (Donaldson, 2001). According to Galbraith (1973) and Scott (2003), central premises of contingency theory are: (1) there is no one best way to organize; (2) any way of organizing is not equally effective; and (3) the best way to organize depends on the nature of the environment to which the organization relates.

Since its emergence within MIS research, the contingency theory approach suggests the influence of a number of variables on the performance of IS (Weill & Olson, 1989). Andres and Zmud (2002) developed a research model that explains the effects of task interdependence, goal conflict, and coordination strategies on productivity and software satisfaction. Zhu (2002) evaluated contingency approaches to IS design and Lai (1999) applied contingency theory in order to examine computer added software engineering task fit on software developer's performance. With regard to contingency theory, a company that is regulated seeks to attain fit between organizational characteristics and regulatory requirements in order to obtain high performance, e.g. in terms of wealth effects.

2.2 Regulation as Contingency Variable in MIS

A series of corporate failures and scandals in the last years led to an increased awareness of IS risks and necessary regulatory measures within both industry and government. With such regulations, authorities respond to various events by recent governance reforms. For instance, Basel III Capital Accord or the European Markets in Financial Instruments Directive (MiFID) also affect IS regulations to reduce future losses and to increase investor confidence (Woods, 2009). We perceive regulation as internal or external principles, rules, or laws designed to control or govern organizations. Nevertheless, so far the influence of regulations on individual organizations and their MIS success got only little to no attention within IS research. For example, Clark et al. (2007) did a thorough exploration of the dynamic structure of Management Support Systems (MSS) in order to derive relevant constructs that have an influence on MSS success. However, the degree of regulation and its effects on the MIS organization did not appear in their model although, with no doubt, regulations influence IS. For example, effective data control strategies are necessary to mitigate data quality risks and hence to improve internal and inter-organizational decision making and external regulatory compliance (Bai et al., 2011, Nicolaou & McKnoght, 2006).

However, empirical findings on the adoption of IS regulations and their impact on MIS are hardly covered (Teuteberg, 2010). Apart from the regulatory requirements, which dictate the management of IT risks as a subset of enterprise risks, many economic reasons for monitoring and governing IT risks (Weiß & Winkelmann, 2011) exist. The general diffusion, the cross-linkage, and the increasing performance of IT systems are examples that lead to an enlarged error-proneness and result in a higher level of IT risk potential. As a result of missing research on regulations and its impact on MIS organization, we subsequently derive determinants for the influence of regulation on MIS.

3 A Model for the Influence of Regulation on MIS

Our research model is inspired by the contingency framework for MIS (Weill & Olson, 1989) and adapts a previous version of a model for the influence of regulation on MIS (Becker et al., 2011). We utilize the framework in order to operationalize our perspective of regulations that influence MIS organization and MIS success variables. Therefore, we present an exploratory research model which is depicted in Figure 1. All Hypotheses are summarized in Table 1. A detailed description of the underlying assumptions, the model constructs, and theoretical foundations can be found in Becker et al. (2011). In the following, we shed light on the model differences and explain in detail the new construct degree of regulation.

In comparison to the original model of Becker et al. (2011) we left out the construct task interdependence since task as a contingency variable originally refers to “the types of activities to be supported by information systems” (Weill & Olson, 1989, p. 64). The investigation at hand does not focus on IS that enables regulatory compliance. Rather we investigate the influence of regulation on IS from an organizational perspective. Thus, task interdependency does not appear in the model at hand.

Environment is identified as an important contingency variable, not solely for organization research but also in MIS research (Donaldson, 2001, Weill & Olson, 1989). Environment can be operationalized in three ways. First, environment as an external variable of the organization (Benson & Parker, 1985). Second, environment as an internal variable that shapes the organization (Ginzberg, 1979). Third, environment as both, a variable for the volatility of the market environment and a variable for the complexity of the MIS environment (Pyburn, 1983).

Since organizations are faced with regulation in different ways, the research model follows the latter approach. On the one side, regulations influence the entire company from outside of the company. Following the OECD (1997), external regulation is considered to be social regulation that prevents public interests, particularly the environment and consumer. For instance, in year 2000 the United States legislation signed the complex SOX into law. In order to avoid penalties, financial institutions inevitably had to adopt SOX within short time, which also resulted into an increase of awareness of IT compliance among management boards (Kim, 2007, Mohan & Chen, 2007).

IS often hold valuable information that are vital for organization’s success and therefore have to be protected against unauthorized access and data breaches (e. g., Cavusoglu et al., 2004, Ifinedo, 2011). Since researchers find out, that organizational employees are the weakest link in ensuring secure IT (e. g., Stanton et al., 2005), management boards have to internally clarify process directives, e.g. data access-control mechanisms, which lead, on the other side, to internal regulation.

Recapitulating, external regulation is assumed to be indifferent within one industry sector, whereas internal regulation should depend on the organization itself. In the research model, the contingency variable environment is therefore operationalized using the construct *degree of regulation*.

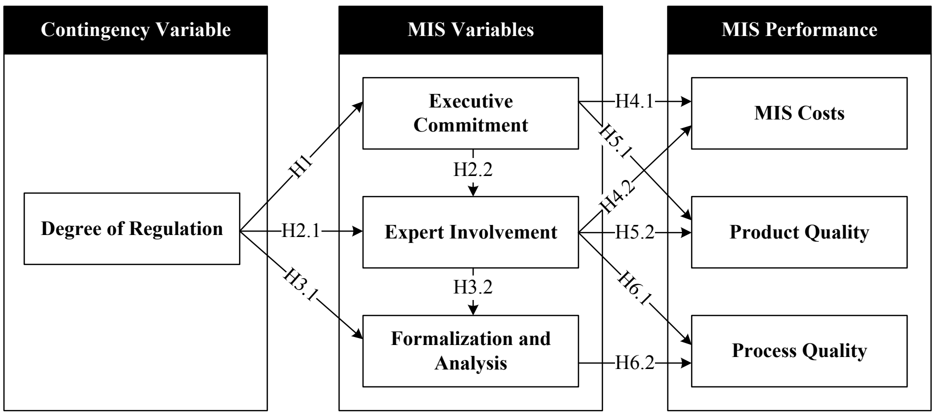

Figure 1. Research Model (adapted from Weill & Olson (1989) and Becker et al. (2011))

According to Weill and Olson (1989) typically investigated areas of MIS or the MIS function are MIS management, implementation, development of MIS, and structure. We operationalize MIS management by using the construct *executive commitment* for IT compliance. In the following, we use the term IT compliance in order to explicate that (1) IT is compliant with legal requirements (e. g.

relevant data privacy requirements) and that (2) IT is utilized in order to support the compliance of existing business processes (e. g. in terms of fraud detection modules etc.). We operationalized MIS implementation tasks with *expert involvement* (e. g., Baroudi et al., 1986, Wixom & Watson, 2001). In interdisciplinary teams it is essential to establish a common ground which leads to the operationalization of MIS development by applying the construct *formalization and analysis*. We omit the operationalization of structure in the model at hand because structure refers to the degree of centralization and integration of MIS as well as hardware deployment (Ein-Dor & Segev, 1982), which both are not perceived to be adequate variables for measuring the influence of regulation.

MIS performance comprises variables that are usually operationalized by perceptual measures, such as user satisfaction, system success, system effectiveness and system innovativeness (Weill & Olson, 1989). MIS success is, among other factors, related to *MIS costs*. Assuming an equal IS quality, costs for MIS determine how efficient the MIS organization operates. In addition, we operationalize the MIS performance variables satisfaction and effectiveness with the constructs IS *product quality* and development *process quality*. Product quality describes the satisfaction with the software product in terms of regulatory compliance and the construct process quality comprises the fulfillment of time and budget constraints in regulatory-driven IT development projects.

Hypothesis	Construct Relationship
H1	The more an organization is regulated the more executive commitment for regulatory IT compliance is needed.
H2.1	The more an organization is regulated the more compliance experts are required in IT implementation projects.
H2.2	The more executive commitment for IS compliance leads to more involvement of compliance experts in IS development projects.
H3.1	A high degree of regulation leads to more utilization of formalized design and analysis methods.
H3.2	More involvement of compliance experts in IS development projects leads to more formal design and analysis approaches.
H4.1	A strong executive commitment for regulatory IT compliance leads to relatively higher MIS costs.
H4.2	More compliance experts being involved in regulatory-driven IS development processes lead to relatively higher MIS costs.
H5.1	Executive commitment for regulatory IT compliance leads to qualitatively better information systems.
H5.2	A stronger involvement of compliance experts in IS development processes leads to more compliant IS.
H6.1	The involvement of more compliance experts in regulatory-driven IS development projects leads to more efficient IS design processes.
H6.2	An intensive utilization of formal design and analysis methods in regulatory-driven IS projects leads to qualitatively better IS development processes.

Table 1: Hypotheses

4 Research Design

4.1 Data Collection

Our data collection goals are twofold. First, we aim to collect data from experts with many years of IS project experience, such as senior managers. In this way, we increase the probability that each respondent knows about the specific requirements of regulatory-driven IT development projects. Second, we need respondents from different industry sectors in order to get an insight into a different degree of regulation and its consequences. The rationale behind is that within one industry, we will most likely receive an equal degree of regulation.

To collect data, we developed a questionnaire (see Appendix) and deployed it through an online and paper-based survey. An e-mail invitation to attend in the online survey was sent to IT and compliance managers of the retail sector. Altogether, we invited 60 persons to attend in the online study. The data from the paper-based survey was collected in two ways. First, we sent the survey together with an invitation letter to 200 IT and compliance managers in banks, insurance companies and financial IT service providers. Second, the survey was deployed on two large industry and e-Government conferences. The first conference had 60 visitors, mainly IT managers of the retail industry. The e-Government conference, mainly visited by IT managers of the public sector, had 150 visitors.

Summing up, we received 105 full responses from respondents located in Germany, Switzerland, and Austria with an average response rate of 22 percent. We collected the data between July and December 2011. 44 organizations can be considered to be small (10-250 employees), 48 are medium-sized (250-1,000 employees), and 13 organizations employ more than 1,000 people. The size of the IT department a firm maintains comprises on average 170 employees (SD: 625.59). 37 firms develop their software by own, whereas 68 purchase their software externally. 24 percent of the respondents are senior managers, 58 percent are middle-level managers, and 18 percent are advisors. The average work experience is 18.44 years (SD: 9.94).

4.2 Analysis

We identified the partial least squares (PLS) approach to be most suitable for analysis since our research model consists of both reflective and formative constructs. The exploratory nature of this study leads to a research model that has not been tested in literature yet; therefore our objective is more theory development than theory testing.

These aspects are in line with the partial least squares approach, so we selected SmartPLS software (Ringele, 2005) in Version 2.0.M3 for path analysis and also as a bootstrap resampling tool in order to determine significances within the research model. We employed SmartPLS software with the parameter settings as follows. Some observations contain missing values, so we chose to apply Missing Value Algorithm using Mean Replacement Algorithm, which substitutes missing values with the indicator mean. We chose Mean Replacement Algorithm to keep fragmented samples over Casewise Replacement Algorithm, which would drop fragmented data samples entirely from analysis. For applying the PLS algorithm, Path Weighting is selected as the weighting scheme since it considers the direction of relationship between the latent variables. Data metric is set to Mean 0, Var 1. Maximum iterations are 300 with an abort criterion of 1.0E-5 and 1.0 as the initial weight. The Bootstrapping Algorithm is applied with 105 cases and 5,000 samples. According to Tenenhaus (2005), the number of cases has to be equal to the number of observations. A sample size of at least 5,000 is required for substantial assessment of significances (Hair et al., 2011). Individual sign changes are used to ensure that signs of path coefficients of bootstrap subsamples agree with original path coefficient signs.

5 Results

Major criterion for evaluating the structural model is the level of explained variance of the endogenous constructs. Therefore, Chin (1998) suggests R-Square values of approximately 0.670 substantial, values around 0.333 average, and values of 0.190 and lower weak. Figure 2 presents an overview of the structural model evaluation results. We perform Q^2 in order to obtain predictive capabilities of the structural model. By applying the blindfold procedure in SmartPLS software, cross-validated redundancy is chosen since it fits better to the PLS approach (Chin, 1998). Figure 2 reflects the predictive power of the structural model. A positive Q^2, which all model constructs provide, is essential for predictive relevance.

Table 2 shows that both Cronbach's alpha and composite reliability have high values above 0.7, which is the required threshold value within exploratory research (Urbach & Ahlemann, 2010). Both Cronbach's alpha and composite reliability have values high enough to keep indicators that have loadings between 0.6-0.7. We provide all final factor loadings in the Appendix. Concerning the model validity, Table 3 shows that each latent variable correlates more with itself than with any other latent variable within the structural model, which is a prerequisite for a valid model. We employ one formative construct to measure the categorical variable industry (IN). We examine indicator validity to assess validity on indicator level. To be sufficient, each indicator's path weight has to be significant at a level of at least 0.05. Three indicators met the significance level. We tested construct validity by means of discriminant validity. Correlations between the formative construct and any other latent variable are less than 0.7, indicating sufficient discriminant validity (Bruhn et al., 2008). The industry variable is important to the research model since it acts as a control variable that absorbs variances arising among different industries. As we assume different extents of regulatory impact among industries, we keep this construct.

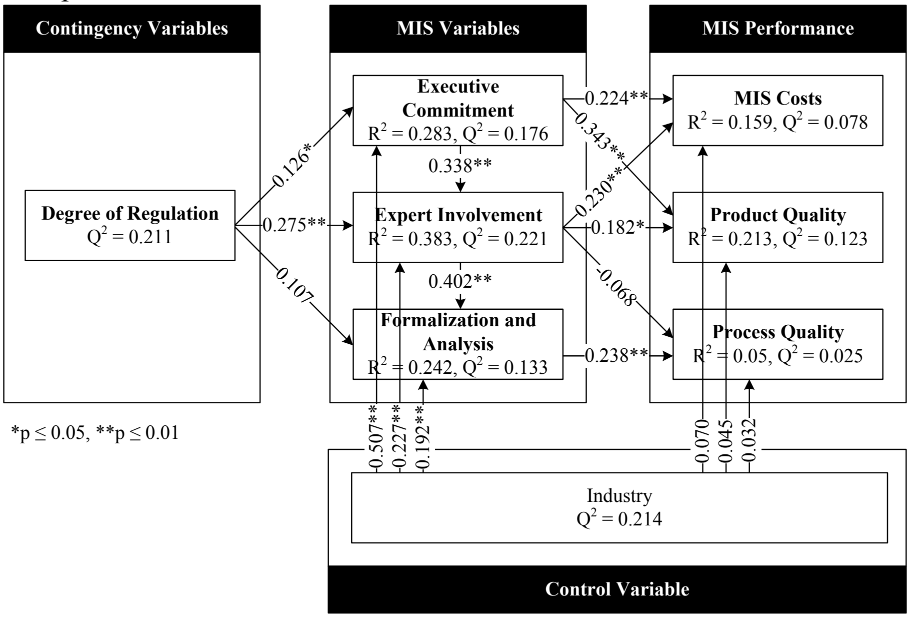

Figure 2. Structural Model

Latent variable	Composite reliability	Cronbach's alpha	AVE
DR	0.814	0.709	0.526
EC	0.884	0.824	0.659
EI	0.849	0.734	0.653
FA	0.831	0.729	0.553
MC	0.886	0.809	0.723
PCQ	0.881	0.801	0.712
PDQ	0.893	0.827	0.712

Table 2. Internal Consistencies

Because the data samples were collected using a single method, there is a potential for common method biases (CMB). We assess CMB as presented in Wells et al. (2011). After adding the unmeasured latent method construct (ULMC), all hypotheses remain significant as are without the ULMC. Only 2 out of 24 paths from the ULMC to the measurement items are significant (DR4, MC3, $p \leq 0.05$). In addition, we looked at the inter-construct correlations. Because none of the constructs are extremely high correlated (more than 0.9), both tests indicate that CMB is not a serious concern.

	DR	EC	EI	FA	MC	PCQ	PDQ	IN
DR	**0.725**							
EC	0.166	**0.812**						
EI	0.379	0.506	**0.808**					
FA	0.211	0.330	0.476	**0.730**				
MC	0.369	0.342	0.343	0.167	**0.850**			
PCQ	-0.008	0.011	0.006	0.217	0.297	**0.844**		
PDQ	0.209	0.433	0.354	0.051	0.057	-0.252	**0.858**	
IN	-0.077	0.517	0.425	0.306	0.263	0.077	0.285	-

Table 3. Inter-Construct Correlations of Latent Variables

6 Discussion

Different industry sectors are faced with a different degree of regulation. While the retail sector is perceived to be less regulated, the financial and public sector is expected to be highly regulated. We reflected this diverse regulatory environment by the construct degree of regulation which has a significant positive influence on the executive commitment (H1) and the involvement of legal and compliance experts (H2.1). The results indicate that the more an organization is regulated the more executive commitment for regulatory compliance of IS exists. We measure the same influence for the involvement of compliance experts. The more an organization is regulated the stronger compliance and legal experts are involved in IS development processes. IS projects are often supported by external experts outside of the MIS (Baroudi et al., 1986, McKeen & Guimaraes, 1997, Palanisamy & Sushil, 2001, Wixom & Watson, 2001). According to the study results, these findings are also valid for regulatory-driven IS projects and the involvement of legal and compliance experts. Referring to found relationships of management support and expert involvement (Anderson, 1985, Poon & Wagner, 2001), the study results confirm these findings for regulatory-driven IS projects. When executive support for IS compliance exists, more compliance experts are involved in such IS projects (H2.2).

Regarding the influence of regulation on the utilization of formal design and analysis methods, we could not prove the expected relationship (H3.1). This is surprising due to the assumed increase of complexity that requires abstraction and the usage of conceptual modeling. If the task of designing regulatory-compliant information systems is strongly interdependent among IS and legal experts, a common ground is indispensible. Modeling techniques support the grounding process and establish a mutual understanding (Kung & Solvberg, 1986, Mylopoulos, 1992). Our results provide evidence that the probability of using formal design and analysis methods in interdisciplinary teams containing IS and legal experts is significantly higher (H3.2). The more compliance and legal experts are involved in regulatory-driven IS projects the more project members use formal methods, such as process and data diagrams, in order to operationalize regulatory system requirements and thereby establish a common ground between team members.

A differing executive commitment, expert involvement, and utilization of formal design and analysis methods have a significant influence on MIS performance. First, when executive commitment for regulatory IS compliance exists, MIS costs for compliance projects are significantly higher (H4.1). We explain this relationship with an increased sensitivity for compliance which in turn increases the willingness to spend money for the compliance of IS. Second, the results provide evidence that a higher involvement of legal and compliance experts leads to relatively higher IT compliance costs (H4.2). One reason might be that the involvement of legal experts leads to more communication overhead. IS and legal experts need to communicate with each other and need to understand each other. The communication process in interdisciplinary IS projects is a challenging task because of the different knowledge and skills. Another reason might be that the cost for these legal experts are simply accounted on IS project cost centers.

We could also prove a significant relationship between executive commitment for regulatory IS compliance and the quality of IS products (H5.1). Thereby, we confirm the relationship that has already been proposed for IS projects in a non-regulated environment (Ravichandran & Rai, 2000). If the management supports compliance-related IS projects, the quality of developed IS is higher in terms of compliance than without it. We expect that only when compliance issues are actively addressed by executive management they will be considered in IS development processes and thus lead to better compliance of IS. Surprisingly this effect could not be confirmed for process quality. A stronger involvement of legal and compliance experts does not necessarily lead to better development processes in terms of time and budget overruns. This might be an indication that team members with legal and compliance skills, involved in regulatory IT compliance projects, cannot use their knowledge to improve the quality of regulatory-driven IS development processes. Thus, we reject hypothesis 6.1.

In line with former studies on influential factors on IS development quality (Doy, 2003, Ravichandran & Rai, 2000), the results provide evidence that a strong utilization of formal design and analysis methods leads to qualitatively better IS development processes (H6.2). Thus, we can confirm that relationship for IS development processes in a regulatory-driven environment. This finding is a first indication for the usefulness and acceptance of conceptual modeling for the task of designing IS based on regulatory requirements. This in turn provides a further motivation for research of modeling techniques and visualization approaches that best fit for legal experts and IS experts. Our results motivate further research in this particular area of conceptual modeling.

Nevertheless, there are some limitations. We employed some variables, whose general applicability was not proven. The degree of regulation, for example, is an own operationalization. Even if the alpha values are above the threshold, its applicability must be proven in other experimental settings. Furthermore, our study focuses just on a part of constructs that have been suggested in the contingency theory of MIS (Weill & Olson, 1989). Constructs, such as user satisfaction as one major driver of MIS success (DeLone & McLean, 1992), was not regarded since the target group of our respondents are IS senior managers and managers on the middle level. Furthermore the differences among countries could not be analysed in this study because the major part of participants came from Germany. The study provides insights into regulatory affected MIS variables. Their fit with the degree of regulation and the combined influence on MIS success must be proven in further research.

7 Conclusion and Outlook

In this paper, we investigate the influence of regulation on the organization of MIS and its effects on MIS success. Based on the contingency theory and its adaptation for MIS, we provide an exploratory research model. We evaluate the model by conducting an empirical study in different industry sectors on a sample of 105 experienced participants from industry and government.

The study provides two major managerial implications. First, CIOs need to focus on the involvement of legal experts in regulatory-driven IT projects. Corresponding management support leads to a stronger involvement of legal experts and improves software quality in terms of regulatory compliance. Second, CIOs should focus on the usage of conceptual modeling and formal analysis methods in regulatory-driven IT projects in order to overcome the existing communication gap between IT and legal experts. When modeling methods are used in such regulatory projects the development process quality is significantly better.

Our research contribution is threefold. First, we present a tested exploratory research model, based on the contingency theory of MIS from Weill and Olson (1989), that explains a part of the regulatory influence on the organization of MIS (Q1). In particular executive commitment and expert involvement are influenced by the degree of regulation.

Second, our model explains partly to what extent MIS variables contribute to the success of MIS in a regulatory-driven environment (Q2). All operationalized MIS variables (executive commitment, expert involvement, and formalization and analysis) are relevant for the success of MIS in a regulatory-driven environment.

Third, the study results motivate more research in the field of conceptual modeling of legal requirements and the interdisciplinary collaboration of IS and legal experts. So far, IS academia puts only little attention to the interrelation of IS and law. The study findings motivate more research in this young research area. Several new questions arise: How do legal and IS experts work together? Do the common modeling techniques fulfill the specific needs of legal experts? How can IS research contribute to increase the efficiency of interdisciplinary teams consisting of IS and legal experts? Also the model demands for a deeper investigation, such as the direct relationship between the degree of regulation and the usage of formalized design and analysis methods. Our work motivates answering these questions and to think about a combined perspective of IS and law.

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Appendix: Questionnaire

Latent Variables		Indicators	Factor Loadings	Source
DR	DR1	The proportion of IT projects that are motivated by compliance requirements is very high.	0.805	Developed and tested by authors
	DR2	IT projects that primarily implement legal requirements are very complex.	0.729	
	DR3	Our software has to fulfill many IT compliance requirements.	0.750	
	DR4	IT compliance requirements to our software change very often.	0.602	
EC	EC1	IT projects that implement compliance requirements are in responsibility of top management.	0.865	Adapted from Wixom and Watson (2001)
	EC2	Top management encourages activities required for IT compliance progress.	0.898	
	EC3	Top management provides a budget for ensuring IT compliance in projects.	0.665	
	EC4	IT compliance expert's satisfaction is a major concern of top management.	0.800	
EI	EI1	IT experts and compliance experts work together on IT compliance projects.	0.784	Adapted from Wixom and Watson (2001)
	EI2	Compliance experts are assigned full-time to parts of the IT compliance project.	0.812	
	EI3	Compliance experts often perform hands-on activities, e.g. data or process modeling, for visualizing software requirements.	0.828	
FA	FA1	Formal techniques such as Prototyping are regularly applied in IT compliance projects for eliciting software requirements.	0.752	Adapted from Ravichandran and Rai (2000)
	FA2	Idea generation techniques, such as Brain Storming or Mind Mapping, are used for system development in IT compliance projects.	0.686	
	FA3	Formal techniques, such as Quality Function Deployment, are often used in IT compliance projects to transform technical requirements to system design.	0.807	
	FA4	Standard representation schemes, such as data or process models, are often used in IT compliance projects.	0.721	
MC	MC1	IT compliance projects result in relatively high costs.	0.837	Developed and tested by authors
	MC2	The part of costs accounted to IT compliance requirements is comparatively high.	0.931	
	MC3	The costs for implementing IT compliance-motivated requirements are very high.	0.776	
PCQ	PCQ1	IT compliance motivated projects usually overrun budget costs.	0.801	Adapted from Ravichandran and Rai (2000)
	PCQ2	Schedule overruns are common in most IT compliance projects.	0.884	
	PCQ3	Backlog of development work that is accounted to IT compliance tasks is high.	0.885	
	PCQ4	Fixing bugs and other types of rework ascribed to IT compliance violations account for a significant proportion of system development.*	-	
PDQ	PDQ1	IT compliance projects result in software that conforms to the requirements of compliance experts.	0.857	Adapted from Ravichandran and Rai, (2000)
	PDQ2	Software functionalities meet all IT compliance requirements.	0.877	
	PDQ3	IT compliance auditors are satisfied with the overall quality of the system.	0.794	
	PDQ4	IT compliance auditors often have complaints about IT compliance.*	-	

* Variable not considered in the structural model due to too small factor loadings.