

# Compliance Principles for Decision Management Solutions at the Dutch Government

## Koen Smit

Research chair Digital Smart Services  
HU University of Applied Sciences Utrecht  
Utrecht, the Netherlands  
Email: [koen.smit@hu.nl](mailto:koen.smit@hu.nl)

## Martijn Zoet

Research chair Optimizing Knowledge-Intensive Business Processes  
Zuyd University of Applied Sciences  
Sittard, the Netherlands  
Email: [martijn.zoet@zuyd.nl](mailto:martijn.zoet@zuyd.nl)

## Raymond Slot

Research chair Information Systems Architecture  
HU University of Applied Sciences Utrecht  
Utrecht, the Netherlands  
Email: [raymond.slot@hu.nl](mailto:raymond.slot@hu.nl)

## Abstract

Since decision management is becoming an integrated part of business process management, more and more decision management implementations are realized. Therefore, organizations search for guidance to design such solutions. Principles are often applied to guide the design of information systems in general. A particular area of interest when designing decision management solutions is compliance. In an earlier published study (Zoet & Smit, 2016) we took a general perspective on principles regarding the design of decision management solutions. In this paper, we re-address our earlier work, yet from a different perspective, the compliance perspective. Thus, we analyzed how the principles can be utilized in the design of compliant decision management solutions. Therefore, the purpose of this paper is to specify, classify, and validate compliance principles. To identify relevant compliance principles, we conducted a three round focus group and three round Delphi Study which led to the identification of eleven compliance principles. These eleven principles can be clustered into four categories: 1) surface structure principles, 2) deep structure principles, 3) organizational structure principles, and 4) physical structure principles. The identified compliance principles provide a framework to take into account when designing information systems, taking into account the risk management and compliance perspective.

**Keywords** Decision Management, Compliance, Principles, Government

## 1 Introduction

A business process realizes business objectives or goals, thereby creating value for the organization. Business processes management is used by organizations to manage and execute their coordinated, value-adding activities (Rikhardsson, Best, Green, & Rosemann, 2006). A specific type of activity are decisions (Breuker & Van de Velde, 1994). Nowadays decision management is becoming an integrated part of business process management. An example of this is the recently released Decision Model and Notation (DMN) standard (Object Management Group, 2015). For both business process management as well as decision management compliance issues are an important consideration when designing, deploying and executing business processes and/or decisions.

Research investigating the relationship between compliance and business processes is executed, amongst others, by Caron, Vanthienen & Baesens (2013), Ghose & Koliadis (2007), Rikhardsson, Best, Green & Rosemann (2006) and Sienou, Lamine & Pingaud (2008). The purpose of the previously mentioned research is to integrate the business process management discipline and compliance (management). Thereby influencing the manner, in which business processes are designed, analyzed, configured, enacted and evaluated. Now that more and more decision management solutions are introduced, organizations are searching for guidance to design such solutions in a compliant manner. In multiple other disciplines, such as system engineering and industrial engineering, the utilization of principles is an important mechanism to guide the design of products and information systems. A principle is a statement of an organization's belief about how they want to use a specific product or information system. In our context, principles are therefore statements of an organization's belief on how to design decision management solutions taking into account compliance requirements.

Research on compliance and decision management is commonly addressed as a singular oriented problem, meaning that compliance demands focus on a specific problem (Liao, 2004; Wagner, Otto, & Chung, 2002). Yet, previous research has shown that compliance requirements have a common design problem. A common design problem indicates that common problem classes, for which design solutions can be created, exist. In an earlier published study (Zoet & Smit, 2016) we focused on the design problem decision management in general. This research extends the previous study by solely focusing on principles from a compliance perspective. The compliance principles that affect decision management solutions are structured along the following structures: 1) the deep structure, 2) the organizational structure 3) the physical structure and, 4) the surface structure (Strong & Volkoff, 2010; Weber, 1997). With these premises, the following research question is addressed: "*Which principles are essential to design a compliant decision management solution?*" Answering this question will help organizations better understand the design and management of decision management solutions while taking compliance into account.

The paper is structured as follows: In section two the relationship between operational and compliance risk and its influence on business processes and decision management is discussed. This is followed by section three in which the research method utilized to identify the compliance principles for compliance is elaborated upon. Furthermore, the collection and analysis of our research data are described. Subsequently, our validated collection of compliance principles is presented. Finally, in Section six, conclusions and suggestions for further research are discussed.

## 2 Background and related work

Decisions are amongst the most important assets of an organization (Blenko, Mankins, & Rogers, 2010). A decision is: "*the act of determining an output value (the chosen option), from a number of input values, using logic defining how the output is determined by the inputs.*" Examples of decisions are: 1) determine what illness a patient has, 2) determine the risk factor for a specific customer or 3) determine what medicine a patient needs. If an organization can't consistently make and execute the right decision(s), large risks are taken that can eventually lead to high costs or bankruptcy. Following the previous example: imagine what happens when a doctor makes the wrong decision continuously or a customer with a high- risk factor gets appointed a low-risk factor. Decision management always received a lot of interest both from research and practice (Arnott & Pervan, 2005). One of the latest developments is the introduction of the Decision Model and Notation (DMN) in September 2015, by the Object Management Group (OMG). The DMN standard recognizes two levels of abstraction for decisions: decision requirements and the decision logic. The decision requirements level is captured in a decision requirements diagram and is used to identify decisions, the input data and business knowledge needed to make the decision, and the knowledge source on which the decision logic is based. At the decision

logic level, the business rules applied to make a decision are specified. The highest level of abstraction; represented with the decision requirements diagram, recognizes four key concepts: 1) a decision, 2) business knowledge, 3) input data, and 4) a knowledge source. The decision logic level has no key concepts, as decision logic could be represented by different representations such as decision trees, decision tables, and/or natural languages. The representation selected to represent the decision logic does not influence the decision requirements level.

The “*entirety of all measures that need to be taken in order to adhere to laws, regulations and guidelines within the organization, subsumed as compliance sources*” is defined as compliance (Daniel et al., 2009). A rising concern in information systems engineering is compliance management. Managing compliance can be defined as the process of assessing an organizational adherence to a set of legal requirements and expectations (Breau, 2009). Examples of laws and regulations organizations have to comply with are the Payment Card Industry Data Security Standard (PCI DSS), the Federal Information Security Management Act (FISMA), the Foreign Account Tax Compliance Act (FATCA), the BASEL accord, and the Health Insurance Portability and Accountability Act (HIPAA) (Zoet, 2014). Not adhering to compliance, also referred to as noncompliance, poses organizations with various risks, for example, legal fines, civil fines, re-engineering costs, public harms, consumer churn, and loss of public trust (Breau, 2009).

Compliance is increasingly affecting the way decisions are designed, specified and executed. Legislation and regulations can precisely dictate or restrict how decisions should be designed, specified and executed. This is, for example, the case with tax laws, which is often defined by national regulations, i.e. calculation of taxes according to income scales. Furthermore, compliance affects decision making in terms of transparency. An example of this form of influence can best be described with how the Dutch government is enforced to provide Dutch civilians with information on with what data, how and by whom decisions are taken regarding applications for child benefits or licenses. The third form of influence that is becoming increasingly important is the exploitation of responsibilities of decision making. For example, in the governmental sector, compliance states that decisions regarding amnesty are convened by the Dutch Immigration and Naturalization Service. However, the law dictates that the minister of justice is appointed as final responsible. Outside the governmental context, the responsibility regarding decisions and their outcomes are often convened with, for example, managers, CFO’s and CEO’s (Nutt, 1993).

The concept of compliance is researched from different perspectives in which three general views can be distinguished: 1) the analysis of compliance law, 2) the realization of the internal system to establish compliance, and 3) the actual reporting of compliance to the outside world. Research on the realization of the internal system is highly focused on providing design solutions for specific problems classes. For example, Pittet et al. (2000) limit their research to hand hygiene in the healthcare sector whereas O’Grady et al. (2001) focus on the singular problem of catheter-related infections. Research with a broader scope, but still problem class-oriented, is executed by Goedertier and Vanthienen (2006) and Caron et al. (2013) who look at the design of patterns for compliant business processes. In our research, we focus on compliance principles that limit the choices an organization has to create a specific design solution for a specific problem class (Winter, 2011). Therefore, instead of evaluating specific instances of a compliance solution which also reduces generalizability of our results, we look at the principles that ground the instantiation of specific compliance solutions.

Multiple definitions and types of principles are discussed in literature, like scientific principles, normative principles, system principles, and design principles. We will not discuss the differences and/or underlying similarities of those concepts. A detailed view on this is presented in the work of Greefhorst and Proper (2011). In this paper, we solely focus on design principles. A design principle is defined as (Greefhorst & Proper, 2011): “*A normative-principle on the design of an artifact. As such, it is a declarative statement that normatively restricts design freedom.*” A simple example of a design principle for the modeling of business processes is formulated as follows (Johannesson & Perjons, 2001, p17): “*Each request needs to be confirmed*”. This pair of request and confirmation is optionally followed by a notification. Another example of a design principle regarding enterprise architecture is formulated as (Richardson, Jackson, & Dickson, 1990): “*Information systems will need to be developed using formal planning and software engineering methodologies.*”

Greefhorst and Proper (2011), argue that design principles can be interpreted as a rule of conduct, as they guide/direct the enterprise by normatively restricting design freedom. Principles fill the gap between high-level strategic intentions and concrete design decisions. Principles ensure that a solution is future-directed, and can guide design decisions. Furthermore, they document fundamental choices in

an accessible form and ease communication with all relevant stakeholders. Based on a design science research approach, Greefhorst and Proper (2011) propose eight steps to define principles: 1) determine drivers, 2) determine principles, 3) specify principles, 4) classify principles, 5) validate and accept principles, 6) apply principles, 7) manage compliance, and 8) handle changes. The first step 'determine drivers' exists out of collecting drivers to serve as starting point to define the principles. Drivers that serve as input for the definition of principles can be risks, goals, objectives, values, issues, potential rewards, and/or constraints. However, many drivers are not explicitly documented, so they have to be collected from stakeholders. After the relevant drivers have been collected they are translated into candidate principles, in the second step 'determine principles'. This step exists out of three phases. First, candidate principles are derived from drivers, domain knowledge, and/or existing principles, after which this list is filtered and the relevant principles are selected. Each relevant principle is further generalized or specified to the right level of abstraction. During the third step 'specify principles' the principles are further detailed. This means that the rationale, implications, and an example are specified. After the rationale, implications, and an example are added, the principles are validated within the organization(s). The next two steps ('apply principles' and 'manage compliance') focus on applying the principles and making sure the organization complies with them. Lastly, Greefhorst and Proper (2011) propose an eighth step: 'handle changes'. They argue that defined principles can change because drivers can change and, therefore, a change management process should be in place. One can also argue that the eighth step is not a separate step but step seven should be connected to step one (creating a lifecycle), since the identification of new and changing drivers is part of step one: 'determine drivers'. In this research, the focus will be on step one, to and including, step five. Step six, seven, and eight are beyond the scope of this research due to the fact that the principles need to be implemented and utilized over a longer period by the participating organizations in order to measure their effectiveness, and, based on feedback, apply changes.

To structure the identified compliance principles, the dimensions and ontological foundations of the extended information systems framework is applied (Weber, 1997). The extended information system framework has been proposed by Strong and Volkoff (2010), describing that principles can be categorized into four categories: 1) deep structure, 2) organizational structure 3) physical structure, and 4) surface structure. Deep structure elements are subjects that describe real-world systems, their properties, states and transformations (Weber, 1997). Organizational structures are the roles, control and organizational culture represented within organizations or within solutions (Strong & Volkoff, 2010). Physical structure elements describe the physical technology and software in which the deep structure is embedded (Weber, 1997). Surface structure elements describe the elements that are available in the information system to allow users to interact with the information system (Strong and Volkoff, 2010).

### 3 Research method

The goal of this research is to identify compliance principles that limit the freedom with regards to decision management solutions. In addition to the goal of the research, also, the maturity of the research field is a factor in determining the appropriate research method and technique(s). The maturity of the object under research: compliance principles for decision management is nascent (Kovacic, 2004; Nelson, Peterson, Rariden, & Sen, 2010; Zoet, 2014). Focus of research in nascent research fields should lie on identifying new constructs and establishing relationships between identified constructs (Edmondson & Mcmanus, 2007). Summarized, to accomplish our research goal, a research approach is needed in which a broad range of possible compliance-focused principles for decision management are explored and combined into one view in order to contribute to the body of knowledge, taking into account the five steps of Greefhorst and Proper (2011).

Adequate research methods to explore a broad range of possible ideas / solutions to a complex issue and combine them into one view when a lack of empirical evidence exists consist of group-based research techniques (Delbecq & Van de Ven, 1971; Murphy et al., 1998; Okoli & Pawlowski, 2004; Ono & Wedemeyer, 1994). Examples of group based techniques are Focus Groups, Delphi Studies, Brainstorming and the Nominal Group Technique. The main characteristic that differentiates these types of group-based research techniques from each other is the use of face-to-face versus non-face-to-face approaches. Both approaches have advantages and disadvantages, for example, in face-to-face meetings, provision of immediate feedback is possible. However, face-to-face meetings have restrictions with regard to the number of participants and the possible existence of group or peer pressure. To

eliminate the disadvantages, we combined the face-to-face and non-face-to-face technique by means of applying the following two group based research approaches: a Focus Group and a Delphi Study.

## 4 Data collection and analysis

Data for this study is collected over a period of six months, through three rounds of focus groups (round 1, 2 and 3: experts focus group) and a three-round Delphi study (round 4, 5 and 6 Delphi study), see Figure 1. Between each individual round of the focus group and Delphi Study, researchers consolidated the results (round 1, 2, 3, 4, 5, 6 and 7: research team). Both methods of data collection are further discussed in the remainder of this section.

Research Team	Experts: Focus Group	Experts: Delphi Study
Round 1: Preparation Focus Group		
Round 2: Consolidation	Round 1: Elicitation	
Round 3: Consolidation	Round 2: Elicitation, Refinement and Validation	
Round 4: Consolidation	Round 3: Elicitation, Refinement and Validation	
Round 5: Consolidation	Round 4: Elicitation, Refinement and Validation	
Round 6: Consolidation	Round 5: Refinement and Validation	
Round 7: Consolidation	Round 6: Refinement and Validation	

Figure 1: Visualization of the research approach

### 4.1 Focus groups

Before a focus group is conducted, a number of key issues need to be considered: 1) the goal of the focus group, 2) the selection of participants, 3) the number of participants, 4) the selection of the facilitator, 5) the information recording facilities, and 6) the protocol of the focus group. The goal of the focus group was to identify compliance principles for decision management solutions. The selection of the participants should be based on the group of individuals, organizations, information technology, or community that best represents the phenomenon studied (Strauss & Corbin, 1990). In this study, organizations and individuals that deal with a lot of business rules represent the phenomenon studied. Such organizations are often financial and government institutions. During this research, five Dutch government institutions participated. Based on the written description of the goal and consultation with employees of each government institution, participants were selected to take part in the three focus group meetings. In total, twelve participants took part who fulfilled the following positions: three enterprise architects, two business rules architects, three business rules analysts, one project manager, one IT architect, and two policy advisors. Each of the participants had, at least, five years of experience with business rules. Delbecq and van de Ven (1971) and Glaser (1978) state that the facilitator should be an expert on the topic and familiar with group meeting processes. The selected facilitator has a Ph.D. in Decision Management, has conducted 7 years of research on the topic, and has facilitated many (similar) focus group meetings before. Besides the facilitator, five additional researchers were present during the focus group meetings. One researcher participated as 'back-up' facilitator, who monitored if each participant provided equal input, and if necessary, involved specific participants by asking for more in-depth elaboration on the subject. The remaining four researchers acted as a minute's secretary taking field notes. They did not intervene in the process; they operated from the sideline. All focus groups were video and audio recorded. A focus group meeting took on average two hours. Each focus group meeting followed the same overall protocol, each starting with an introduction and explanation of the purpose and procedures of the meeting, after which ideas were generated, shared, discussed and/or refined

In an earlier study (Zoet & Smit, 2016) we discussed the identification of general design principles for decision management in more detail. In this study, we refer to the results of these round after which we discuss the identification of the compliance principles. The first round of data collection of this previous

study yielded 343 general principles. Consolidation of these results eventually led to the deletion of 321 principles, presenting a grand total of 22 consolidated and validated general principles for the design of decision management solutions.

The 22 general principles are the starting point for this study, the identification and analysis of the compliance principles. Prior to the first round, participants were informed about the purpose of the focus group meeting and were invited to submit their current compliance principles applicable regarding the decision management problem space. Each of the participants submitted the principles who, according to them, affect their compliance demands, in advance to the first focus group meeting. During the first focus group participants got the opportunity to elaborate upon their submitted compliance principles. After the individual presentations, participants discussed the usefulness of each compliance principle. For each proposed compliance principle, the principle ID, label, rationale, classification, and instantiations were discussed and noted, see table 1 for an example. Because these characteristics have been discussed before the main focus was on the rationale for compliance. The first round resulted in 1) the refinement of the principle labels, descriptions, examples, rationale and classification, and 2) the deletion of 11 principles.

Principle ID:	o6					
Principle label:	Decisions, business rules, and data are recorded according to two time dimensions					
Description:	Decisions, business rules, and data must be recorded according to two time dimensions. The first time dimension is the system time, the second time dimension is the business time. The business time dimensions record the date when a decision, business rule or piece of data is valid (Bus_Start) and the date it's validity ends (Bus_end). The system time records the time the decision, business rule or piece of data is entered into the system (Sys_Start) and when it's updated (Sys_End).					
Example(s):	This example shows a schematic overview of business rule 45 and the registration of system time and business time:					
	<b>BR_ID</b>	<b>Content</b>	<b>Sys_Start</b>	<b>Sys_End</b>	<b>Bus_Start</b>	<b>Bus_End</b>
	045	A	04-07-2014	14-04-2014	04-04-2014	∞
	045	A	14-04-2014	14-04-2014	04-04-2014	14-04-2014
Rationale:	This compliance principle is useful in situations where decisions are evaluated based on laws no longer in effect. For example, a decision is made in 2013. A citizen objects to the decision in 2015. In this situation, the decision should be evaluated against the business rules utilized in 2013, and not against the business rules being valid in 2015. When a lawsuit is being processed, the system must be able to retrospectively reconstruct the situation with 1) the data of the relevant stakeholder used in 2013 and 2) the business rules applied in 2013.					
Classification:	Deep structure					

Table 1 – Example compliance principle result: Decisions, business rules, and data are recorded according to two time dimensions.

After the first focus group, the researchers consolidated the results. Consolidation of the results comprised the detection of double principles and incomplete principles. This process is executed as follows. All compliance principles have been transformed into columns and rows in an (ordinal) comparison table. An example snapshot that was utilized has been added in Table 2.

		<b>Compliance principle 3</b>				
		Description	Example	Rationale	Classification	Goal
<b>Compliance principle 21</b>	Description	=/				
	Example		=/			
	Rationale			==		
	Classification				=/	
	Goal					=/

Table 2: Snapshot Meta-Model Comparison Table

For each compliance principle the description, example, rationale, classification, and goal were compared by three researchers, which comprised the back-up facilitator and two 'minutes' researchers from the focus groups. When double principles or incomplete principles were discovered a note was

made and was added to the results of the consolidation. In situations where the three researchers didn't agree on the comparison, the fourth researcher, the facilitator of the focus groups, compared the principles and discussed the results with the first three researchers until consensus was reached.

The results of the consolidation were sent to the participants of the focus group two weeks in advance for the second focus group meeting. During these two weeks, the participants assessed the consolidated results in relationship to four questions: 1) "Does the principle affect compliance of the decision management solution?", 2) "Are all compliance principles described correctly?" (in terms of the principle label, accompanied examples, and its rationale), 3) "Do I want to remove a compliance principle?", and 4) "Do we need additional compliance principles?". During the second focus group, the participants discussed the 11 principles. Again, the researchers consolidated the results and send them to the participants two weeks in advance. During the third focus group, the participants discussed the refined 11 compliance principles. The discussion did not lead to new compliance principles and focused on further refinement of the existing compliance principles in terms of descriptions, rationale, classification, and goals of each of the 11 compliance principles.

## 4.2 Delphi Study

Before a Delphi study is conducted, also a number of key issues need to be considered: 1) the goal of the Delphi study, 2) the selection of participants, 3) the number of participants, and 4) the protocol of the Delphi study. The goal of the Delphi study was twofold. The first goal was to validate and refine existing principles identified in the focus group meetings, and the second goal was to identify new principles. Based on the written description of the goal and consultation with employees of each organization, participants were selected to take part in the Delphi study. In total, 44 participants took part. thirty-two experts, in addition to the twelve experts that participated in the focus group meetings, were involved in the Delphi Study. The reason for involving the twelve experts from the focus groups was to decrease the likelihood of peer-pressure amongst group members as could have been the case in the focus group meetings. This is achieved by exploiting the advantage of a Delphi Study which is characterized by a non-face-to-face approach. The non-face-to-face approach was achieved by the use of online questionnaires that the participants had to return via mail. The thirty-two additional participants involved in the Delphi Study had the following positions: three project managers, one enterprise architect, ten business rules analyst, four policy advisors, one IT-architect, five business rules architects, two business consultants, one functional designer, one tax advisor, one legal advisor, one software engineer, one knowledge management advisor, and one legislative author. Each of the participants had, at least, two years of experience with business rules. Each round (4, 5, and 6) of the Delphi Study followed the same overall protocol, whereby each participant was asked to assess the principles in relationship to five questions: 1) "Are all compliance principles described correctly?", "2) Do I want to remove a compliance principle?" 3) "Do we need additional compliance principles?", 4) "Does the principle contribute to compliance?" and 5) "How does the principle affect the decision management problem space?"

Additionally, to guard consistency of the selection of compliance principles by the participants, both the physical introduction at the start of the focus group meetings and the written introduction for the Delphi study contained literature regarding compliance and principles. This ensures a consistent interpretation of the concepts compliance and principles. The literature utilized regarding compliance and principles is identical to the definitions provided in the literature section of this paper.

## 5 Results

In this section, the identified principles are presented and the reduction of freedom they realize is described. The principles have been categorized along the dimensions of the ontological foundations of the extended information systems framework (Strong and Volkoff, 2010). A visualization of the classification is shown Figure 2. Table 1 contains the description of a principle taken from the derived list of principles. The example includes: 1) the principle's ID, 2) its label, 3) a description, 4) a short practical example, 5) a rationale, and 6) the classification of the principle. Due to space limitations, the remaining 10 principles are presented per category or a combination of categories by a shorter representation, only describing 1) the principle's ID, 2) the principle's label, and 3) (a short) the description of the principle.

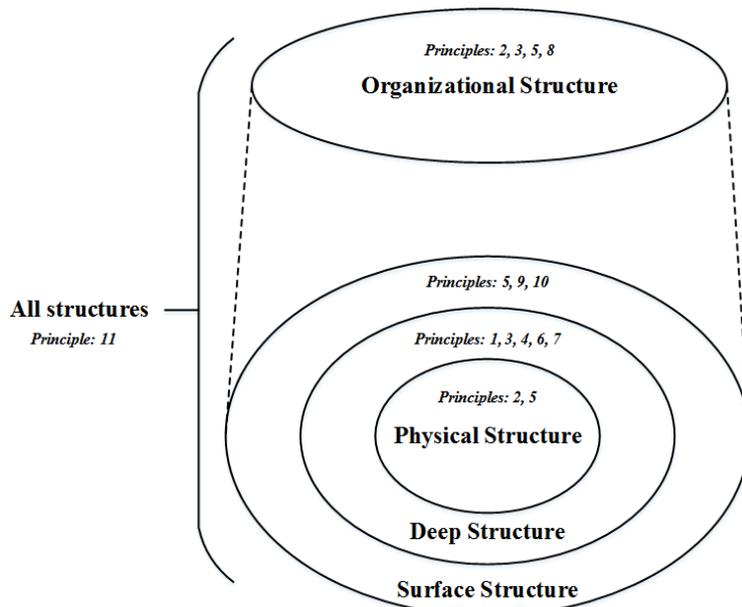


Figure 2: Classification of compliance principles

## 5.1 Compliance principles

In this sub-section, the derived compliance principles are presented. The possible overlap of each principle with regards to their classification is depicted in figure 2.

### Principle 1: IT does not formulate business rules

The first principle prescribes that decisions and underlying business rules should always be specified by an employee from the business domain (non-IT-professional). Examples of roles from the business are: tax specialist, risk specialist or compliance specialist. Employees from the IT department are not allowed to formulate or change the business rule. The rationale behind this choice is the expertise needed to 1) read and interpret laws and regulation and be able to 2) transform the source documents into a decision architecture and business rule (sets) is expertise which differs from IT expertise.

### Principle 2: Authorization for decision-making

The second principle prescribes that organizations should implement authorization mechanisms for decision-making so that only authorized employees can make decisions. The rationale behind this principle is that employees which are not allowed to make a specific decision are not able to do so. An example from one specific government agency is that the law prescribes who should take a specific decision. If the decision is taken by another role the application is unlawful.

### Principle 3: Ownership of a decision is defined

The third principle focuses on the explicitation of ownership and/or accountability per decision. It can be regarded an extended version of principle 2. Organizations often do not define the roles and responsibilities of employees, functions or departments with respect to a specific decision. Blenko and Roger (2010) identified this problem and addressed this problem by creating RAPID. RAPID is a framework which is used to define which role each department, team or person has with regards to a specific decision. According to their research, ambiguity regarding accountability of decisions could originate from the following four bottlenecks: 1) global versus local, 2) center versus business unit, 3) function versus function, and 4) inside versus outside partners. Furthermore, Blenko and Roger showed that defining roles for decisions increases organizations effectiveness.

Take for example the collaboration between two government institutions concerning the calculation of child benefits. In this particular case both the Dutch Tax and Customs Administration and the Dutch Social Security Agency execute decisions to decide whether a family is eligible for receiving child benefits, the height of the child benefits, and for how long the family will receive child benefits. The Dutch Social Security Agency actually makes this decision to grant child benefits while the Dutch Tax and Customs Administration makes this decision to calculate other benefits.

### Principle 4: Each decision and related data need to be traced

The fourth principle stresses the importance of being able to trace how decisions were taken. To be able to do so, the activity's input, applied business rules, and output must be stored. The rationale behind this principle is the ability to check how a specific decision was taken. Take for example a situation where student benefits are wrongfully rejected based on the data and documents delivered by the student. A law in the Netherlands states that students have the possibility to appeal against the decision of a governmental agency. If they choose to file for appeal the governmental agency responsible for providing student benefits needs to evaluate if an error was made and in the case an error was made, correct the error.

**Principle 5: Communication with the same standards wherever possible, communication with different standards where desirable**

The fifth principle focuses on the utilization of communication standards (BR-related languages). Communication between stakeholders which are involved in the business rules management processes must be aligned. Where possible, the same terms, in different situations should have the exact same definitions. This can be supported by means of a centralized list with definitions that can be utilized by different stakeholders. Where desirable, the same terms have different definitions in different situations. For this, a translation has to be made for each 'different' translation of the definition and added to the definition list.

For example, the Dutch Tax and Customs Administration forces all employees and partners to work with standard communication protocols. As the size of the organization expands, communication regarding business rules and decisions will get more complex. As standards are applied as much as possible, common languages will be adopted, potentially lowering communication issues and improving collaboration between stakeholders regarding business rules and decisions. However, the principle states that for some (critical) instances organizations should be able to utilize different standards (other than the acceptable ones). It goes without saying that this should be avoided as much as possible.

**Principle 6: Decisions, business rules, and data are recorded according to two time dimensions**

The sixth principle dictates that decisions, business rules, and data are recorded according to two time dimensions, which is described in detail in our example in table 1.

**Principle 7: All business rules refer to a source**

Decisions and underlying business rules are based on one or more sources. By referring the actual business rules to a source, organizations can more easily argue why a specific decision has been made. In addition, it also makes impact analysis of changing laws easier. Take for example laws and regulations regarding taxation of income. In the Netherlands alone, this particular law affects over nine million Dutch citizens. When business rules are utilized in (automated or partly automated) decision services, its design should be based upon sources in all relevant and valid legal documentation. This is important so that none of the business rules utilized in the decision services can be questioned regarding legality by the people affected by the decisions it takes.

**Principle 8: Gaming only allowed by gamers**

The eighth principle prescribes that, where necessary, 'playing' with business rules should be limited. When Organizations are unable to do so clients possibly start to experiment in order to achieve the optimal results for them. An argument that some participants made is that employees should be allowed to game. The argument they list for this is that sometimes, when applying law reasonableness and fairness, is more important than applying the law by the actual letter.

For example, when clients are able to experiment while applying for disability allowances, decisions regarding the eligibility, duration, and the height of the allowances could be changed ('played') to realize more positive outcomes. As stated in the previous paragraph an employee must be allowed to do so.

**Principle 9: Transparency concerning decision making for clients and users**

The ninth principle stresses that governmental agencies design its services in a client-oriented manner. It is important that clients recognize the services provided and understand the decision-making progress (minimally high-level).

Take for example the process of a request for unemployment benefits. Usually, this process is complex and can run for multiple weeks or months depending on the difficulty of the given situation. A request for unemployment benefits is processed in multiple process activities by multiple departments, employing multiple specialists. To reduce concerns or impatience of clients and users that submitted the request, a portal is available where the progression of the request is shown.

### **Principle 10: Sharing knowledge concerning the execution of laws, regulations, and policies with employees, partners, and clients**

The tenth principle states that organizations should share their knowledge regarding the design and execution of laws, regulations, and policies with employees and clients. With regards to government institutions, this means that they should provide the decision models to third parties as well as the decision services. In the first case, third parties can assess how the actual decision is made while in the second case they can actually use the decision service to make the decision. This would solve the problem that is addressed in principle three. The Dutch Tax and Customs Administration can review the decision service of the Dutch Social Security Agency. If they agree with the model the Dutch Social Security Agency created they can use the decision service. If they don't agree they can discuss the model with the Dutch Social Security Agency and try to come to a consolidated decision model.

### **Principle 11: Utilize government-wide standards**

The eleventh and last principle prescribes the use of government-wide standards. Government standards describe a structured way in which data and business rules should be handled or how processes should be performed. For example, the Dutch government utilizes multiple standards regarding Enterprise architecture, communication, ICT, etc. These standards focus on standardization of activities concerning data management, process management, and rule management. An example of this is the Dutch Governmental Reference Architecture (NORA). It is built on top of a set of basic principles for digital services delivered by the whole Dutch government. Utilizing such widely applied standards potentially results in more efficient and effective collaboration regarding decision management.

## **6 Conclusions and limitations**

In this paper, we aimed to find an answer to the following question: “*Which principles are essential to design a compliant decision management solution?*” To accomplish this goal, we conducted a study combining a three round focus group and three round Delphi Study. Both were applied to retrieve compliance principles from participants, 44 in total, employed by five governmental institutions. Our rounds of data collection and analysis resulted in 11 relevant compliance principles which should be taken into account when designing a decision management solution. From a research perspective, our study provides a fundament for design principles focused on compliance, which can be applied to create or implement a decision management solution. An important step as the identified principles can now be applied in practice, and their impact can be measured and further evaluated upon. From a practical perspective, our study provides organizations and (enterprise) architects within organizations with a set of principles that can be applied to guide the design of decision management solutions. It offers a framework that can structure thinking about the solution that needs to be implemented, taking into account the compliance perspective.

Several limitations may affect our results. The first limitation concerns the sampling and sample size. The sample group of participants is solely drawn from government institutions in the Netherlands. While we believe that government institutions are representative for organizations implementing decision management, further generalization towards non-governmental organizations, amongst others, is recommended. Taken the sample size of 44 participants into account, this number needs to be increased in future research. Moreover, a possible limitation in our research setup (focus groups and Delphi study) was the difference in minimum years of experience with regards to decision management. This may have led to the participants of the Delphi study not formulating additional compliance principles, they only supplemented the existing compliance principles. This research focused on identifying new constructs and establishing relationships given the current maturity of the decision management research field. Although the research approach chosen for this research type is appropriate, research focusing on further generalization should apply different research methods, such as quantitative research methods, which also allow us to incorporate larger sample sizes to validate our findings. Lastly, future research could focus on the effects of the implemented principles.

## **7 References**

Arnott, D., & Pervan, G. (2005). A critical analysis of decision support systems research. *Journal of Information Technology*, 20(2), 67–87.

- Blenko, M. W., Mankins, M. C., & Rogers, P. (2010, June). The Decision-Driven Organization. *Harvard Business Review*. Retrieved from <https://hbr.org/2010/06/the-decision-driven-organization>
- Breaux, T. (2009). *Legal requirements acquisition for the specification of legally compliant information systems*. ProQuest.
- Breuker, J., & Van de Velde, W. (1994). *CommonKADS library for expertise modelling: reusable problem solving components* (21st ed.). Amsterdam: IOS press/Ohmsa.
- Caron, F., Vanthienen, J., & Baesens, B. (2013). Comprehensive rule-based compliance checking and risk management with process mining. *Decision Support Systems*, 54(3), 1357–1369.
- Daniel, F., Casati, F., D'Andrea, V., Strauch, S., Schumm, D., Leymann, F., ... Hacid, M. (2009). Business Compliance Governance in Service-Oriented Architectures. In *Proc. of the IEEE 23rd Intl. Conference on Advanced Information Networking and Applications (AINA'09)*. IEEE Press.
- Delbecq, A. L., & Van de Ven, A. H. (1971). A group process model for problem identification and program planning. *The Journal of Applied Behavioral Science*, 7(4), 466–492.
- Edmondson, A. C., & Mcmanus, S. E. (2007). Methodological Fit in Management Field Research. *Proceedings of the Academy of Management*, 32(4), 1155–1179.
- Ghose, A. K., & Koliadis, G. (2007). Faculty of Informatics Faculty of Informatics - Papers Auditing Business Process Compliance ( Preprint ), 169–180.
- Glaser, B. G. (1978). *Theoretical sensitivity: Advances in the methodology of grounded theory*. Sociology Press.
- Goedertier, S., & Vanthienen, J. (2006). Designing compliant business processes with obligations and permissions. In *Business Process Management Workshops* (pp. 5–14). Springer Berlin Heidelberg.
- Greefhorst, D., & Proper, E. (2011). *Architecture principles: the cornerstones of enterprise architecture* (4th ed., Vol. 4). Springer Science & Business Media.
- Johannesson, P., & Perjons, E. (2001). Design principles for process modelling in enterprise application integration. *Information Systems*, 26(3), 165–184.
- Kovacic, A. (2004). Business renovation: business rules (still) the missing link. *Business Process Management Journal*, 10(2), 158 – 170.
- Liao, S. (2004). Expert system methodologies and applications—a decade review from 1995 to 2004. *Expert Systems with Applications*, 28(1), 93–103. <http://doi.org/10.1016/j.eswa.2004.08.003>
- Murphy, M. K., Black, N., Lamping, D. L., McKee, C. M., Sanderson, C. F. B., & Askham, J. (1998). Consensus development methods and their use in clinical guideline development. *Health Technology Assessment*, 2(3).
- Nelson, M. L., Peterson, J., Rariden, R. L., & Sen, R. (2010). Transitioning to a business rule management service model: Case studies from the property and casualty insurance industry. *Information & Management*, 47(1), 30–41. <http://doi.org/10.1016/j.im.2009.09.007>
- Nutt, P. C. (1993). The formulation processes and tactics used in organizational decision making. *Organization Science*, 4(2), 226–251.
- O'Grady, N. P., Alexander, M., Dellinger, E. P., Gerberding, J. L., Heard, S. O., Maki, D. G., & Pearson, M. L. (2001). *Draft guideline for the prevention of intravascular catheter-related infections*. Atlanta, GA.
- Object Management Group. (2015). Decision Model And Notation (DMN), Version 1.0. Retrieved from <http://www.omg.org/spec/DMN/1.0/>
- Okoli, C., & Pawlowski, S. D. (2004). The Delphi method as a research tool: an example, design considerations and applications. *Information & Management*, 42(1), 15–29.
- Ono, R., & Wedemeyer, D. J. (1994). Assessing the validity of the Delphi technique. *Futures*, 26(3), 289–304.
- Pittet, D., Hugonnet, S., Harbarth, S., Mourouga, P., Sauvan, V., Touveneau, S., & Perneger, T. V. (2000). Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *The Lancet*, 356(9238), 1307–1312.
- Richardson, G. L., Jackson, B. M., & Dickson, G. W. (1990). A principles-based enterprise architecture: Lessons from Texaco and Star Enterprise. *MIS Quarterly*, 14(4), 385–403.
- Rikhardsson, P., Best, P., Green, P., & Rosemann, M. (2006). Business Process Risk Management and Internal Control: A proposed Research Agenda in the context of Compliance and ERP Systems. In *Proceedings of the Second Asia/Pacific Research Symposium on Accounting Information Systems*. Melbourne.
- Sienou, A., Lamine, E., & Pingaud, H. (2008). A Method for Integrated Management of Process-risk. In *Proceedings of the 1st International Workshop on Governance, Risk and Compliance: Applications in Information Systems*. Montpellier.

- Strauss, A., & Corbin, J. M. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Sage Publications, Inc.
- Strong, D., & Volkoff, O. (2010). Understanding Organization-Enterprise System Fit: A Path to Theorizing the Information Technology Artifact. *MIS Quarterly*, 34(4), 731–756.
- Wagner, W. P., Otto, J., & Chung, Q. B. (2002). Knowledge acquisition for expert systems in accounting and financial problem domains. *Knowledge-Based Systems*, 15(8), 439–447.
- Weber, R. (1997). *Ontological Foundations of Information Systems*. Coopers and Lybrand and the Accounting Association of Australia and New Zealand.
- Winter, R. (2011). Design solution analysis for the construction of situational design methods. In *In Engineering Methods in the Service-Oriented Context* (pp. 19–33). Springer Berlin Heidelberg.
- Zoet, M. (2014). *Methods and Concepts for Business Rules Management* (1st ed.). Utrecht: Hogeschool Utrecht.
- Zoet, M., & Smit, K. (2016). Business Rules Management Principles in the Dutch Governmental Context. In *PACIS 2016 Proceedings* (p. Paper 260).

**Copyright:** © 2016 authors. This is an open-access article distributed under the terms of the [Creative Commons Attribution-NonCommercial 3.0 Australia License](https://creativecommons.org/licenses/by-nc/3.0/australia/), which permits non-commercial use, distribution, and reproduction in any medium, provided the original author and ACIS are credited.