The Influence of IT Governance and Innovation Management Practices on the Innovation of Large-Scale Logistics Systems in the Upstream Offshore Oil and Gas Industry

By

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Abstract

The current context of the oil and gas industry and its need for more efficient operations have resulted in the examination of the potential for digital innovations to reduce costs, enhance productivity and boost performance. Specifically, digital innovations in large-scale logistics systems, referred to as Information Infrastructures (IIs), represent an opportunity for more efficient logistics strategies. However, there is limited research on how to enable digital innovations in this domain. This research focuses on the innovation of IIs and is conducted in the context of logistics in the upstream offshore oil and gas industry. The present study identifies IT governance and innovation practices which have been found to influence IS innovation and examines their influence on the innovation of IIs in the domain of logistics in the oil and gas industry. Through a Delphi study, a total of 47 practices that are perceived to influence the innovation of logistics IIs in the oil and gas industry were found. Further, the levels of impact of these practices in terms of their "effectiveness" and "ease of implementation" were determined, and a minimum baseline of practices that can be applied in organizations to foster innovation was proposed. These findings have theoretical and practical implications not only for the oil and gas industry but also can be applied to other systems/industries.

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Chapter 1: Introduction

The current context of the upstream offshore oil and gas industry is being shaped by complex forces. The most accessible hydrocarbons resources have been almost fully exploited. As a result, the oil and gas industry has been moving operations to less accessible areas, in deeper waters and with harsh environments (Milaković, Ehlers, Westvik & Schütz, 2014; Kvie, 2015). To further exacerbate the situation, the price of oil has stagnated over the past few years. This tumultuous context, calls for more efficient operations and has resulted in the examination of the potential of digital innovations to reduce costs, enhance productivity and boost performance (Choudhry, Mohammad, Tee Tan, & Ward, 2018).

The main activities in offshore installations in oil and gas, comprise those activities required to search for, recover, and produce crude oil and natural gas. This includes: maintenance, drilling, operating wells, and logistics. While there is the potential for digital innovations to improve all of these areas, this thesis focuses on logistics. Logistics, the *"delivery of all products and services necessary for operations to and from the offshore field"* (Milaković, Ehlers, Westvik, & Schütz, 2014, p. 1), plays a key role in all of these offshore upstream activities. The need for increased effectiveness and efficiency requires changes in these activities, and every change in the mode of operations has a direct impact on the way that goods, information, and cash flow in the logistics area. Moreover, the current context of the industry involves great logistic challenges and constraints, such as the real threats caused by inclement weather, the long distances from/to offshore installation, the lack of infrastructure, the high cost that occur with every delay in offshore operations, and the high cost related to the use of offshore supply vessels for transportation (Milaković Ehlers, Westvik & Schütz, 2014; Aas, Gribkovskaia, Halskau Sr, & Shlopak, 2007).

Organizations are examining the potential of digital innovations to deal with the increasing challenges with logistics in the offshore upstream oil and gas industry. Digitalization of logistics activities through digital innovations, such as more advanced computational power, unmanned vehicles, cloud computing, and the "Internet of things" (IoT), has the potential to transform the oil and gas industry. It is pertinent to start by defining the terms digitalization and innovation. Gartner defines digitalization as "the use of digital technologies to change a business model and provide new revenue and value-producing opportunities". While innovation refers to "the implementation of a new or significantly improved product, or process, a new marketing method or a new organizational method in business practices, workplace organization or external relations" (OECD/European Communities., 2005, p. 46). Digital innovation represents an opportunity for more efficient logistics strategies as it allows new ways of cooperation and integration among relevant stakeholders. Enhanced communication and interaction along the supply chain can provide more recent and accurate data, thereby enhancing the visibility and transparency of the supply chain. Furthermore, other factors that significantly affect logistics activities such as environmental conditions can become more predictable and consequently manageable (Gomez, Grand, & Grivas, 2015). Thus, it is clear that the evaluation and adoption of digital innovations is fundamental for oil and gas companies to have more efficient logistics activities.

1.1 Research Questions

As organizations adopt more digital innovations, their information systems (IS) become increasingly complex. The adoption and incorporation of digital innovations into existing IS and organizational practices results in *"large-scale", "inter-connected"* and *"integrated"* IS where multiple digital technologies interact with social elements such as: users, organizations, institutions and organizational practices. Such *"large-scale", "inter-connected"* and *"integrated*" systems

with technical and non-technical elements are referred as Information Infrastructures (IIs) (Hanseth & Monteiro, 1998; Hepso & Monteiro, 2009). For instance, in the field of logistics, SAP technology has been deployed in organizations as an IS. However, over time SAP often evolves to an II as it incorporates new business requirements or technical innovations. So, the result is the emergence of a complex large-scale system in which technical elements such as information systems and networks, and non-technical elements such as individuals, organizations and practices, interact.

The innovation of IIs is a complex task that requires the management of multiple interdependent social and technical factors (i.e. environment, organizations, users, practices, IS, networks, etc.) (e.g. Ribes & Polk, 2014; Grisot, Hanseth, & Thorseng, 2014; Sanner, Manda, & Nielsen, 2014). For instance, Grisot, Hanseth, & Thorseng, (2014) examined the innovation process of an II utilized for hospital-patient communication and demonstrated how multiple social and technical elements interacted in such a process. The hospital created an IT unit to manage the II; this unit was responsible for conducting the II innovation process. Such process included workshops with clinical staff and patients' organizations (i.e. social elements) where clinical professionals were asked to describe the information practices of hospital-patient communication in their departments and provide possible uses of II for patient communication in their daily practice. The decision on whether to use II in each unit was a collective decision that involved clinical staff and patients' organizations. The input generated from those workshops determined the compatible IT innovations (both social and technical) that were incorporated into the II to offer simple, adaptable and easy to use solutions.

As can be noted from the example above, multiple social and technical elements intervene in the innovation of IIs. Furthermore, such social and technical elements can enable and constrain

II innovation (Hanseth & Monteiro, 1998). Therefore, it is important to investigate how those factors can be managed (i.e. managerial practices) to enable the incorporation of digital innovations into the existing legacy systems and practices of the organization.

Innovation management, and to a lesser extent, IT governance practices have been shown to influence the ability of organizations to innovate their IS, but there have not been any studies which have examined the impact of these practices on the innovation of IIs. This exploratory and interdisciplinary study addresses the gap in the literature by examining the extent to which innovation management and IT governance practices influence the digital innovation of IIs. This research focuses on the innovation of IIs and is carried out in the area of logistics in the upstream offshore oil and gas industry. This study identifies IT governance and innovation practices which have been found to influence IS innovation and examines their influence on the innovation of IIs in the context of logistics in the oil and gas industry. The research questions for this thesis are:

1. What are the innovation management and IT governance practices that influence the innovation of logistics IIs in the upstream offshore oil and gas industry?
2. What are the levels of impact of such practices in terms of their "effectiveness" on innovation of logistics IIs in the upstream offshore oil and gas industry?
3. What are the levels of impact of such practices in terms of their "ease of implementation" on innovation of logistics IIs in the upstream offshore oil and gas industry?
4. What is a minimum baseline of IT governance and innovation management practices that organizations can apply in practice to encourage innovation in organizations?

A Delphi study is conducted to examine these research questions. Delphi methodology is a multistage questionnaire-based consensus reaching technique. This methodology is adequate

because it is suitable to exploratory theory building on complex interdisciplinary issues that can be solved by building the most reliable consensus of a group of experts. This thesis contributes by building on prior work in this area to improve the understanding of the extent to which innovation management and IT governance practices impact the innovation of logistics IIs. This study bridges the gap among the IT governance, innovation management and IIs literature by integrating practices from IT governance and innovation management domains, and determining their influence on the innovation of IIs. Practically speaking, the findings from this research may help companies in the upstream offshore oil and gas industry to design innovation management practices and IT governance structures, process and relational mechanisms that enable them to innovate their logistics IIs. Moreover, although this study examines logistics IIs, the findings may prove useful to any organization interested in digital innovation.

The following sections of this chapter provide an introduction to logistics IIs, the innovation of logsitcis IIs, and the influence of IT governance on innovation. The chapter ends with a summary and an outline of the thesis.

1.2 Logistics Information Infrastructures (IIs)

The term Information Infrastructure refers to:

> IT based infrastructures at the application level, not lower level IT based telecommunication networks like for instance ATM networks. An *information infrastructure* can be described as an IS except that it is shared by a large user community, across geographical areas such that it might more appropriately be seen as an infrastructure than a system. (Hanseth & Monteiro, 1998, p. 7).

A prominent conceptualization of the term IIs is provided by Hanseth and Monteiro (1998), who postulated six critical characteristics of IIs. Table 1, on the next page, contains a detailed description of these six characteristics.

Table 1: The six critical characteristics of IIs (Hanseth and Monteiro, 1998)

II Features	Description
1. Enabling	They support an extensive range of activities and they have the capability to open up a range of new activities
2. Shared	IIs are "shared" *"by the members of a community in the sense that it is the one and the same single object used by all of them. In this way infrastructures should be seen as irreducible, they cannot be split into separate parts being used by different groups independently"* (p. 41)
3. Openness	There are no limits for both, the numbers of participants involved (users, stakeholders, vendors, organizations, and institutions) or for the number of technical components such as networks, nodes, applications etc.
4. Heterogeneous	1. The nature of IIs components: II´s are composed of different kinds of elements such as humans, organizations, institutions and technological parts 2. IIs constitute "ecologies of networks", which refers to the diversity of the elements of an infrastructure 3. The same function can be implemented in multiple different forms
5. Socio-technical	The interaction between technical and non-technical elements (e.g. "*the interplay between technical and non-technical (social, organizational, human, etc.) issues"* (p. 7).
6. Installed base	The existence of legacy systems and practices. IIs *"are considered as always already existing, they are NEVER developed from scratch. When "designing" a "new" infrastructure, it will always be integrated into or replacing a part of a later one"* (p. 47).

These six characteristics of IIs outlined in Table 1, enabling, shared, open, heterogeneous, socio-technical and installed base differentiate IIs from traditional IS. Hanseth & Monteiro, (1998) explained that the traditional perspective of IS is:

> implicitly based on assumptions where the information systems are closed, stand-alone systems used within closed organizational limits. They are assumed developed within a hierarchical structure - a project (managed by a project leader and a steering group) - which is a part of a larger hierarchical structure - the user organization (or the vendor organization in case of a commercial product) (p.4).

Due to this differentiation, the innovation process of IIs is different than the one of traditional IS. Therefore, it is important to examine whether the innovation management and IT governance practices which have been found to influence the innovation of traditional IS also

apply to the innovation of IIs. To clarify this distinction further, the next section introduces the process of the innovation of IIs.

1.3 Innovation of IIs

Innovation of IIs can occur through the emergence of new requirements or new technical opportunities. Some studies argue that innovation of IIs is performed through the process of "Cultivation", which refers to the process of changing in an incremental and gradual manner and entails the acknowledgment of an "installed base." "Cultivation" posits that the innovation process of IIs implies their natural process of evolution and is constrained and enabled by the "installed base." That is, every new element has to be integrated and made compatible with the existing legacy systems and practices. In this sense IIs cannot be "designed" from scratch, rather they are "cultivated" based on their "installed base" and evolve in a gradual and incremental form. (Hanseth and Monteiro, 1998; Grisot, Hanseth, & Thorseng, 2014). Consider the example of the "Naval Logistics Information Infrastructure" (NLII) that was developed in the United States to support the optimization of the logistics activities. The legacy systems of the NLII consisted of SAP-based enterprise integration solutions. However, over time new Information Technology (IT) that supported the optimization of the logistics activities was needed. In response, a technical innovation was implemented in the NLII. It consisted of integrating a grid of active Radio Frequency Identification Devise (RFID) geospatial nodes interacting with microsatellites and networks of RFID devices into the existing systems (i.e., "installed base") (Farquhar, 2010). In other words, the innovation that occurred was a result of a cultivation of the NLII to include the incorporation of the RFID technologies.

This thesis aims to postulate a set of IT governance and innovation management practices as a strategy for "cultivation". That is, the practices that facilitate the incorporation of digital innovations into existing legacy systems and practices.

1.4 Influence of IT governance on innovation

Innovation of IIs requires the management of multiple socio-technical factors; thus, it is essential to investigate the managerial practices that influence an organization´s ability to innovate. One element that has been shown to influence an organization´s capability to innovate is IT governance. IT governance is:

> an integral part of corporate governance and addresses the definition and implementation of processes, structures and relational mechanisms in the organization that enable both business and IT people to execute their responsibilities in support of business/IT alignment and the creation of business value from IT-enabled investments (De Haes & Van Grembergen, 2009, p. 61).

"Processes" addresses the management and implementation of IT procedures, "Structures" refer to the formal roles and positions of the IT decision making, and "Relational Mechanisms" comprises IT leadership, partnerships, informal meetings and Information Systems. (Hèroux & Fortin, 2016).

IT governance can enhance an organization´s capacity for continuous change by creating environments that encourage innovation (Hèroux & Fortin, 2016). It comprises both technical and human resources, and its scope in terms of innovation includes the design of the IT infrastructure, the management of the organizational units that have a stake in the IT services, and the creation of liaison positions and authority structures to allocate responsibility and resources for innovation purposes. Essentially, IT governance involves ensuring control over IT resources, approving and

managing innovation projects, and influencing authority and communication patterns amid innovators. Consequently, the ability of an organization to innovate digitally depends on the decisions made at this level (Tarafdar & Gordon, 2007).

IT governance is contingent on a variety of factors, the IT governance strategy that works well for a firm does not necessarily works for another firm. Des Haes and Grembergen, (2006) elaborated on three contingences that influence IT governance 1) size (e.g. small, medium, large), 2) industry (e.g. finance, pharma/health, production, etc.) and 3) geography (e.g. global, North-America, Asia- Oceania, etc.). For instance, larger industries may have more resources to implement a richer mix of IT governance mechanisms, some sectors may be more dependent upon IT to conduct their activities than other sectors, and specific standards and processes may not be implemented in certain regions of the world due to culture or history. The oil and gas sector is shaped by various aspects such as the presence of global companies, high reliance upon IT to conduct their activities, and their focus on emergency response. Thus, looking into particularly the oil and gas industry, this research examines IT governance practices that foster innovation in logistics IIs and how those practices support and sustain the business strategies of oil and gas companies.

A search of the IT governance literature did not find any research that focus on logistics IIs; however, three studies were found that examined topics that are relevant to IT governance and logistics. Cegielski, Jones-Farmer, Wu, and Hazen (2012) examined the extent to which the environmental, task and inter-organizational uncertainities influence the adoption of digital innovations in logistics, specifically cloud computing technology. Those uncertainities are related to the domain of IT governance; for example, the "environmental" construct includes the cost of adopting, managing and operating a system, the "task" construct includes "functionality", that is

the systems` capability to match processess, and inter-organizational uncertainities can be derived from the relationships among the supply chain stakeholders. Van de Wijngaert, Versendaal, and Matla (2008) explored the relationship between business/IT alignment (a core concept in IT governance) and the adoption of RFID technology in logistics. That is, the authors investigated the degree in which IT governance ("structures", "processes" and "relational mechanisms") sustains the organization's strategy and objectives and its relationship with the adoption of RFID technology. The authors developed a business-IT aligment framework for logistics to evaluate the readiness of a firm to adopt the RFID technology. Further, Gomez, Grand and Grivas (2015) mentioned factors that can inhibit the use of digital innovations in logistics, including: dissimilar communication standards among the different parties of the supply chain, fearfulness to information sharing with other parties, concerns related to security of data and systems, and the large amount of resources that have to be allocated to innovation purposes. Those factors fall within the domain of IT governance since IT governance represents the authority and communication patterns among innovators; thus is responsible of managing innovation projects and resources (Tarafdar & Gordon, 2007). Moreover, IT governance also consists of "*defining integration and standardization requirements for IT infrastructure planning and security management"* (Tarafdar & Gordon, 2007, p. 365)

1.5 Influence of management on innovation

A great deal of research in the field of innovation management has studied the influence of multiple factors and practices on IT innovation. This abundance of literature have permitted the existence of extensive works of literature review on this field (e.g. Damanpour, 1991; Jeyaraj,

Rottman, & Lacity, 2006; Hameed, Counsell, & Swift, 2012). An example of literature that examines the influence of management practices on IT innovation is the study of Khoumbati, Themistocleous, & Irani (2006). Through a case study in the health care sector, the authors confirmed and validated the influence of various management practices (i.e. innovation determinants) (e.g. "IT support", "evaluation frameworks", and "physicians and administrators relationships") on IT innovation. The authors provided the importance of each of the factors in terms of the role they play in IT innovation and their interrelationship. Chong & Ramaseshan (2005) studied the influence of a set of factors on IT innovation. Through a survey methodology, the authors determined that innovation determinants such as "communication channels", "complexity", and "compatibility", significantly influence the IT innovation in Australian companies.

Based on the discussion above, the impact of various innovation management practices on IT innovation is demonstrated; thus, it is important to investigate the innovation determinants (including managerial practices) that influence the innovation of logistics IIs in the upstream offshore oil and gas industry.

1.6 Summary

This chapter has explained the motivation of this research and its practical relevance. It is important to examine the extent to which Innovation management and IT governance practices influence the innovation of logistics IIs in the oil and gas industry due to the industry's recent focus on how digital technologies can enable them to reduce costs and enhance productivity. Also, this chapter has introduced the research questions, methodology and contributions of this study, as well as the core concepts of this research.

This thesis is divided into six chapters; the next chapter will describe the literature review conducted in the domains of IIs, IT innovation management and IT governance. Chapter 3 will provide explanation of the IT governance practices ("structures", "processes" and "relational mechanisms"), and the innovation management practices that were included in this Delphi study to be examined. Chapter 3 also will discuss the six propositions of this study. Chapter 4 will describe in detail the methodology and the analysis procedures that were utilized to conduct this research. Chapter 5 will present results of the Delphi study. This thesis concludes with Chapter 6 which will discuss the conclusions, implications and limitations, and then, identify areas for future research.

Chapter 2: Literature review

This chapter presents a review of the relevant literature in the domains of IIs, innovation management, and IT governance. First, the review of the II literature discusses prominent conceptualizations of this term and presents an overview of previous studies that have examined innovation of IIs, including the process of *"cultivation"* and the role of *flexibility* and *standardization* in the innovation of IIs. The second section of the literature review addresses the IT governance domain. This section provides an overview of the IT governance literature, including both the management-level, and the board level literature. An emergent stream of research in this field that examines the relationship between IT governance practices and innovation are also discussed. The third section presents a review of the innovation management literature. A great deal of literature has examined the influence of innovation determinants the IT innovation adoption in organizations. Consequently, exhaustive literature reviews have been published in this area. This section describes these literature reviews and identifies the most significant innovation determinants found in these works. The Chapter concludes with a summary of the findings.

2.1 Information Infrastructures (IIs)

This section is divided in two parts, the first part contains the most prominent conceptualization of the term IIs and the second part contains a description of various studies that have examined IIs innovation.

2.1.1 Conceptualization of the term "Information Infrastructure"

The most prominent conceptualizations of the term *"Information Infrastructure"* incorporates its heterogeneous nature by emphasizing their technical and non-technical elements, and the socio-technical relations of their elements. One of those prominent conceptualizations was provided by Hanseth and Monteiro (1998) who postulated six characteristics of IIs, including the socio-technical and heterogenous aspects. Such conceptualization is described in detail in Chapter 1. Another prominent conceptualization of the term IIs was provided by Star and Ruhleder (1996) who postulated that IIs emerge with the configuration of the eight dimensions showed in Table 2.

Table 2: Eight dimensions of IIs (Star & Ruhleder, 1996)

	Dimension	**Definition**
1.	Embeddedness	IIs are inside of social or technological arrangements
2.	Transparency	IIs invisibly supports activities
3.	Reach of scope	Both, spatial and temporal. IIs are not limited to one site, practice or one event
4.	Being learned as part of memberships in a group	"*the taken-for-grandness of the artifact and organizational arrangements is a sine qua none of membership in a community of practice"* (p.113)
5.	Links with conventions of practice	*"IIs shape and are shaped by the conventions of a community of practice"* (p.113).
6.	Embodiment of standards	IIs can be incorporated into others infrastructures through standardization
7.	Being built on an installed base	IIs *"does not grow de novo: it wrestles with the "inertia of the installed base" and inherits strengths and limitations from that base"* (p.113).
8.	Becoming visible upon breakdown	*" The normally invisible quality of working infrastructure becomes visible when it breaks"* (p.113)

As can be noted, the conceptualizations provided by Star and Ruhleder (1996), and Hanseth and Monteiro (1998) reach consensus in two common factors: 1) the heterogenous composition of the IIs (technical and non-technical elements) and 2) the critical role of the existing installed base.

IIs have been extensively examined in the health care and government sectors (Hanseth & Monteiro, 1998; Pipek & Wulf, 2009; Grisot, Hanseth, & Thorseng, 2014; Ribes & Polk, 2014; Sanner, Manda, & Nielsen, 2014); consequently, the following sections describe studies that were conducted within those sectors. However, a review of the literature in the domain of IIs revealed limited research on logistics IIs (Farquhar, 2010). In the field of logistics, IIs allow logistics IS to be integrated with all their suppliers and customers (Hanseth & Monteiro, 1998). Thus, a particular characteristic of logistics IIs is that they necessarily involve active participation of external stakeholders, and their scope goes beyond the organizational limits. Hence, the logistics II can be regarded as an inter-organizational infrastructure which requires active collaboration among various stakeholders with different interests and expectations (Sanner, Manda, & Nielsen, 2014). Therefore, the management and innovation of logistics IIs is a complex task that deserves deep examination. This research intends to contribute to fill the gap in literature of logistics IIs by providing a clear understanding of the innovation of logistics IIs. The next section describes some studies on the need to innovate IIs and the process of IIs innovation as the "cultivation" of the installed base.

2.1.2 The innovation of IIs

IIs are dynamic and changeover time as they incorporate technical innovations into their installed base. IIs inovation can be spurred as a response to a changing environment, the availability of technical oportunities or the emergence of new requirements. For example, Kaniadakis and

Constantinides, (2013) performed a study that addressed the necessity of innovating IIs in response to a changing market and the emergence of new requirements and necessities. In their study, the authors examined the role of financial II innovation as the process that enables the introduction of the financial innovation "securitization". "Securitization" refers to the transition of the "primary mortgage market" (where borrowers obtain loans from lenders) to the securitization market (where lenders sell those mortgages to investors). For the UK banks, securitization implies the innovation of the existing "installed base" of primary mortgages. Findings revealed that such innovation in the financial II was crucial to enable UK banks to plug into the securitization chain. Pipek and Wulf (2009) developed a framework for "designing" (i.e., improving) IIs based on the term "*infrastructuring"* and the eight characteristics of IIs postulated by Star and Ruhleder (1996; 2002). According to the authors, "designing" occurs as a result of an infrastructure breakdown or the incorporation of an innovation in the IIs. In this context, an innovation can be spurred by the emergence of new requirements or the availability of new technical opportunities. The authors elaborated on the term "infrastructuring" to comprise all activities that are involved in a successful establishment of IIs´ usage (such activities include: "designing", using, implementing and further developing infrastructures), and examined how organizational work practices build and innovate IIs.

Some scholars have conceptualized the process of IIs innovation as "the cultivation of an installed base" (Hanseth & Monteiro, 1998; Sanner, Manda, & Nielsen, 2014; Grisot, Hanseth, & Thorseng, 2014), which refers to the historical and gradual accretion of socio-technical arrangements that are built on an "installed base." Building an II is a process that requires time, all elements are interconnected, and over time new necessities and requirements emerge and have to be integrated into the existing legacy systems and practices (Hanseth and Monteiro, 1998). Based

on the concept of "cultivation", Sanner, Manda, & Nielsen (2014) offered a perspective of how organizational innovations become "viable extensions" of evolving IIs. Through the analogy of "Grafting" in horticulture (which entails the placement of a portion of one plant (scion) into a portion of another plant (rootstock) to create and propagate hybrid plants that contain certain desirable features) the authors explored IIs innovation as the process in which organizational "goal-oriented" IS amalgamate into evolving IIs. A critical factor in the horticultural grafting process is the compatibility of the scion and rootstock; likewise, in IIs, the critical factor is the compatibility of the innovation and the installed base. The authors proposed that the concept of compatibility or "congeniality" refers to the ability of an innovation to successfully be integrated and adjusted to an II and coevolve with it.

Grisot, Hanseth, & Thorseng (2014) examined the evolution of a Medical Health infrastructure through a longitudinal study over a 10-year period and took the concept of "cultivation" of the installed base as their basis to understand the bottom up innovation of IIs. The authors elaborated on three aspects of the cultivation strategy: process orientation (refers to the process of incremental changes of the IIs over time), user mobilization (users required to be motivated and mobilized to use the innovation) and learning (the selection process where designers judge which parts are working well and which are not). Also, the study examined the role of infrastructural architectures on IIs innovation and concluded that successful IIs innovation include three types of innovation: Innovations "of" the overall infrastructure, which conditionate the innovations "in" the components of the existing II, and, innovations "on" the top of IIs, which involve the changes in the applications running on the II.

Some studies have examined the concepts of "standardization" and "flexibility", which are strongly related to the "cultivation" process (Hanseth & Monteiro, 1998). Standardization implies stability and standards ensure that one technological component can be successfully incorporated into an existing II. Standards are not easy to make nor change when they have already been implemented and widely used. However, as IIs are dynamic and changing, in order to allow such changes, IIs' standards should be flexible and easy to adapt to new requirements. Ribes and Polk (2014) posited the question *"How should infrastructure adapt to a changing world?"* (Ribes & Polk, 2014, p. 288), and explained that this question is often answered with some variation of the recommendation *"remain flexible"*. However, the study claimed that "flexibility" was largely defined in terms of the "socio-technical" facet of change, which includes changes in coordination and collaboration technologies, social organization, users and IS. The study stated that IIs research should consider other facets of change. Through the investigation of a long-term research infrastructure, the authors postulated two additional facets of change: "the techno-scientific" (changes in scientific methods, instruments and research objects) and the "institutional" (changes in regulatory and funding rules). The study examined how II research has changed over time, meshing all the three facets of changes in its evolution and describing how those changes have emerged. Thus, the study demonstrate that "flexibility" plays a crucial role in the evolution and innovation of IIs, and its conceptualization should be comprehensive and include the different facets of change.

This section has described the most prominent conceptualizations of the terms IIs, and the studies that have examined innovation of IIs. IIs are large-scale, integrated and interconnected IS whose innovation is enabled and constrained by their installed base (i.e., "cultivation"). As such

the innovation process of such systems is a complex task that needs to be examined further. The next section addresses the literature review in the field of IT governance.

For the realization of this research, IT governance and innovation management practices are examined as a strategy for "cultivation". That is, this research will identify the IT governance and innovation management practices that enable innovation of logistics IIs in the oil and gas industry. Such practices should facilitate that digital innovations which are intended to meet current and future organizational needs are incorporated into the existing legacy systems and practices (i.e., "cultivation"). Thus, this research will propose a set of IT governance and innovation management practices as a strategy to facilitate the incorporation of new technology into the existing legacy systems and practices.

2.2 IT governance

IT governance has been viewed from the management-level (e.g. Brown and Grant, 2005) and the board-level (e.g. Jewer and McKay, 2012). The first two sections of this section discuss these perspectives in turn; the third section describes the stream of research that examines the IT governance scope, and the fourth section addresses the studies related to IT governance and innovation.

2.2.1 IT governance: The management- level

In a review of the IT governance literature at the management-level, Brown and Grant (2005) organized the literature into three categories: 1) IT governance forms; 2) contingencies of IT governance forms, and; 3) the convergence of these categories (Weil and Ross (2004). These are discussed in turn.

2.2.1.1 IT governance forms

The body of literature that investigated IT governance forms comprises studies that examine two basic IT governance structures: centralized IT governance, which refers to all decision-making authority that is allocated in a central IS organizational unit, and; decentralized IT governance which refers to decision making authority that is allocated among business units. Studies in this stream of research examined the advantages and disadvantages of these two basic IT governance structures (Cross, Earl, & Sampler, 1997; Keen, 1981; Olson & Chervany, 1980). Other studies in this category examined "less-rigid" forms of governances; those studies constitute what Grant (2005) called "the vertical and horizontal expansion". The horizontal expansion addresses the relationship between IT governance forms and the various types of IT decisions. That is, this stream of research examines the impact of centralization and decentralization on diferent types of IT decisions, such as: "system operation", "system development", and "system management", instead of the IS organization as a whole (Boynton & Zmud, 1987).

The "vertical expansion" involved three "methods of expansion". First, the *"continous classification"*, which refers to the studies that examined multiple degrees of centralized and decentralized IT governance (Ein-Dor & Segev, 1978). Second, the *"discrete nominal clasification"* which included governance forms such as the "Federal Government Framework" (Zmud, Boynton, & Jacobs, 1986; Boynton & Zmud, 1987; Brown, 1997; Brown & Magill, 1994), which balanced the benefits of centralized and decentralized structures, and is based in the analogy of typical federal goverments that provide general centralized direction in the form of policies and guidelines but allows subdivisions with certain degree of autonomy. In the context of IT, the "Federal Government Framework" involves a centralized IS unit that provides core services but allows subdivisions to control a portion of the overall IS function.

The "hybrid IS governance" model has been related to the "Federal Government Framework" (Brown & Grant, 2005); this model allows some business units to adopt a centralized governance form while other business units adopt a decentralized governance form within the same organization. That is, the management of some IS functions such as "system development" or "system operation" is decentralized to some business units but not to others business units of the same firm (Brown, 1997; Brown & Magill, 1994). Another framework included in the second method of expansion is "The recentralized government model", which refers to organizations that previously adopted a descentralized form of IT governance but then moved to more a centralized structure (Brown & Magill, 1994).

Finally, the third method of expanssion is the *"re-definition of the extreme points",* which involves studies that examined how organizations allocate decision-making responsibility in the context of a decentralized structure. The general idea of the studies in this category involves line managers taking responsibility of the use of IT, while the responsibility of core services such as *"corporate infrastructures, planning, and operations"* is taken by a centralized IS unit (Boynton, Jacobs, & Zmud, 1992).

2.2.1.2 IT governance contingency analysis

The body of literature in this stream of research is focused on determining which IT governance structure is the best option for which organization. In doing so, this stream of research is based on the analysis of multiple elements that influence the success of individual IT governance forms. That is, a *"universal best IT governance structure does not exist. Rather the best IT governance solution for a given firm is contingent on a variety of factors"* (Brown & Grant, 2005, p. 703). Studies in this category examined from single and multiple contingencies for organizations that adopt a single form of IT governance structure in all their business units, to more complex studies

that addressed the analysis of multiple contingencies for organizations that adopts different forms of IT governance structures for their business units.

Studies that analized single and multiple contingencies for organizations that adopt a single form of IT governance structure in all their business units found substantial conclusions related to contingent factors and IT governance forms. For instance, the examination of the contingent factor "*Organizational Structures and Decision-Making Structures*" revealed that there is not enough evidence to support the idea that centralized organizations lead to a centralized IT structures, and decentralized organizations lead to a decentralized IT structures. The study of the contingent factor "*Competitive and Business Strategy*" indicated that organizations with "conservative/defender" competitive strategies were more prone to adopt centralized IT governance structures than companies with more "aggressive" competitive strategies (Tavakolian, 1989). The examination of the contingent factor "*firm size*" determined that the organizational size did not influence the adoption of a particular IT governance form (Olson & Chervany, 1980; Tavakolian, 1989). However, the study of Ein-Dor & Segev, (1982) found a relationship between IT governance structure and "*firm size*", when the contigent factor is operationalized in terms of revenue rather that number of employees. Those contributions constituted the foundation for research that studied the multiple, interacting contigency factors, but was still concerned with the overall IT governace form.

Complex studies emerged addressing the analysis of multiple contingencies for organizations that adopt different forms of IT governance structures for their business units. For instance, Brown (1997) conducted an investigation on the contigent factors that influence the IT governance form for individual business units. The findings revealed that the contingencies

"*decision-making structure", "business unit autonomy", "competitive strategy",* and *"industry stability*" influenced the IT governance form of individual business units.

2.2.1.3 Convergence of IT governance forms

Brown and Grant (2005) argued that the study of Weill and Ross (2005) is an amalgam of the two streams of research of IT governance mentioned above. Weill and Ross (2005) provided a framework that mapped a set of mutually exclusive IT governance "structures" (i.e., 1) Business Monarchy 2) IT Monarchy 3) Feudal 4) Federal 5) IT Duopoly) against five IT decision areas (i.e., IT decisions, IT principles, IT architecture, IT infrastructure strategies, business application needs, and IT investment and prioritization). Hence, that framework postulated that the IT governance form is contingent on the type of IT decision to be made. The stream of research "IT governance contingency analysis" is also included in the framework. Five factors to determine the IT governance structure are identified as: 1) strategic and performance goals, 2) organizational structure, 3) governance experience, 4) size and diversity, and 5) industry and regional differences.

2.2.2 IT governance: The board- level

The body of literature that examines the role of the Board in IT governance can be divided in three streams of research: 1) the prescriptive stream which posits that boards should actively oversight IT investment and strategies (Nolan & McFarlan, 2005; Trites, 2004; Buckby, Best, & Stewart, 2005); 2) the descriptive stream which examine the state of practice of the board involvement in IT governance (Andriole, 2009; Bart & Turel, 2010; De Haes & Van Grembergen, 2006), and; 3) the studies that aim to explain the antecedents and consequences of board involvement in IT governance.

Within the prescriptive stream, Nolan & McFarlan, (2005) argued that there is not a model of board involvement that works well for all organizations, instead the level of board involvement

in IT activities is contingent on various factors including the role of IT in the firm's strategy. Therefore, the authors proposed "The IT Strategic Impact Grid", which provides board members with a tool to recognize their firms' position and the level of board involvement required by their firms. The model is based on how much the firm relies on IT for operations (i.e., defensive IT) and how much the firm needs new IT for its competitive advantage (i.e., strategic IT). Depending on where the organization is located in the matrix a set of questions are suggested for boards to consider about IT governance. Further, the authors suggested that the creation of IT governance committees depends on where the companies are located in the grid. For example, boards of "defensive IT" firms would want to have the assistance of an IT expert in their audit committees, while "strategic IT" organizations would want to have the assistance of an independent IT governance committee.

Trites (2004) studied the IT governance responsibilities of the board of directors through the examination of a set of 20 questions posited by the Information Technology Advisory Committee (ITAC) to help board members fulfill their IT governance responsibilities. The author found that the board responsibilities for IT include: 1) strategic planning (e.g. board involvement in the strategic planning process, the strategic plans approval and the process of monitoring results), 2) internal control (i.e. the existence of a structure that governs the use of IT in the organization and how the IT policies are communicated to the organizational members), 3) business risk (how management assesses risk), and 4) privacy and legal issues (legal issues concerned with the use of software and hardware).

On the other hand, the descriptive stream of research has revealed a gap between the level of board involvement in IT governance that is prescribed in the literature and the level of board

involvement in IT governance in practice. For instance, Andriole (2009) aimed to describe the state of practice of the board involvement in IT governance. In doing so, the author conducted interviews and a survey to senior business technology executives and found a very limited board involvement in IT governance. The study found limited board participation in IT planning or oversight. The author concluded that boards are *"missing opportunities to optimize operational and strategic technology investments"* (Andriole, 2009, p. 374). Bart & Turel, (2010) aimed to examine the extent to which 27 questions posited by Canadian Institute of Chartered Accountants (CICA) was being used in practice. Such questions constitute a framework for IT board governance and are intended to help board members to execute their IT governance responsibilities. The authors conducted a survey to Canadian companies and found a gap between the questions that postulate the CICA IT board governance framework and the questions that corporate directors considered important. Moreover, on average board members ask only 12 questions (44.4%) from a total of 27 questions. The authors concluded that the corporate directors may not be paying enough attention to IT governance issues due to lack of knowledge or education.

Within the third stream of research, the study of Jewer and Mc Kay (2012) aimed to explain the antecedents of board IT governance and its consequences. In doing so, the authors conducted interviews and a survey of corporate directors and found that the level of board involvement in IT governance is influenced by a set of board characteristics and organizational factors (i.e. proportion of insiders, board size, IT competency, organizational age, and role of IT in the firm strategy). Further, the findings reveled that board involvement in IT governance has a positive impact on the contribution of IT to organizational performance. Another study in this stream of research was conducted by Turel & Bart, (2014); the authors aimed to explain the antecedents and consequencences of board involvement in IT governance utilizing "The IT Strategic Impact Grid"

developed by Nolan & McFarlan, (2005). Thus, the authors found that board involvement is contingent on the organizational need for 1) new IT and 2) fast and reliable IT. Further, findings revealed that high levels of board involvement in IT governance augmented organizational performance.

The three streams of research described above have revealed the key role of the board involvement in IT governance. Furthermore, such board involvement in IT governance implies organizational benefits like the optimization of strategic technology investments (Andriole, 2009), which in turn involves the resources allocated to IT innovation. Thus, board involvement in IT governance should play a relevant role on innovation of logistics IIs. This research investigates the impact of board practices on the innovation of logistics IIs in the upstream offshore oil and gas industry.

2.2.3 Redefinition of the IT governance scope

Some scholars have postulated that IT governance can be deployed utilizing a mix of practices "structures", "processes" and "relational mechanism" (Peterson, 2002; Peterson, 2004; Webb, Pollard, & Ridley, 2006; De Haes & Van Grembergen, 2005; De Haes & Van Grembergen, 2008; De Haes & Van Grembergen, 2009). IT governance "structures" adresses the *"structural (formal) devices and mechanisms for connecting and enabling horizontal, or liaison, contacts between business and IT management (decision-making) functions"* (Peterson, 2004, p.14). That is, "structures" involves the existence of clearly defined roles and responsibilities and a diversity of IT/business committees such as the "IT steering committee" and the "IT strategy committee". Commonly, the "IT steering committee" operates at the management level and is responsible for overseeing major IT projects, IT costs, IT resource allocation, etc. The "IT strategy committee" is

situated at the board level and its major task is to ensure the board involvement in IT governance (De Haes & Van Grembergen, 2006).

IT governance "processes" refers to the *"formalisation and institutionalisation of strategic IT decision making or IT monitoring procedures"* (Peterson, 2004, p.15). IT governance "processes" in organizations can be implemented through control and process frameworks such as Control Objectives for Information and Related Technologies (COBIT) framework, service level agreements (SLA), COSO/ ERM framework, and Charge back arrangements total cost of ownership (e.g. Activity based costing), etc. (De Haes & Van Grembergen, 2006).

IT governance "relational mechanisms" refers to "*the active participation and collaborative relationships among, corporate executives, IT management, and business management*" (Peterson, 2004, p. 15). The IT governance "relational mechanisms" are crucial for achieving and sustaining the IT/business alignment (De Haes & Van Grembergen, 2006). The implementation of the "relational mechanisms" in organizations involves practices such as "strategic dialogue", "sharing learnig", and training (De Haes & Van Grembergen, 2006).

Peterson (2002) aimed to provide understanding of IT governance "processes". In doing so, the author examined existing IT governance practices "processes" and two competing theories related to that type of practices: 1) the "methodological comprehensiveness" theory (which supports the comprehensive analysis of IT decisions through analytical tools and methodological frameworks), and 2) "social capabilities" theory (which called for the shared understanding and experimentation of the different stakeholders to deal with the "uncertainties" and "ambiguities" of the IT governance "processes"). The findings revealed that the effectiveness of IT governance "processes" is related to a combination of both theories; that is, existing management tools and

frameworks are insufficient to govern IT effectively; instead it is required that such management tools and frameworks be combined with stakeholders' judgement and experience. Webb, Pollard, & Ridley (2006) attempted to provide a definition of IT governance with the motivation of recognizing the *"broad reach"* of the concept. The authors argued that IT governance should incorporate the formal decision-making structures with control and accountability. Thus, through a concept analysis methodology, the authors provided a conceptualization of the term that incorporates IT governance "structures" and "processes".

Peterson (2004) aimed to analyze IT governance from a holistic perspective. In doing so, the author argued that an integral view of IT governance should include the capabilities (both business and IT) that the organization possess; such capabilities involved the "structure", "processes", and "the relational" IT governance capabilities. Further, the author argued that effective IT governance is focussed on "Horizontal Integration Capabilities" (HIC) which refers to the ability "to coordinate and integrate formal and informal IT decision-making authority across business and IT communities" (Peterson, 2004, p. 14). According to the author the HIC capabilities can be classified as: 1) structural (connection), 2) Process (coordination), and 3) relational (collaboration). Thus, the author called for effective IT governance architectures that integrate "structural", "processes" and "relational" capabilities to sustain business value from IT in complex and dynamic environments. The study concluded with a framework with which business and IT executives can evaluate the effectiveness of their IT architecture. De Haes & Van Grembergen (2005) studied how organizations are using a mix of "structures" "processes" and "relational mechanisms" to build their IT governance frameworks. In order to do so, the authors conducted a series of pilot cases of Belgian organizations. The results revealed that organizations are applying a mixture of "structures" "processes" and "relational mechanisms" to construct their

IT governance frameworks. Common IT governance practices found in the pilot cases included the existence of an IT steering committee ("structures"), the Information Technology Infrastructure Library (ITIL) framework ("processes"), and cross-functional business/IT training ("relational mechanisms").

2.2.4 IT governance and innovation

An emergent stream of research in the domain of IT governance examines the relationship between IT governance practices and innovation. Only a few studies were found that examine the link between IT governance and innovation; however, the consensus seems to be that IT governance can enhance innovation (Tarafdar and Gordon, 2007; De Haes & Van Grembergen, 2013; Heroux and Fortin, 2016;). Tarafdar & Gordon (2007) studied how IS competencies influence process innovation in organizations. Through a case study in the health care sector, the authors found six IS competencies that affects process innovation. One of these IS competencies was *IT governace*. In the hospital case IT governance facilitated process innovation in three different forms: 1) by creating liasion positions (i.e., the "Clinical Information System Specialist" that served as a bridge between the physicians and the IS senior management, and the "Departmental Systems specialist" represented by an IS professional with clinical education in charge of transmitting to the project teams the requirements and problems of the end users); 2) by creating dedicated project teams that ensured the availability of resources, and; 3) through technology standardization that ensured technical compatibility of software and hardware.

Through a case study of a commercial airline, De Haes and Van Grembergen, (2013) demonstrated that operation costs can be reduced by an improvement of IT governance "structures", "processes" and "relational mechanisms". The reduction in operations costs was primarily related to more rigorous selection and portfolio management process. Findings revealed

that such savings in operations costs resulted in an increase in the resources allocated to IT innovation. Svahn, Mathiassen, & Lindgren (2017) identified four competing concerns that companies face when embracing digital innovations. Such competing concerns fall within the domain of IT governance. For instance, the competing concern "Innovation governance" refers to the managerial mechanisms that allow innovation, and the competing concern: "Innovation collaboration" addresses the internal and external organizational skills and their relationship with innovation.

Many studies have investigated the relationship between innovation and a set of concepts that are related to IT governance "relational mechanisms" such as: *cross-training, co-location, job-rotation, communication and knowledge management*. For instance, Fernandez et al. (2014) studied the influence of IT competency on *external learning* (which refers to the firm´s ability to create and integrate new knowledge by means of inter-organizational interaction) and *internal learning* (which refers to the firm´s knowledge obtained through own resources and experience); and the relationship of IT competency, external and internal learning competency, and Commercial Success of Innovation (CSI) (performance measure that addresses innovations with potential of commercial significance, which are considered successful if their return on investment is achieved). The authors found that internal and external learning competencies are associated with CSI, and the relationship between IT competencies and CSI is mediated by external and internal learning. Anderson et al. (2008) developed a theoretical model of architectural knowledge development in inter-organizational IT innovations. Architectural knowledge refers to the knowledge created through a collective achievement to align heterogenous technologies and actors in an innovation process. Through a case study of the transportation industry in Sweden, the study identified four

dimensions of architectural knowledge that can help the implementation of inter-organizational IT innovations.

2.3 IT innovation management

A great deal of research has been conducted examining various factors and attributes that influence innovation in both, individual and organizational contexts (e.g. Damanpour, 1991; Jeyaraj, Rottman, & Lacity, 2006; Hameed, Counsell, & Swift, 2012). This section focuses on examining the research which have studied the role of multiple factors on the innovation of IT at the organizational level.

A large number of studies have examined multiple organizational factors that influence the IT innovation in organizations; and multiple literature reviews have been conducted in this domain (Jeyaraj, Rottman, & Lacity, 2006; Hameed, Counsell, & Swift, 2012). Jeyaraj, Rottman, and Lacity (2006) examined 51 studies on IT innovation published between 1992 and 2003 to identify the best /worst and promising predictors of IT innovation in organizations. In the study, 100 predictors of IT innovation in organizations were identified. Table 3 shows the best /worst and promising predictors of IT in organizations identified by Jeyaraj et al. (2006).

Table 3: The best /worst and promising predictors of IT innovation in organizations (Jeyaraj et al., 2006)

The most predominant innovation predictors	• *relative advantage* (studied 13 times) • *top management support* (studied 12 times) • *organization size* (studied 12 times) • *compatibility* (studied 10 times) • *complexity* (studied 9 times).
The best innovation predictors for the construct "adoption"	• *top management support* (studied 5 times and significant 5 times) • *external pressure* (studied 5 times and significant 5 times) • *organizational size* (studied 6 times and significant 5 times)
The best innovation predictors, when the "adoption" construct was operationalized as either "adoption" or "diffusion"	• *external pressure* (studied 6 times and significant 6 times) • *professionalism of the IS unit* (studied 8 times and significant 7 times) • *external information sources* (studied 8 times and significant 7 times) • *top management support* (studied 12 times and significant 10 times)
The promising predictors of organizational IT innovation	• *environmental instability* (studied 3 times and significant 3 times) • *top management characteristics* (studied 3 times and significant 3 times)
The "*worst predictors*" (i.e., the less effective predictors in this study)	• *IS maturity* (studied 5 times and significant 2 times) • *compatibility* (studied 10 times and significant 4 times) • *Organization Structure – Centralization* (studied 7 times and significant 4 times) • *IS Department Size* (studied 7 times and significant 4 times)

Hameed, Counsell, and Swift (2012) conducted a literature review on the IT innovation management field to develop a model for IT innovation in organizations. From a sample of 151 published studies, 41 organizational innovation determinants were extracted. Table 4 indicates the most predominant innovation determinants identified in the work of Hameed et al., (2012)

Table 4: The most predominant IT innovation determinants in organizations identified by Hameed et al., (2012)

The most predominant innovation determinants (Hameed, Counsell, & Swift, 2012)	• *Organization size* (studied 102 times and significant 64 times) • *IT expertise* (studied 59 times and significant 43 times) • *Top management support* (studied 51 times and significant 39 times) • *Resources* (studied 44 times and significant 23 times) • *Centralization* (studied 35 times and significant 16 times) • *IS department size* (studied 34 times and significant 22 times) • *Specialization* (studied 28 times and significant 22 times) • *IS infrastructure* (studied 28 times and significant 19 times).

As demonstrated above, various innovation predictors have been widely investigated. This abundance of literature allows the identification of the most significant IT innovation predictors. For instance, the literature review conducted by Jeyaraj et al. (2006) and Hameed et al., (2012) reached consensus in the important role of the innovation management practices "*Top management support"* and *"IT expertise" (*including "*professionalism of the IS unit")* in IT innovation. These practices can be examined to determine the role they play in innovation of logistics IIs in the oil and gas industry. Moreover, it could be determined the innovation management practices that facilitate digital innovations to be incorporated into the existing legacy systems and organizational practices (i.e., cultivation). Further, to our knowledge no studies have investigated the role of innovation predictors on logistics IIs in the oil and gas industry; thus, this research is necessary to fill this gap in the literature.

2.4 Summary

This chapter has provided a review of the literature conducted in the fields of IIs, IT innovation management and IT governance. The review of the IIs literature described studies that postulated prominent conceptualizations of the term IIs, and the stream of research that examined the evolution and innovation process of IIs. The literature reviewed in this domain indicated limited research that investigate logistics IIs.

The review of the IT innovation management literature has discussed the influence of multiple innovation management practices/factors in the IT innovation in organizations. Further, the evolution of the stream of research that has examined the IT governance "structures", "processes" and "relational mechanisms" was examined. Similar to the innovation management literature, the literature review in this domain identified limited research that has addressed the relationship between IT governance and innovation.

This thesis addresses these gaps in the literature by providing an understanding of the extent to which IT governance and innovation management practices impact the innovation of logistics IIs. Further, this understanding allows IT governance and innovation management practices to become a strategy for "cultivation" of the logistics IIs. The next chapter analyzes important IT governance and innovation management practices that are proposed to impact logistics IIs

Chapter 3: Research propositions

This chapter present the research propositions of this thesis. The propositions focus on identifying and evaluating the IT governance and innovation management practices that influence the innovation of logistics IIs. This process is essential to determine the practices that facilitate digital innovations which are intended to meet current and future organizational needs being incorporated into the existing legacy systems and practices (i.e., cultivation). Thus, these propositions constitute a key element of this research and are examined with a Delphi study. This chapter is divided in four sections. The first and second sections describe the IT governance practices (structures, processes, and relational mechanisms) and innovation management practices that are proposed to influence the innovation of logistics IIs. The third section discusses the propositions of this study, and the chapter ends with a summary.

3.1 IT governance practices that influence the innovation of logistics IIs in the oil and gas industry

This thesis examines a set of propositions around 33 IT governance practices developed by De Haes & Van Grembergen (2008, 2009) and is based on a further study by Hèroux and Fortin, (2016). These studies form the theoretical basis of the set of propositions on the IT governance practices which are proposed to influence the innovation of logistics IIs in the oil and gas industry.

A set of 33 IT governance practices developed by De Haes & Van Grembergen (2008, 2009) were postulated for IS. Likewise, Hèroux and Fortin, (2016) examined the influence of IT governance on IS innovation. That is, these studies did not relate IS with IIs. However, it is proposed that IT governance practices are applicable to IIs. Further, it is proposed that IT governance practices influence the innovation of logistics IIs in the oil and gas industry. Thus, this

study identified IT governance and innovation practices which have been found to influence IS innovation and used a Delphi study to examine their influence on the innovation of II in the context of logistics in the oil and gas industry.

This section starts with an explanation of how IT governance is deployed in organizations. Then, this section addresses the practices developed by De Haes & Van Grembergen (2008, 2009) and their implications in a later study that demostrate the influence of IT governance on the innovation.

3.1.1 Deployment of IT governance in organizations

This thesis utilizes the definition of IT governance provided by De Haes & Van Grembergen (2008, 2009). *"IT governance consists of the leadership and organisational structures and processes that ensure that the organisation's IT sustains and extends the organisation's strategy and objectives"* (De Haes & Van Grembergen, 2008, p. 444). IT governance is contingent on a variety of factors; that is, the IT strategy that works well for a firm does not necessarily work for another company (De Haes & Van Grembergen, 2006; Brown & Grant, 2005)". Some of these contingencies are organizational size, industry and the geographical location of the company (De Haes & Van Grembergen, 2006). For example, larger organizations are likely to have broader resources to implement a set of IT governance mechanisms than smaller firms; further, those large companies may need a "richer" mix of IT governance mechanisms due to the complexity of their organizations. Moreover, some industries are more dependent upon IT than others; this is the case of the financial sector which is one of the first industries that utilized IT to operate and as such is more mature in this domain. Thus, the financial sector likely needs a more solid IT governance framework than other sectors. (De Haes & Van Grembergen, 2006)". To our knowledge no studies have provided an IT governance framework for IIs nor for logistics in the oil and gas industry. Therefore, although

this research is focused on IT innovation, it also contributes by providing an understanding of the IT governance mechanisms that can be integrated with logistics II in the oil and gas industry.

De Haes & Van Grembergen, (2006) studied how organizations are implementing IT governance "structures", "processes", and "relational mechanisms" and provided various cases that exemplify how organizations are deploying IT governance. For example KBC is a Belgian financial company with a centralized IT department; its IT governance "structures" practices included the existence of various committees consisted of business and IT people, its "processes" practices included "SLA" and "Charge back arrangements total cost of ownership (e.g. Activity based costing)", and its "relational mechanisms" practices included intranet and an IT governance internal magazine. CM is a Belgian health insurance firm, whose IT governance practices "structures" consisted of the existence of four different national and regional committees to ensure that IT and business people participated in strategy development and prioritization, its "processes" practices included SLA and the ITIL framework, and its "relational mechanisms" practices included IT communication to the business to explain and repeat IT issues defined by the CIO such as the IT architecture and the IT budget.

The discussion above demonstrates that IT governance is contingent on a variety of factors and has been deployed in organizations through a mixture of "structures", "processes", and "relational mechanisms". Thus, it is important to analyze the mixture of IT governance practices that can be deployed in the oil and gas industry to innovate their logistics IIs. The next section addresses the IT governance practices that are evaluated in this Delphi study and their implications on IT innovation.

3.1.2 The IT governance "structures", "processes", and "relational mechanisms" of the Delphi study

De Haes & Van Grembergen (2008, 2009) conducted a three-round Delphi study to obtain a list of IT governance practices (structure, processes and relational mechanisms) for the Belgian financial sector. The first round started with a compilation of IT governance practices extracted from previous literature and a pilot case research, in which respondents were asked to provide feedback on those practices. In the second round, participants were asked to rank and evaluate on a scale from 0 to 5 the practices for both, the perceived *effectiveness* and *ease of implementation*. In the third round, participants were asked to re-evaluate their scores considering the group averages. The result was a list of 33 IT governance practices for the Belgian financial sector that enabled the required degree of business business/IT alignment in organizations.

In 2016, Hèroux and Fortin built upon these studies. They analyzed the influence of IT governance, IT competence and IT business alignment on innovation. The authors argued that the impact of IT governance on innovation depends on the level of IT/ business alignment. The methodology of that study consisted of a mail survey, where IT governance (structures, processes and relational mechanisms) was measured by a set of items that included the list of practices developed by De Haes & Van Grembergen (2009). Their findings revealed that IT governance (particularily "processes" and "relational mechanisms") significantly correlated with process and product innovation. Furthermore, IT/business alignment positively correlated with IT governance and innovation; that is, the higher the degree of IT-business alignment, the greater is the impact of IT governance on innovation.

Although the concept of IIs differs from the one of traditional IS, IT governance "structures", "processes", and "relational mechanisms" are applicable to IIs. This is because, like

the managerial practices of IS, those of IIs also include 1) the definition of roles and responsibilities; that is, the locus of authority for IT activities (i.e. "structures"). 2) the formalization and institutionalization of the IT policies and monitoring procedures (i.e., processes). 3) the formal and informal mechanisms that facilitate the interaction of organizational members and the coordination of IT activities across organizational units (i.e., relational mechanisms). An example of the above is the study of Grisot, Hanseth, & Thorseng, (2014); this study described the innovation process an II utilized for hospital-patient communication. That study identified managerial practices related to "structures", "processes", and "relational mechanisms". The existence of practices related to "structures" is identified when the study identifies that the leader of the IT department created a new unit named "research and patient services" to manage the II for hospital-patient communication and appointed a unit manager. The existence of methodologies to manage IT projects (i.e., processes)" can be recognized when the study notes that the II had to meet requirements concerned with security and handling of health information. Finally, the "relational mechanisms" can be identified when the II innovation process included workshops with IT people and clinic staff to conclude possible uses of the II for patient communication. Therefore, the IT governance practices posited are applicable to IIs. Furthermore, the study of Heorux & Fortin (2016) found a positive correlation between IT governance and innovation. Thus, this thesis proposes that IT governance practices apply to IIs and should influence the innovation of logistics IIs in the oil and gas industry.

Based on the above research, this thesis proposes that the same 33 IT governance practices - "structures", "processes", and "relational mechanisms" - posited by De Haes & Van Grembergen (2008, 2009) and further examined by Hèroux and Fortin (2016) positively influence the innovation of logistics IIs. Furthermore their effectiveness in terms of the role they play in an

organization's ability to innovate its logistics IIs should be high. Thus, these practices should be regarded as a strategy for "cultivation". That is, these practices facilitate digital innovations to be incorporated into the existing legacy systems and organizational practices. Table 5, 6 and 7 contain each of these IT governance practices (structures, processes and relational mechanisms) and their definition.

Table 5: IT governance practices "structures" adapted from De Haes & Van Grembergen, (2008)

IT governance practice "structures"		
Practice		**Definition**
1	CIO (Chief Information Officer) on executive committee	CIO is a full member of the executive committee
2	CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	CIO has a direct reporting line to the CEO and/or COO
3	Security / compliance/ risk officer	Function responsible for security, compliance and/or risk, which possibly impacts IT
4	IT project steering committee	Steering committee composed of business and IT people focusing on prioritising and managing IT projects
5	IT strategy committee at level of board of directors	Committee at level of board of directors to ensure IT is regular agenda item and reporting issue for the board of directors
6	IT expertise at level of board of directors	Members of the board of directors have expertise and experience regarding the value and risk of IT
7	Integration of governance/ alignment tasks in roles and responsibilities	Documented roles and responsibilities include governance/alignment tasks for business and IT people
8	IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	Steering committee at executive or senior management level responsible for determining business priorities in IT investments.
9	IT security steering committee	Steering committee composed of business and IT people focusing on IT related risks and security issues
10	IT governance function	Function in the organisation responsible for promoting, driving and managing IT governance processes
11	Architecture steering committee	Committee composed of business and IT people providing architecture guidelines and advise on their applications
12	IT audit committee at level of board of directors	Independent committee at level of board of directors overviewing IT assurance activities

Table 6: IT governance practices "processes" adapted from De Haes & Van Grembergen, (2008)

IT governance practice "processes"		
Practice		**Definition**
1	Strategic information systems planning	Formal process to define and update the IT strategy
2	IT performance measurement	IT performance measurement in domains of corporate contribution, user orientation, operational excellence and future orientation
3	Portfolio management (incl. business cases, information economics, Return on Investment, payback)	Prioritisation process for IT investments and projects in which business and IT is involved
4	IT governance assurance and self-assessment	Regular self-assessments or independent assurance activities on the governance and control over IT
5	Project governance /management methodologies	Processes and methodologies to govern and manage IT projects
6	Service level agreements	Formal agreements between business and IT about IT development projects or IT operations
7	IT governance framework COBIT	Process based IT governance and control framework
8	Benefits management and reporting	Processes to monitor the planned business benefits during and after implementation of the IT investments / projects
9	IT budget control and reporting	Processes to control and report upon budgets of IT
10	COSO / ERM	Frameworks for internal control
11	Charge back arrangements total cost of ownership (e.g. Activity based costing)	Methodology to charge back IT costs to business units, to enable an understanding of the total cost of ownership

Table 7: IT governance practices "relational mechanisms" adapted from De Haes & Van Grembergen, (2008)

IT governance practice "relational mechanisms"		
Practice		**Definition**
1	Cross-training	Training business people about IT and/or training IT people about business
2	Informal meetings between business and IT executive/ senior management	Informal meetings, with no agenda, where business and IT senior management talk about general activities and directions.
3	Co-location	Physically locating business and IT people close to each other
4	IT leadership	Ability of CIO or similar role to articulate a vision for IT's role in the company and ensure that this vision is clearly understood by managers throughout the organisation
5	Executive / senior management giving the good example	Senior business and IT management acting as "partners".
6	Corporate internal communication addressing IT on a regular basis	Internal corporate communication regularly addresses general IT issues
7	Knowledge management (on IT governance)	Systems (intranet…) to share and distribute knowledge about IT governance framework, responsibilities, tasks, etc.
8	Business/IT account management	Bridging the gap between business and IT by means of account managers who act as in-between
9	IT governance awareness campaigns	Campaigns to explain to business and IT people the need for IT governance
10	Job-rotation	IT staff working in the business units and business people working in IT

3.2 Innovation management practices proposed to influence the innovation of logistics IIs in the oil and gas industry

Since innovation management practices have been found to influence the innovation of IS in other fields, this thesis examines the impact of these practices on the innovation of Logistics IIs in the upstream offshore oil and gas industry. Such an examination might allow determining the innovation management practices that enable the incorporation of digital innovations into the

existing legacy systems and organizational practices (i.e., cultivation). For this purpose, first, it should be identified which innovation determinates are relevant to IIs. In order to do so, prominent innovation determinants that have been found to influence IS innovation were extracted from the innovation management literature and linked to the six key characteristics of IIs identified in the works of Hanseth and Monteiro (1998).

As mentioned in Chapter 1, the six key characteristics of IIs identified in the works of Hanseth and Monteiro (1998) make IIs different from IS. However, this thesis proposes that these innovation determinants are applicable to IIs because they are related to the key attributes of IIs and; therefore, their influence on II innovation can be examined. For example, the openness characteristics helps distinguish IIs from IS because in IIs there are no limits for the numbers of participants involved (users, stakeholders, vendors, organizations, and institutions) or for the number of technical components such as networks, nodes, applications, etc. (Hanseth & Monteiro, 1998). Thus IIs characteristic (i.e. "openness") can be linked with the innovation determinant "*openness",* which involves the extent of external contacts that organizational members establish with other organizations (Lai & Guynes, 1997). Following this procedure, 12 innovation management practices that are applicable to IIs were constructed. Table 8 contains a summary of these 12 innovation management practices. These practices are examined in detail in the following sections.

Table 8: Innovation management practices that influence the innovation of logistics Information Infrastructures (IIs) in the upstream offshore oil and gas industry

Innovation Practice	Definition
1. Degree of top management support towards Innovation of Logistics II	Involvement, enthusiasm, motivation, and encouragement provided by management towards the acceptance of Logistics II innovation (Damanpour , 1991)
2. Degree of relevant technical expertise	IT/II education and experience of organizational members (i.e. other than top management) (Damanpour , 1991)
3. Degree of centralized structure	Degree to which II/Innovation decision-making and authority lie exclusively within the corporate IT function (centralization) versus distributed amid individual working units (decentralization) (Damanpour , 1991)
4. Degree of formalization	Emphasis on following rules and procedures in conducting organizational activities (Damanpour , 1991)
5. Amount of slack resources	Financial and human resources that an organization has beyond what it minimally requires to operate. Commonly, financial slack is used as sources of finance or changes in an organization`s budget (Damanpour , 1991)
6. Degree of openness/ external communication	The interaction of members of a system with others who are external to the system. It includes information sharing and involvement and participation in extra organizational professional activities (Damanpour , 1991; Lai & Guynes, 1997)
7. Degree of Logistics II planning	The extent to which organizations plan their Logistics IIs in terms of requirement analysis, II analysis and design, and resource control. (Thong, 2001)
8. Norm Encouraging Change	Employees' positive attitudes towards Logistics II innovation, including the changes that this entails in the work place and habits (Lai & Guynes, 1997)
9. Degree of training provided to employees	The availability of relevant training to users of the II.
10. Degree of internal communication	Communication among different business units involved in logistics activities. It includes organizational integration mechanisms such as the degree to which these business units share decisions and the number of contacts (face-to-face and others) among their people (Damanpour , 1991)
11. IS Installed Base	Refers to the existing technical components of the Logistics Installed Base such as systems, applications, nodes, networks, etc.
12. Change Management	Presence of continuous improvement practices such as the identification of new requirements or availability of new technical opportunities.

3.2.1 Degree of top management support towards innovation of logistics II

Degree of top management support towards innovation of logistics II refers to the involvement, enthusiasm, motivation, and encouragement provided by management towards II innovation. *"Top Managers´ attitudes toward innovation"* is an innovation determinant related to this practice and refers to executives who encourage, accept new ideas and forge agreements and approvals with people to implement an innovation (Damanpour 1991; Damanpour & Schneider, 2006). This innovation determinant has been investigated in several studies and has demonstrated its importance. For example, Damanpour and Schneider (2006) studied the impact of a set innovation determinants on the different stages of the innovation adoption process. The findings revealed that "*managers favourable attitude toward innovation"* positively influence all the phases of the innovation adoption process. Further, this innovation determinant had stronger impact on innovation adoption than other determinants related to *"environment"* and *"top managers´ demographics"* characteristics. The literature review in the field of IT innovation conducted by Hammed et al., (2012) found that the determinant: *"CEO attitude"* towards innovation was significant in 10 of 11 studies. Likewise, the determinant: *"Top managers support"* (refers to the involvement, enthusiasm, motivation and encouragement provided by management towards an innovation (Ifinedo, 2011)) was significant in 39 out 51 studies. More recently, Pichlak (2016) analyzed a set of factors that potentially influence the IT innovation adoption process. The results indicated that the factor: *"Top Managers´ attitudes toward innovation"* influenced all the stages of the innovation process.

Top Managers´ attitudes toward innovation can be considered a social element that interacts with the IIs. Thus, this innovation management practice can be linked to the IIs characteristics: social-technical (because IIs are composed of social and elements), 2)

heterogeneous (because IIs are composed of a different kind of element, and Installed base (because *Top Managers´ attitudes toward innovation* is part of the existing organizational practices that interact with the IIs). Thus, it can be expected that the *Degree of top management support towards innovation of logistics II* influences the innovation of logistics IIs in the oil and gas industry.

3.2.2 Degree of relevant technical expertise

Degree of relevant technical expertise involves the IT/II education and experience of organizational members (i.e. other than top management). "Professionalism" is an innovation determinant related to *Degree of relevant technical expertise* and refers to the professional knowledge of organizational members which requires both, education and experience (Damanpour, 1991). Damanpour (1991) argued that "professionalism" is associated positively with IT innovation in organizations because "it increases boundary spanning activity, commitment and self-confidence" to move beyond what is already established (Damanpour, 1991, p. 558). Furthermore, "IT expertise" is another related innovation determinant, which has been widely studied and found significant in 43 out of 59 innovation studies (Hameed et al., 2012). One of these studies was performed by Theo and Ranganathan (2004) who examined the acceptance of business to business (B2B) electronic commerce in Singapore. The authors identified the lack of "IT expertise" in organizations as a crucial factor that negatively influenced the acceptance of this technology in organizations. This issue was identified in two dimensions, the first refers to an identified shortage of staff with appropriate technical skills and experience and the second was related to the time required to develop the required skills and expertise for B2B e-commerce technology.

Degree of relevant technical expertise can be regarded as a social element that interacts with the IIs. Therefore, the IIs characteristics that are related to this practice are: social-technical, heterogeneous and Installed base. Hence, the *Degree of relevant technical expertise* should influence the innovation of logistics IIs in the oil and gas industry.

3.2.3 Degree of centralized structure

Degree of centralized structure refers to the degree to which II/innovation decision-making and authority lie exclusively within the corporate IT function (centralization) versus distributed amid individual working units (decentralization). Some studies in the innovation literature have studied the role of centralized organizational structures on IT innovation with mixed results (Damanpour, 1991; Jeyaraj et al., 2006; Hammed et al., 2012). A literature review performed by Hameed et al., (2012) found the innovation determinant "*centralization"* significant in 16 (46%) out of 35 innovation studies. Damanpour (1991) posited that "*centralization"* negatively influences the IT innovation in organizations because the concentration of decision-making authority inhibits innovative solutions. Conversely, work environments that encourage participation of organizational members enable innovation, and promotes members´ awareness, commitment and involvement. Another related innovation determinant is *"Vertical differentiation"*, which refers to the number of levels of hierarchy within an organization. It is associated negatively with innovation in organization since large numbers of hierarchical levels make communication more difficult and inhibit the flow of new ideas (Damanpour, 1991).

In the field of IIs centralized and decentralized infrastructures have also been examined. Industrial platforms with centralized control such as google android and IOS act as a foundation upon which multiple firms (business ecosystems) can develop complementary products, technologies or services. Thus, in this context, IIs with centralized control enable third party

innovation of products, technologies and services (Eaton, 2016). On the other hand, Hanseth & Monteiro, (1998) stated that a primary attribute of IIs is the lack of centralized control since IIs can be considered as a network of distributed, interconnected and interoperable technologies, and the ownership is frequently dispersed and distributed. Further, IIs implies collaboration between diverse stakeholders with different interest, resources and expectations; as the IIs grows, the control is dispersed and embedded in "socio-technical arrangements" (Sanner et al., 2014). Therefore, it is important to investigate the role of *Degree of centralized structures* in the innovation of logistics IIs in the oil and gas industry.

3.2.4 Degree of formalization

Degree of formalization refers to the emphasis on following rules and procedures in conducting organizational activities. In the Innovation literature, the innovation determinant *"formalization"* is defined by the emphasis on obeying rules and procedures for performing organizational tasks and can be measured by the existence of rule manuals and job descriptions (Damanpour, 1991). The work of Hameed et al., (2012) revealed that *"formalization"* was significant in 10 out of 27 innovation studies. Damanpour (1991) posited a negative association between *"formalization*" and innovation, because flexibility and low emphasis on rules and procedures enable innovation.

In the field of IIs, formal standardization is a key factor for developing an II (Hanseth & Monteiro, 1998). Standards ensure that new technological components can be incorporated into the existing installed base. However, flexible infrastructures are required to enable innovation of IIs. Further, "*formalization* increases complexity, accordingly less formalization means larger flexibility"*(* (Hanseth & Monteiro, 1998, p. 155). IIs are dynamic and changing; thus, flexibility is imperative to incorporate new requirements and necessities to the installed base (Hansent and

Monteiro 1998; Ribes & Polk, 2014). Therefore, it is important to investigate the *Degree of formalization* that enable the innovation of logistics IIs in the oil and gas industry.

3.2.5 Amount of slack resources

Amount of slack resources is based on the innovation determinant "slack resources" and involves the financial and human resources "*that an organization has beyond what it minimally requires to operate*. Commonly, *financial slack is used as sources of finance or changes in an organization`s budget*" (Damanpour, 1991, p. 589). Damanpour (1991) indicated that "slack resources" positively influence the IT innovation because those resources permit organizations to acquire technological innovations, afford the cost of innovations´ deployment, take risks, and absorb cost of failure and explore new ideas. Damanpour and Schneider (2006) examined the effects of the innovation determinant *"Economic health" (*which refers to the availability of financial resources that allows organizations to invest in innovations, take risks and absorb failures) on IT innovation. This innovation deteminant positively infuences all the stages of the innovation process. Chan & Ngai (2007) studied the influence of a set of innovation determinants on an organizations´decision to adopt the "*web-based training (WBT)*" innovation. The findings revealed that the determinant *"financial resources"* (which represents the availabilty of financial resources to invest in the innovation deployment), were a crucial factor that significantly affected the acceptance of the WBT in Hong Kong. Furthermore, the paper claimed that this innovation deteminant was a cornerstone of success in the WBT acceptance.

Amount of slack resources can be regarded as a social element of the IIs. Therefore, the IIs characteristics that are related to this practice are: social-technical, heterogeneous and Installed base. Therefore, *Amount of slack resources* should influence the innovation of logistics IIs in the oil and gas industry.

3.2.6 Degree of openness/external communication

Degree of openness/external communication refers to the interaction of members of a system with others who are external to the system. It includes information sharing as well as involvement and participation in extra organizational professional activities. According to the innovation management literature, the determinants: "*openness", "trust"* and "*external communication"* are associated positively with IT innovation (Damanpour, 1991; Damanpour & Schneider, 2006; Lai & Guynes, 1997; Soliman & Janz, 2004). "*External communication"* refers to the degree in which organizational members participate in extra-organizational professional activities. It represents the organizational ability to interact with its environment. This determinant is associated positively with innovation since high levels of organizational interaction with its environment can bring innovative ideas to the organization.

The innovation determinant *"openness*" can be understood as the degree in which *"members of a system are connected to others, who are external to the system"* (Lai & Guynes, 1997, p. 148). This includes information sharing and the extent of external contacts that organizational members stablish with other organizations. Innovative organizations exchange information with their environment efficiently; sharing information between entities entails benefits such as: technical advantages resulting from the collected information and an open work environment that promote trust. Such work environments motivate employees to try new ideas (Lai & Guynes, 1997; Damanpour, 1991; Damanpour & Schneider, 2006). Furthermore, the role of the innovation determinant "*trust*" is considered crucial for cooperative relationships, within this context, "*trust"* can influence the IT innovation decisions in organizations (Soliman & Janz, 2004).

In the field of IIs, existing research shows that IIs are characterized by their "openness". "Openness" refers to the fact that in IIs there are no limits for either, the number of technical components (networks, nodes, applications, etc.) or for the numbers of participants involved (users, stakeholders, vendors, organizations, and institutions). Thus, in IIs, high levels of communication and collaboration between parties should be achieved. Moreover, "openness" involves the "enabling" characteristic of IIs because IIs enable multiple activities of a wide range of users (Hanseth & Monteiro, 1998). Furthermore, the unlimited number of participants involved in the IIs may imply that over time the IIs grow and new users and services should be incorporated into the IIs. This situation suggests the need to innovate the IIs. Thus, "openness" requires flexible infrastructures to enable innovation. Furthermore, "openness" requires flexible standards to ensure new IT to be incorporated into the IIs.

Based on the discussion above, the *Degree of openness/external communication* should play a crucial role in logistics IIs in the upstream offshore oil and gas industry.

3.2.7 Degree of logistics II planning

The degree of logistics II planning concerns the extent to which organizations plan their Logistics IIs in terms of requirement analysis, II analysis and design, and resource control in the implementation of new technologies. Previous research in the innovation management field has examined innovation determinants that can be related to this practice. For instance, the innovation determinant *"strategic planning"* has been associated positively with IT innovation (Thong, 2001; Teo and Ranganathan, 2004; Bruque & Moyano, 2007). Thong (2001) stressed the importance of "*strategic planning"* in terms of requirements analysis, systems design and analysis, and resource control in the implementation of new technologies within organizations. The author posited that

organizations have greater possibilities to achieve successful implementation of innovations if they can spend more time in *"IS planning"*. Teo & Ranganathan (2004) found that adopting an IT innovation is a strategic decision. As such, it is crucial that organizations have a formal plan and a task force to provide direction and focus during the IT innovation process.

Degree of logistics II planning can be regarded as part of the existing installed base of organizational practices. As such, this practice can be related to the IIs characteristics: social-technical, heterogeneous and Installed base. Therefore, the *Degree of logistics II planning* should play a crucial role in the innovation of logistics IIs in the oil and gas industry.

3.2.8 Norms encouraging change

Norms encouraging change involves the employees' positive attitudes towards Logistics II innovation, including the changes that this entails in the work place and work habits. This innovation practice is based on the innovation determinant, *"Norm Encouraging Change",* and addresses the employees' positive attitude towards innovation (Lai & Guynes, 1997). Commonly, when an innovation is implemented many changes take place in the organization. Thus, employees' positive attitude towards change constitutes a crucial factor to facilitate innovation in organizations; those changes can occur in different organizational dimensions, such as work habits, culture, organizational structure and governance.

Innovation of logistics IIs in the upstream offshore oil and gas industry can entail several modifications in the way organizations work. As IIs are open, shared, heterogenous, compounded by technical and social elements, and have an installed base; those modifications can occur in several dimensions. Therefore, *Norms encouraging change* should be essential to foster logistics IIs innovation in the oil and gas industry.

3.2.9 Degree of training provided to employees

Degree of training provided to employees refers to the availability of relevant training to users of the II. Within the innovation management literature, the innovation determinant *"training"* has been studied and has been found to have a positive association with IT innovation. The work of Hameed et al. (2012) identified that 9 (69%) out of 13 studies on IT innovation found this innovation determinant significant. Bradford & Florin (2003) developed a model of Enterprise Resource Planning (ERP) implementation success in organizations. The authors found that "*training"* facilitates the implementation of innovations since this determinant not only contributes to the achievement of organizational performance measures, but also influences user satisfaction.

Other innovation determinants related to *"training"* have been found to influence the IT innovation. For instance, Chai and Ngai, (2007) identified *"organizational readiness"* to be a significant factor that influence the decision to adopt the WBT innovation in organizations. *"Organizational readiness"*, includes the level of IT knowledge among non-IT professionals. The study found, not only the level of IT knowledge among top managers was a critical factor for innovation in organizations, but also the level of IT knowledge of the individual learners who are able to take advantage of the innovation.

The definition of II provided by Hanseth and Monteiro (1998) stressed the heterogenous nature of the IIs in the sense that they are composed of different kind of elements; that is, the technical elements and the non- technical elements. The non- technical elements of IIs involve all the social elements that interact with IIs, such as individuals, attitudes, culture, training, and user experience. Thus, training should be needed to encourage logistics IIs innovation in the oil and gas industry.

3.2.10 Degree of internal communication

The *degree of internal communication* addresses the communication among different business units involved in logistics activities. It includes organizational integration mechanisms such as the degree to which these business units share decisions and the number of contacts (face-to-face and others) among their people. Within the innovation literature, Damanpour (1991) stated that the innovation determinant *"internal communication"* is positively associated with innovation. It represents the extent of communication between organizational units, and increases diversity and dispersion of ideas in the organization. It is comprised of two types of integration mechanisms: 1) formal mechanisms (i.e. steering committees), and 2) the informal mechanisms such as the number of contacts face to face among people at the same and different levels. It can be measured by the number of mechanisms of integration in the organization and the frequency of their meetings.

IIs requires high levels of interaction since IIs constitute socio-technical networks with multiple participants (Hanseth & Monteiro, 1998) including organizational members from various departments. Thus, the *Degree of internal communication* should influence the innovation of logistics IIs in the oil and gas industry.

3.2.11 IS installed base

IS installed base refers to the existing technical components of the Logistics Installed Base such as systems, applications, nodes, networks, etc. Within the IT innovation management literature, related innovation determinants to *IS installed Base* have been studied. For instance, Eder & Igbaria (2001) have examined the role of *"IT infrastructure"* in intranet diffusion and infussion in organizations. *"IT infrastructure"* represents the set of shared and tangible IT resources that enable business applications, and is the "*key"* to the *"feasibility"* in the IT innovation deployment. The

authors found that flexibility of the existing *"IT infrastructure"* impacts the deployment of IT innovations. So, more flexible *IT infrastructures* positively impact the deployment process of IT innovations in an organization.

A similar conclusion is stated in the literature on IIs. In this field, the idea that the "Installed Base" enables and constrains innovation is widely accepted (this implies the "enabling" characteristic of IIs) (Hanseth & Monteiro, 1998). Furthermore, the concepts of "*flexibility"* and "*standardization"* are strongly related to the "cultivation" process. "Standardization" represents "*stability"* and standards ensuring that one technological component can be integrated into an existing II. Specifically, IIs standards belong to the classification of "compatibility standards". Those standards indicate that "one component may successfully incorporate into a larger system given the adherence to the interface specification of the standard" (Hanseth & Monteiro, 1998, p. 57). Nevertheless, flexibility is crucial in order to allow innovation of IIs since they are dynamic and changing. Therefore, standards should be flexible and easy to adapt to new requirements (Hanseth & Monteiro, 1998). Therefore, flexible infrastructures are required to enable innovation of IIs; however, the existing technical components of the logistics Installed Base are the "key" of the "feasibility" in the IT innovation deployment.

3.2.12 Change management

Change management addresses the presence of continuous improvement practices such as the identification of new requirements or availability of new technical opportunities. *"Performance Gap"* is an innovation determinant related to *change management*, and refers to the degree organizations are willing to adopt an innovation as a response to the gap between performance and satisfaction with their existing technology (Kima and Garrison, 2010). Business environments are

continuously changing as a response to the emergence of IT innovations; these changes cause existing technologies to become insufficient in fulfilling organizational expectations. Moreover, core business technologies often become obsolete or overloaded, leading organizations to a continuous evaluation and acceptance of IT innovations. Kima & Garrison (2010) studied the influence of *"Performance Gap"* on an organization willingness to evaluate the RFID technology. The findings revealed that this innovation determinant positively influenced the RFID evaluation, and "evaluation" influences the acceptance of the innovation. The authors argued that the RFID was more likely to be evaluated for acceptance if organizations recognized that their existing technology did not fulfill their needs.

Modern business contexts are dynamic and changing, and as response organizations are conducting *Change Management* practices to identify new requirements and technical opportunities. Moreover, *Change Management* involves the evaluation of the acquisition of digital innovations that represent a potential for future growth. This is consistent with the process of "cultivation ", which implies the incorporation of new technology into the existing legacy systems and practices to meet current and future needs (Ciborra, 1997).

Therefore, *Change management* can be regarded as part of the existing installed base of organizational practices. As such, this practice can be related to the IIs characteristics: social-technical, heterogeneous and Installed base. Thus, it can be expected that *Change management* influences the innovation of logistics IIs in the oil and gas industry.

3.3 Propositions

This section posits seven propositions that involve IT governance (structures, processes and relational mechanisms) and innovation management practices and their relationship with

innovation of logistics IIs in the oil and gas industry. These propositions are related to the research questions of this study. Figure 1 and Table 9 show the propositions of this study and their relationship with the research questions. The rest of this section addresses in detail each of the seven propositions.

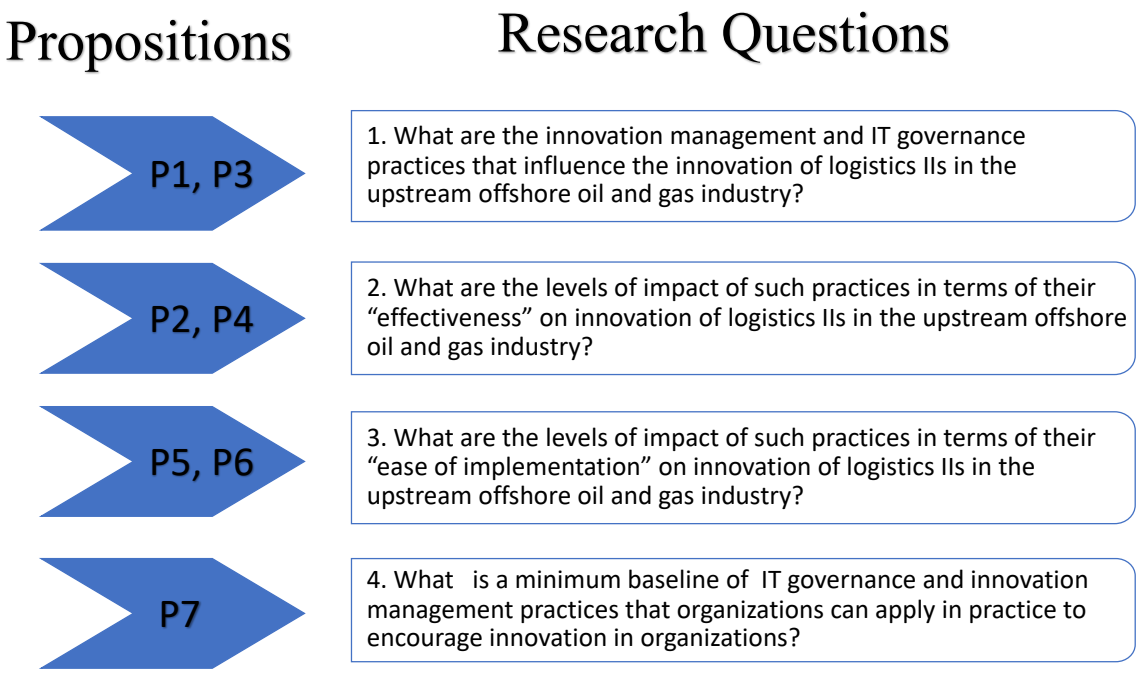

Figure 1:Links between propositions and research questions

Table 9: The seven propositions of the study

		Prediction	Involved Practices
RQ1	P 1	IT governance and innovation management practices have a positive (i.e. not negative) influence on the innovation of logistics IIs in the upstream offshore oil and gas industry.	* IT governance (structures, processes and relational mechanisms) * Innovation management practices : *1) Degree of top management support towards Innovation of Logistics II, 2) Degree of relevant technical expertise, 3) Amount of slack resources, 4) Degree of openness/external communication, 5) Degree of Logistics II planning, 6) Norm Encouraging Change, 7) Degree of training provided to employees, 8) IS Installed Base, 9) Degree of internal communication,* and 10) *Change Management*
RQ2	P 2	IT governance and innovation management practices are an effective way of enabling an organization to innovate its logistics IIs in the upstream offshore oil and gas industry.	* IT governance (structures, processes and relational mechanisms) * Innovation management practices : *1) Degree of top management support towards Innovation of Logistics II, 2) Degree of relevant technical expertise, 3) Amount of slack resources, 4) Degree of openness/external communication, 5) Degree of Logistics II planning, 6) Norm Encouraging Change, 7) Degree of training provided to employees, 8) IS Installed Base, 9) Degree of internal communication,* and 10) *Change Management*
RQ1	P 3	*Degree of Centralized structure* and *Degree of formalization* have a negative (i.e. not positive) influence on the innovation of logistics IIs in the upstream offshore oil and gas industry.	Innovation management practices: *Degree of Centralized structure* and *Degree of formalization*
RQ2	P 4	*Degree of Centralized structure* and *Degree of formalization* are an ineffective way of enabling an organization to innovate its logistics IIs in the upstream offshore oil and gas industry.	Innovation management practices: *Degree of Centralized structure* and *Degree of formalization*

		Prediction	Involved Practices
RQ3	P 5	IT governance practices "structures" and Innovation management practices related to "structures" are easier to implement than IT governance "processes" and "relational mechanisms", and innovation management practices related to "processes" and "relational mechanisms"	IT governance and Innovation management practices related to "structures" , "relational mechanisms" and "processes"
RQ3	P 6	IT governance practices "relational mechanisms" and Innovation management practices related to "relational mechanisms" are easier to implement than IT governance "processes", and innovation management practices related to "processes "	IT governance and Innovation management practices related to "relational mechanisms" and "processes"
RQ4	P 7	The Minimum Baseline of IT governance and innovation practices is composed of more practices (including both IT governance and innovation management practices) related to "structures" and "processes" than practices related to "relational mechanisms"	IT governance and Innovation management practices related to "structures" ,"relational mechanisms" and "processes"

3.3.1 Propositions 1 and 2

It has been discussed that the IT governance practices (structures, processes, and relational mechanisms) developed by De Haes & Van Grembergen, 2008, 20009) have been found to positively influence the innovation of IS. Although the notion of IIs is different from the one of traditional IS, it is proposed that the IT governance practices posited are applicable to IIs because the managerial practices of IIs include 1) the decision-making structures to define the locus of authority for IT activities (i.e. "structures"), 2) the formalization and institutionalization of the IT

policies and monitoring procedures (i.e., "processes") and 3) the formal and informal mechanisms that enable the interaction of organizational members and the coordination of IT activities across organizational units (i.e., "relational mechanisms"). Furthermore, a positive correlation between IT governance and innovation has been found in previous research (Heorux & Fortin, 2016). Thus, it is proposed that IT governance practices apply to IIs and it is imperative to investigate the mixture of ("structures", "processes" and "relational mechanisms") that enable organizations to innovate their IIs.

It also has been discussed that in general, the innovation management practices described in the literature have been found to positively influence the innovation of IS. The previous section of this chapter has explained how those innovation management practices can be linked to the six key characteristics of IIs stated in the works of Hanseth and Monteiro (1998) (i.e. enabling, shared, openness, heterogenous, socio-technical, and installed base). Thus, it is proposed that these 12 innovation management practices are also applicable to IIs.

Based on the discussion above, IT governance ("structures", "processes" and "relational mechanisms") and innovation management practices (i.e. *1) Degree of top management support towards Innovation of Logistics II, 2) Degree of relevant technical expertise, 3) Amount of slack resources, 4) Degree of openness/external communication, 5) Degree of Logistics II planning, 6) Norm Encouraging Change, 7) Degree of training provided to employees, 8) IS Installed Base, 9) Degree of internal communication,* and 10) *Change Management)* should be highly effective in terms of the role they play in orgnizations' ability to innovate their IIs. Therefore, these practices should be regarded as an effective strategy for "cultivation". That is, these practices facilitate digital innovations to be incorporated into the existing legacy systems and organizational practices.

Therefore, it is proposed that:

Proposition 1: The identified IT governance and innovation management practices have a positive (i.e. not negative) influence on the innovation of logistics IIs in the upstream offshore oil and gas industry.

Proposition 2 : The identified IT governance and innovation management practices are an effective way of enabling an organization to innovate its logistics IIs in the upstream offshore oil and gas industry.

3.3.2 Propositions 3 and 4

This chapter also discussed innovation determinants related to the innovation management practices *Degree of Centralized structure* and *Degree of formalization,* that have been examined in previous innovation studies and found to negatively influence IT innovation (Damanpour, 1991). As explained previously in this chapter, one main reason that explains why the innovation determinant "centralization" has been found to negatively influence IT innovaiton is that the concentration of decision-making authority inhibits innovative solutions; conversely, work environments that encourage participation of organizational members enable innovation (Damanpour, 1991).

It has been explained that industrial platforms with centralized control such as google android and IOS act as a foundation upon which multiple firms can develop complementary products, technologies or services; thus, these centralized IIs enable innovation (Eaton, 2016). However, it should be considered that a key attribute of IIs is the lack of centralized control because IIs are a network of interconnected technologies, and their ownership is commonly dispersed (Hanseth & Monteiro, 1998). Further, logistics IIs are charachterized by the existance of diverse

stakeholders with different interest, resources and expectations; thus, it can be expected that the control and ownership of IIs would be dispersed. (Hanseth & Monteiro, 1998; Sanner et al., 2014).

The innovation determinant *"formalization*", which refers to the emphasis on following rules and procedures to conduct organizational tasks (Damanpour, 1991), has been found to negatively influence IT innovation because flexibility and low emphasis on rules and procedures enable innovation (Damanpour, 1991). Although, formal standardization is essential to ensure that digital innovations can be incorporated into the existing installed base, flexible infrastructures are required to enable innovation of IIs. "Furthermore, *"Formalization"* increases *"complexity; accordingly,* lows levels of "*formalization"* allow larger *"flexibility"*. IIs are dynamic and changing. Thus, flexibility is crucial to enable digital innovations to be incorporated into the installed base (Hanseth & Monteiro, 1998).

Based on the discussion above, the innovation management practices *Degree of Centralized structure* and *Degree of formalization* are proposed to negatively influence the IIs innovation and not be effective in terms of the role they play in orgnizations' ability to innovate their IIs. Thus, these practices are not part of an effective strategy for "cultivation". That is, these practices are not effective in facilitating digital innovations to be incorporated into the existing legacy systems and organizational practices. Hence, it is proposed that:

Proposition 3: The identified innovation management practices *Degree of Centralized structure* and *Degree of formalization* have a negative (i.e. not positive) influence on the innovation of logistics IIs in the upstream offshore oil and gas industry.

Proposition 4 : The identified innovation management practices *Degree of Centralized structure* and *Degree of formalization* are ineffective ways of enabling an organization to innovate its logistics IIs in the upstream offshore oil and gas industry.

3.3.3 Propositions 5 and 6

As mentioned in the first part of this chapter, the study of De Haes & Van Grembergen, (2008) examined the ease of implementation of the IT gorvernace (structures, processes, and relational mechanisms). That study found that IT governance practices "structures" are easier to implement than IT governance "processes" and "relational mechanisms", and IT governance "relational mechanisms" are easier to implement than IT governance "processes". The innovation management practices proposed in this study can be associated at different degrees to the IT governance domains (i.e., structures, processes and relational mechanisms). This association can be obtained considering the definitions provided by Peterson (2004), and the definitions of the 12 innovation management practices proposed in this chapter; This association is shown in Table 10.

Table 10: Association between IT governance and innovation management practices

IT governance definitions (Peterson, 2004)	Related Innovation Management Practices
IT governance "structures" adresses the *"structural (formal) devices and mechanisms for connecting and enabling horizontal, or liaison, contacts between business and IT management (decision-making) functions"* (Peterson, 2004, p.14).	*Degree of centralized structure; Degree of internal communication*
IT governance "processes" refers to the *"formalisation and institutionalisation of strategic IT decision making or IT monitoring procedures"* (Peterson, 2004, p.15).	*Degree of formalization; Amount of slack resources; Degree of Logistics II planning; IS Installed Base; Change Management*
IT governance "relational mechanisms" refers to *"the active participation and collaborative relationships among, corporate executives, IT management, and business management*" (Peterson, 2004, p. 15).	*Degree of top management support towards Innovation of Logistics II; Degree of relevant technical expertise; Degree of openness/external communication; Norm Encouraging Change; Degree of training provided to employees.*

Based on the discussion above it is proposed that:

Proposition 5: IT governance practices "structures" and Innovation management practices related to "structures" are easier to implement than IT governance "processes" and "relational mechanisms", and innovation management practices related to "processes" and "relational mechanisms"

Proposition 6 : IT governance practices "relational mechanisms" and Innovation management practices related to "relational mechanisms" are easier to implement than IT governance "processes", and innovation management practices related to "processes"

3.3.4 Proposition 7

This research aims to provide a minimun baseline of IT governance and innovation management practices that enable organizations to innovate their logistics IIs in the upstream offshore oil and gas industry. The practices that compose this framework should be highly effective and easy to implement. This implies that the standard that determines the mixture of IT governance and innovation management practices cointained in this framework is more strict for the perceived "effectiveness" than for the perceived "ease of implementation". In other words, the practices contained in this model are determined by first their "effectiveness" and second their "ease of implementation".

The study by De Haes & Van Grembergen, (2008) determined the "effectiveness" of the posited IT governance practices. That study found that in general IT governance practices "structures" and "processes" are perceived as being equally effective but more effective than IT governance "relational mechanisms". As the innovation management practices proposed in this study can be associated at different degrees to the IT governance domains, (i.e., structures, processes and relational mechanisms) (see Table 10); it is proposed that:

Proposition 7: The Minimum Baseline of IT governance and innovation management practices is composed of more practices (including both IT governance and innovation management practices) related to "structures" and "processes" than practices related to "relational mechanisms"

3.4 Summary

This chapter has described the 45 IT governance (structure, processes and relational mechanisms) and innovation management practices being examined in the Delphi study. Furthermore, seven propositions has been postulated, which are linked to the research questions and involve the evaluation of the 45 practices in terms of the role they play in the innovation of logistics IIs in the upstream offshore oil and gas industry. The next chapter will describe the methodology utilized in this research to evaluate these practice.

Chapter 4: Methodology

This chapter is divided in two sections. The first section describes the Delphi method and how this method was utilized to identify and evaluate the innovation management and the IT governance practices that influence the innovation of IIs in the upstream offshore logistics. The second section explains the data analysis procedure conducted to answer the four research questions, and tests the seven propositions of this study.

4.1 Methodology

This section provides a detailed description of the Delphi method, research design, pre-test of the Delphi questionnaire, sampling procedures and participants nomination, as well as the recruitment process and data collection.

4.1.1 The Delphi method

The Delphi method was created by the RAND Corporation in the 1950s, and was utilized in a series of studies (Schmidt, 1997). The objective of this methodology is to solve a complex issue by building the most reliable consensus of a group of experts. This method employs controlled communication between the researcher and participants through the usage of a series of questionnaires to reach consensus. There are different ways that the Delphi method has been applied, but the following is the basic procedure. In the first round of the survey, the researcher designs a questionnaire with relevant questions related to the topic of study. The researcher determines the target population for the study and selects a group of experts from this population on whom to apply the questionnaire. Participants complete the first questionnaire and send their responses to the researcher. The researcher analyzes the data from round 1, generates a report with

the results of round 1 and sends back the report to participants. For the second round, the researcher designs a second questionnaire considering the results of round one and sends the survey to participants. In this way, participants can observe and consider the group responses and judgments and re-evaluate their responses. Additional rounds may be conducted to reach consensus.

An essential benefit of the Delphi method is that it avoids direct confrontation among participants. The controlled interaction that characterizes the Delphi method conduces experts to develop independent thought and form a considered judgment on a particular issue. Moreover, this advantage avoids biases that can be present in direct confrontations such as a proclivity to close one´s mind to a new idea, the tendency to defend a stance once taken, and the inclination to be influenced by other´s opinions which are expressed persuasively (Okoli & Pawlowski, 2004).

However, various limitations have been identified for the Delphi method. For instance, one of these limitations is the significant time commitment that this method requires from the researcher and the participants. From the researcher perspective, this method requires the creation and management of a series of questionnaires and modification them according to participants feedback in previous rounds. From the participants' perspective, this method may require a significant amount of time to complete a series of questionnaires. Participant fatigue is another limitation related to the Delphi method that occurs when the surveys include a large number of questions or topics or when these are difficult to understand (Geist, 2010). Also, participants fatigue can occur between rounds; that is, as the study proceeds, often with 2-4 weeks between rounds, participants become less committed to continue in the study. Participants fatigue represents a significant challenge to the researcher, as also is how to manage and report attrition in data analysis and subsequent rounds (Worrell, Di Gangi, & Bush, 2013).

"Generalizability" can be another concern related to the Delphi method. Generalizing the opinions of a non-representative group of experts to a larger population can be problematic. However, by definition the Delphi method does not rely on statistical samples that represent a population. This method leverages the knowledge of a group of experts, who are considered to have insights above and beyond a representative population. Therefore, the results obtained from the panel may produce meaningful benefits for research and practice (Worrell, Di Gangi, & Bush, 2013).

De Haes & Van Grembergen (2008, 2009) utilized the Delphi method to identify a list of IT governance practices for the Beligium finantial sector. The authors explained that they utilized this method because it was suitable to exploratory theory building on complex interdisciplinary issues, which commonly involves new or future trends. The examination of innovation of logistics IIs in the upstream offshore oil and gas industry is a complex issue that requires experts with knowledge in the fields of IT, Innovation and Logistics. Thus, appropriately this study employed the Delphi method to investigate this complex interdisciplinary issue. Furthermore, it was expected that potential participants for this study would be located around the world. Therefore, the Delphi methodology was suitable as it does not require experts to meet physically.

4.1.2 Research design

This Delphi study was conducted according to the guidelines provided by Okoli and Pawlowski (2004) and Schmidt (1997). Also, the procedure of the Delphi study conducted by De Haes & Van Grembergen (2008, 2009) was followed. This study involved a pre-test of the Delphi instrument, and a series of two online questionnaires. For each round, the questionnaires included 12 innovation management practices that were proposed to influence the innovation of logistics

IIs in the upstream offshore oil and gas industry (these practices were described in detail in Chapter 3), and 33 IT governance practices based on the work of De Haes & Van Grembergen (2009) (also discussed in Chapter 3). Figure 2 shows the research design of this study.

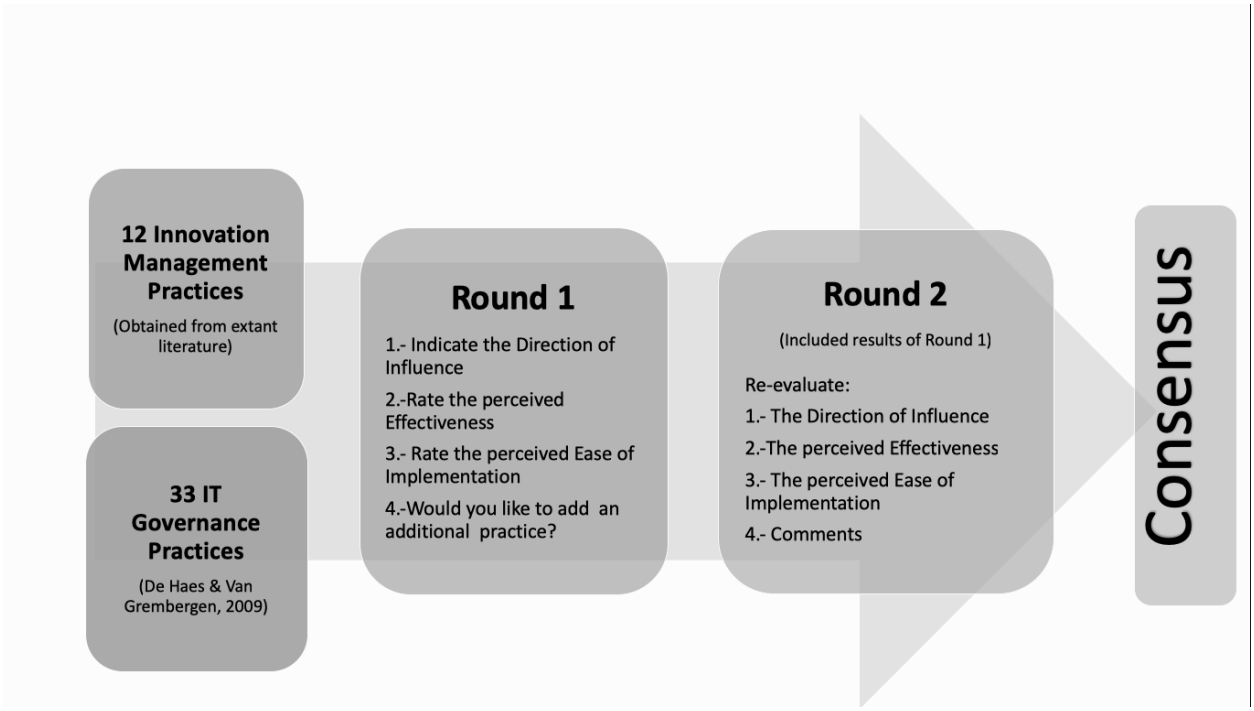

Figure 2:The Delphi study

As this research involved human subjects, it was necessary to have the previous approval of an institutional review board. For this study, the approval was granted by the "Interdisciplinary Committee on Ethics in Human Research" (ICEHR) at Memorial University.

In round one, participants were asked to rate each of the innovation management and IT governance practices, in terms of the influence they play in the ability of organizations to innovate their logistics IIs in the upstream oil and gas industry. The practices were rated on a 5-point scale for the perceived *"Effectiveness*" and the perceived *"Ease of Implementation*". In addition, the first-round questionnaire asked participants to provide: 1) the "direction of influence"

(positive/negative) of each of the practices, and; 2) identify any additional practices that could influence the innovation of logistics IIs in the upstream offshore oil and gas industry. An example of the questionnaire of Round 1 is shown in Appendix D.

The list of innovation management and IT governance practices contained in the second-round questionnaire were determined based on the results of round one, and were ordered based on the value of the group averages (from the largest to the smallest) from round one. In the second round, participants were asked to re-evaluate their responses in the first round considering the group averages from round one for each innovation management and IT governance practice. Also, in these rounds, participants had the opportunity to provide comments on each of the practices. Participants were provided with a report that contained the ranking, the group results, and their own ratings for each of the practices from round one (See Appendix E).

4.1.3 Sampling procedures and participants nomination

A Critical aspect of a Delphi study is the selection of qualified experts since this method requires participants with deep comprehension on a certain issue. Thus, Delphi does not rely on statistical samples that represent a population, instead, a panel size between 10-18 participants has been considered sufficient to get high quality results (Okoli & Pawlowski, 2004).

The ideal participants for this study were experts, both academics and practitioners, in the disciplines of IT (including IIs), Logistics and Innovation. As the topic of this research is a complex and interdisciplinary issue, there may be a limited number of experts with knowledge about the research questions in this study. In order to identify those experts, three different nomination lists were created. The first list included researches and practitioners who, attended a workshop on digitalization of the oil and gas industry in the city of St. John´s, Newfoundland, Canada, and whose area of expertise involves the fields of IT, Innovation or Logistics. The second list

contained academics experts obtained from a review of relevant literature. The third list contained personal contacts of experts who were suitable for participation. A final list of 47 experts were identified as candidates for participation in the Delphi Panel.

4.1.4 Pre-test of the Delphi questionnaire

The pre-test of the Delphi questionnaire consisted of administering the questionnaire to an expert who had previously been identified as a possible participant in the study. This expert was a practitioner with similar expertise levels to those that completed the study. A paper copy of the questionnaire was given to the expert, and the expert was asked to complete the questionnaire and to give feedback regarding the clarity of the questions and definitions of the practices, and the questionnaire format and the writing style. The feedback provided by the expert was used to create an updated questionnaire.

4.1.5 Recruitment process and data collection

The recruitment of participants was conducted online, primarily via e-mail. The invitation to participate in the Delphi study was sent as part of the recruitment process for round one. Participants, who were interested in participating, were asked to click on the survey link and were directed to a new message with detailed information about the subject of the study, the required procedures and the required commitment; this message was followed by the consent form. Qualtrics software (Qualtrics, Provo, UT) was used to administer the Delphi questionnaire.

As this is a very specialized field, two additional recruitment processes were conducted in order to reach unlisted potential participants. The first additional recruitment process was conducted through social media where the online invitation containing the survey link was posted in industry groups on LinkedIn, and other social media venues, such as: Canadian Operational Research Society (CORS) and the Institute for Operations Research and the Management Sciences

(INFORMS). The second additional recruitment process consisted of asking the participants who completed the survey in round one to recommend other experts to participate in this study. Specifically, these participants were asked to send the recruitment email and/or the researcher's contact information to experts they know may be suitable for participation, so that they could contact the researcher of their own volition if they were willing to take part in this study.

In round one the first reminder was emailed to the participants a week after the invitation was sent; a second reminder was sent to experts who had not yet responded a week after the first reminder was sent. Invitations to the second round were sent to all experts who completed the questionnaire in round one. Similar to the first round, participants were asked to click on the survey link and were directed to the second questionnaire displayed on Qualtrics software (Qualtrics, Provo, UT). A week after the invitation for the second round was sent, the first reminder was e-mailed to participants who had not yet responded. A second reminder was sent one day before the second-round survey closed.

Data collection took place over two months. Once the first round was deemed over, data analysis was conducted. Then, the second round questionnarie was revised to include the findings from round one. After the second round, no more rounds were needed to reach consensus.

4.2 Analysis procedure

This Delphi study utilized a quantitative methodology for data analysis which consisted of calculating the response frequency (%), the descriptive statistics (Minimum and Maximum scores, Means, Standard Deviations and Variance), and the Kendall's coefficient of concordance (Kendall's W). Qualtrics software (Qualtrics, Provo, UT) and IBM SPSS Statistics version 25.0 were utilized to obtain the response frequencies and the descriptive statistics in each of the rounds. IBM SPSS Statistics version 25.0 was utilized to obtain the values of Kendall's W.

4.2.1 Kendall's coefficient of concordance

For each round, the analysis of Kendall's W was conducted. This analysis allows determining whether any consensus has been reached, whether the consensus increased, and the strength of the consensus (Schmidt, 1997). To determine the level of agreement of each round, this study employed the standard provided by Schmidt (1997), which posits that a Kendall's (W) value of 0.1 = very weak agreement; 0.3 = weak agreement, 0.5 = moderate agreement, 0.7 = Strong agreement, and 0.9 = unusually strong agreement.

4.2.2 The standard for determining the direction of influence

To set the standard for determining the direction of influence (positive/ negative) of the practices the response frequency (%) was calculated. Response frequencies (%) equal to or greater than 70% determine the positive/ negative direction of influence of the practices and response frequencies (%) of less than 70% do not provide evidence to determine the positive/ negative direction of influence of the practices.

4.2.3 The standard for retaining or eliminating practices

To set the cut-offs for retaining or eliminating practices, the group averages for the perceived "effectiveness" and the perceived "ease of implementation" of each of the practices were

calculated. The Likert scale utilized in both factors ranged from 1 to 5; thus, the median value of this scale was 2.5 for both factors. The researcher set a threshold where practices with means of a value of up to 2.4 would be eliminated, and practices with means of a value of 2.5 or higher would be retained. That is, a value of 2.5 for both, the perceived "effectiveness" and the perceived "ease of implementation", indicated that the practice was fairly effective and easy to implement; thus, this practice would be retained in the study. This part of the data analysis also involves the testing of Propositions 2 and 4.

4.2.4 The standard for determining the practices that composed the minimum baseline of required practices that can be applied in practice to encourage innovation in organizations

This research identifies a set of practices that are highly effective and easy to implement; such practices constitute a minimum requirement of IT governance and innovation management practices that can be applied in practice to foster innovation in organizations. This set of practices was established based on the mean values of each of the practices for the perceived "effectiveness" and "ease of implementation". The standard that determines the mixture of IT governance (structures, processes, and relational mechanisms) and innovation management practices cointained in this framework is more strict for the perceived "effectiveness" than for the perceived "ease of implementation". The researcher set the cut-off where practices with group means of a value greater than 3.9 for the perceived "effectiveness" and group means of a value greater that 3.0 for the perceived "ease of implementation" were postulated as a minimum required of IT governance and innovation management practices that can be applied in practice to foster innovation in organizations. This procedure also implies the evaluation of Proposition 7.

Chapter 5: Analysis and results

This chapter describes the results of this research. This chapter is organized into eight sections. The first part addresses the Kendall coefficient values for rounds 1 and 2.The second section explains the demographic information on the Delphi Panel, the third section describes the results of the sensitivity analysis, the fourth section describes the results of the direction of influence of each of the practices (P1, P3), the fifth section addresses the results for the identification of the influential IT governance and innovation management practices (P2, P4), the sixth section provides the results of the evaluation of the practices (i.e. rankings) for the perceived "effectiveness" and "ease of implementation" (P5, P6). The seventh section of this chapter provides the minimum required for IT governance and innovation management practices to foster innovation of IIs in the upstream offshore oil and gas industry (P7). Finally the chapter ends with a summary of the results.

5.1 Kendall's coefficient of concordance values

Kendall's W value for the first round was 0.801, and for the second round was 0.857. These values indicated a strong level of agreement achieved in each round (Schmidt, 1997). Furthermore, this increasing change in the values of Kendall W between rounds indicates a movement towards consensus between round one and round two. Based on these scores, a strong degree of confidence in the results is concluded; this evidence is adequate and a third round was not started.

5.2 Delphi panel

For round one, 17 experts (36% of the initial list of 47 experts) agreed to participate in the study (from a total of 19 responses, 17 usable responses were obtained in round one). For round two, 12 experts (70% of the experts who participated in round one) continued participating in the Delphi (from a total of 13 responses, 12 usable responses were obtained in round two).

Participants were located in Canada (58%), China (25%), and Norway (17%). There was a balance of academics and practitioners in the Delphi panel since it was composed of 6 academics (50%) and 6 practitioner (50%) experts. The average of total years' experience of participants was 18 years. All academic experts were active faculty members and researchers, all practitioner experts reported to have senior management positions in their organizations. Table 11 shows the Demographic information of the Delphi Panel.

Table 11: Delphi study participants demographics

Demographic Variable	Description	Frequency n=12	Percent
Country	Canada	7	58%
	China	3	25%
	Norway	2	17%
Occupation	Academic	6	50%
	Practitioner	6	50%
Organizational Size (number of employees)	1 - 49	2	17%
	50 - 999	4	33%
	1,000 - 4,999	4	33%
	5,000 or more	2	17%
Total years of work experience	1-3 years	1	8%
	7-9 years	3	25%
	10 years or more	8	67%
Highest level of Education completed	Bachelor's degree in college or similar	6	50%
	Master's degree	0	0%
	Doctoral degree	6	50%

5.3 Sensitivity analysis

As mentioned above, the Delphi panel was composed of 50% academic experts and 50% practitioner experts. It can be possible that the perceptions of these two groups are different. Therefore, a sensitivity analysis (practitioner vs academic) was conducted on the expert

population. The sensitivity analysis compared the responses of the group of academic experts with the responses of the group of practitioners experts in terms of the perceived effectiveness and the perceived ease of implementation of each of the practices. The analysis revealed that, in general, the responses of both groups are aligned. This is concluded because the group averages of the academic experts for each practice for the perceived "effectiveness" and the perceived "ease of implementation" in each round are aligned with the ones of the practitioner experts. Appendix A visualizes the sensitivity analysis (practitioner vs academic) for the first and second round.

5.4 Direction of influence

This section deals with the research question 1. The response frequency (%) for the *direction of influence* of each of the practices in the first and second rounds are shown in Appendix B. The analysis of the *direction of influence* of the IT governance practices "structures", "processes", and "relational mechanisms" indicate that these practices are considered to positively influence the innovation of logistics IIs in the upstream offshore oil and gas industry. The only unexpected exception occurred in the set of IT governance practices "relational mechanisms" with the practice "Job rotation", which was considered to have a positive *direction of influence* by only 50% of the experts and to have a negative *direction of influence* by the remaining 50% of the participants in round two.

Analysis of the *direction of influence* for the innovation management practices (see Appendix B) revealed that 10 of the innovation management practices (i.e., *1) Degree of top management support towards Innovation of Logistics II, 2) Degree of relevant technical expertise, 3) Amount of slack resources, 4) Degree of openness/external communication, 5) Degree of Logistics II planning, 6) Norm Encouraging Change, 7) Degree of training provided to employees, 8) IS Installed Base, 9) Degree of internal communication,* and 10) *Change Management)* were

considered to positively influence the innovation of logistics IIs in the upstream oil and gas industry. This is concluded because at least 70% of the participants supported the positive *direction of influence* of these practices.

In general, the results described above *supported Proposition 1* as a positive *direction of influence* on the IT governance ("structures", "processes", and "relational mechanisms") and 10 innovation management practices were found. The only exception was the IT governance practice: "*Job rotation"*.

Proposition 3 postulates a negative *direction of influence* for the practices *Degree of centralized structure* and *Degree of formalization*. However, the analysis revealed that *Degree of centralized structure* was considered to have a positive "direction of influence" by 50% of the experts and to have a negative *direction of influence* by the remaining 50% of the participants. Furthermore, the positive influence on the practice *Degree of formalization* was supported by 66.7% of the experts. Thus, there is not enough evidence to establish a negative *direction of influence* for these two practices. Therefore, *Proposition 3 was not supported*.

5.5 Identification of the most influential IT governance and innovation management practices

This section is related to the research question number 2. Based on our criterion for retaining or eliminating practices (i.e. practices with a mean value equal of or greater than 2.5 for both, the perceived "effectiveness" and the perceived "ease of implementation" should be retained), the 45 practices included in the first round were retained (group averages for the perceived "effectiveness" and the perceived "ease of implementation" of the first and second rounds are shown in Appendix C). That is, the list of 33 IT governance practices (structures, processes and relational mechanisms) extracted from De Haes & Van Grembergen (2008, 2009) and the proposed

10 innovation management practices were perceived as effective (P2) and easy to implement. The results also provide enough evidence to support Proposition 2.

However, these results also involve the evaluation of Proposition 4 of this study. It was proposed that *Degree of Centralized structure* and *Degree of formalization* would not be *effective* in terms of the role they play in organizations' ability to innovate their logistics IIs in the upstream offshore oil and gas industry. Analysis of the data revealed that these practices are perceived as effective. The mean value for the perceived *"effectiveness"* of the practice *Degree of Centralized structure was 2.7* and of the practice *Degree of formalization was 2.7;* thus, *Proposition 4 was not supported.*

Two practices were provided by participants in round 1 and evaluated in round 2; those practices were perceived as effective and easy to implement (i.e. the value of the group averages of the practices for the perceived "effectiveness" and the perceived "ease of implementation" were greater than 2.4). Such practices are described below :

1. "Sense of responsibility", concerns the extent to which organizational members feel responsible for the innovation deployment success. This practice was classified as part of the set of *innovation management practices*.
2. "Emergency response management": Systems (e.g., intranet) that communicate procedures and communication patterns to follow in events of logistics II breakdowns. This practice was classified as part of the set of IT governance practices "relational mechanisms".

Thus, this study identified a total of 47 IT governance and innovation management practices that influence the innovation of logistics IIs in the upstream offshore Oil and Gas industry.

5.6 The rankings for the perceived "effectiveness" and "ease of implementation" rankings of the IT governance and innovation management practices

This section involves research question 2 and 3. The rankings of the IT governance and innovation management practices for the perceived "effectiveness" and "ease of implementation" are provided in two different perspectives; therefore, in order to establish such rankings, two different analyses were conducted. The first part of this section addresses the *Individual Set Analysis* which provides the rankings of the practices according to the set to which they belong (i.e., IT governance "structures", "processes", "relational mechanisms", and innovation management practices). The second part of this section addresses the *Overall Set Analysis*, which provides the rankings of the practices when all of the IT governance "structures", "processes", "relational mechanisms", and innovation management practices are included in a single set.

As Proposition 2 was supported, the practices examined in both analysis (i.e. the *Individual Set Analysis* and the *Overall Set Analysis*) included the 45 IT governance and innovation management practices involved in the first round of the Delphi, and the 2 additional practices obtained from participants responses. Then, the 47 practices identified in the Delphi study were examined in both analysis.

5.6.1 Individual set analysis

This part is separated into five sections. The first four sections correspond to the rankings of each set of practices; that is, the rankings for IT governance 1) "structures", 2) "processes", 3) "relational mechanisms" and 4) innovation management practices. For each set of practices two tables are provided that summarize the results of the perceived "Effectiveness" and the perceived "Ease of Implementation" from rounds 1 and 2. These tables contain the rankings, group averages, and the standard deviations of each set of practices in the first and second rounds. Also, these

tables visualise the ranking changes occurred between rounds for the perceived "effectiveness" and "ease of implementation".

Finally, the last section reveals the results of a comparison between the different sets of practices in terms of their perceived "effectiveness" and "ease of implementation" (P5, P6).

5.6.1.1 The rankings of the innovation management practices

Tables 12 and 13 show the rankings of the innovation management practices for the perceived "Effectiveness" and the perceived "Ease of Implementation". As it can be noted, the ranking for both factors changed between rounds. For instance, the practices: *Amount of slack resources* and *Degree of training provided to employees* were included in the top five practices for the perceived "effectiveness" in round two; while in the first round these practices were positioned in the place nine and eight respectively.

In round 2, the practices *Degree of top management support towards Innovation of Logistics II, Amount of slack resources* and *"Degree of training provided to employees"* were perceived as highly effective and easy to implement. This finding is supported by participants comments, for example:

"top mgt. support is essential" and *"adequate training is very important"*

Conversely, the practice *Degree of formalization* was perceived as not very effective and not very ease to implement. This can be explained because low levels of formalization allows larger flexibility, which is needed to enable change (Hanseth & Monteiro, 1998).

Table 12: Rankings of the innovation management practices for the perceived "effectiveness"

Innovation Management Practices "Effectiveness"						
Innovation Practices	**Round 2**			**Round 1**		
	Ranking	**Mean**	**Standard Deviation**	**Ranking**	**Mean**	**Standard Deviation**
Degree of relevant technical expertise	**1**	**4.17**	0.69	**2**	**4.12**	0.96
Degree of top management support towards Innovation of Logistics II	**2**	**4.08**	0.95	**1**	**4.18**	0.92
Amount of slack resources	**3**	**3.80**	0.6	9	**3.53**	1.02
Change Management	**4**	**3.75**	0.72	**3**	**4.07**	0.68
Degree of training provided to employees	**5**	**3.73**	0.45	8	**3.69**	1.04
Degree of logistics II planning	6	**3.67**	0.85	**5**	**3.88**	0.99
Degree of Internal Communication	7	**3.58**	0.86	**4**	**3.94**	0.75
Degree of openness / External communication	8	**3.58**	0.49	6	**3.79**	0.94
Sense of Responsibility	9	**3.55**	0.89	_	_	_
Norm Encouraging Change	10	**3.45**	0.66	7	**3.75**	0.66
IS Installed Base	11	**3.40**	0.8	10	**3.50**	1.17
Degree of formalization	12	**3.36**	0.77	11	**3.20**	0.91
Degree of centralized structure	13	**2.70**	0.64	12	**2.73**	1.12

Table 13: Rankings of the innovation management practices for the perceived "ease of implementation"

Innovation Management Practices "Ease of Implementation"						
Innovation Practices	**Round 2**			**Round 1**		
	Ranking	**Mean**	**Standard Deviation**	**Ranking**	**Mean**	**Standard Deviation**
Degree of training provided to employees	**1**	**3.64**	0.64	**1**	**3.81**	0.95
Degree of top management support towards Innovation of Logistics II	**2**	**3.42**	1.04	7	**3.53**	1.24
Amount of slack resources	**3**	**3.4**	0.66	**4**	**3.56**	1.06
IS Installed Base	**4**	**3.4**	0.92	6	**3.56**	1.17
Norm Encouraging Change	**5**	**3.27**	0.62	10	**3.47**	0.88
Degree of Internal Communication	6	**3.17**	0.99	**3**	**3.59**	1.14
Degree of logistics II planning	7	**3.17**	0.8	9	**3.53**	0.98
Change Management	8	**3.08**	0.64	**2**	**3.73**	0.85
Degree of relevant technical expertise	9	**3**	0.71	8	**3.53**	1.24
Degree of openness / External communication	10	**3**	0.41	**5**	**3.56**	1.12
Degree of centralized structure	11	**2.9**	0.54	11	**3.4**	0.95
Degree of formalization	12	**2.73**	0.62	12	**3.12**	1.13
Sense of Responsibility	13	**2.64**	0.77	_	_	_

5.6.1.2 The rankings of the IT governance practices "structures"

Tables 14 and 15 show the rankings of the IT governance practices "structures" for the perceived "Effectiveness" and the perceived "Ease of Implementation" for the first and second rounds. In general, both rankings changed between rounds. An interesting result was that, in the first round, most of the top five practices for the perceived "effectiveness" are also included in the top five practices for the perceived "ease of implementation". However, in the second round, the rankings changed and only the practices *"CIO (Chief Information Officer) on executive committee", "IT project steering committee",* and *"CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)"* were perceived as highly effective and easy to implement.

On the other hand, the practice *IT audit committee at the level of board of directors* was regarded as not very effective and not very easy to implement in the first and second rounds.

Table 14: Rankings of the IT governance practices "structures" for the perceived "effectiveness"

IT governance Practices (structures) "Effectiveness"						
IT Governance Practices "structures"	**Round 2**			**Round 1**		
	Ranking	**Mean**	**Standard Deviation**	**Ranking**	**Mean**	**Standard Deviation**
CIO (Chief Information Officer) on executive committee	**1**	**4.18**	0.39	**1**	**4.24**	0.55
IT project steering committee	**2**	**4**	0	**4**	**4**	0.97
IT expertise at level of board of directors	**3**	**4**	0.43	6	**3.87**	1.02
CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	**4**	**3.91**	0.51	**2**	**4.19**	0.88
Integration of governance/ alignment tasks in roles and responsibilities	**5**	**3.91**	0.29	7	**3.87**	0.96
Security / compliance/ risk officer	6	**3.89**	0.57	**3**	**4.13**	0.93
IT security steering committee	7	**3.8**	0.4	9	**3.63**	0.93
IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	8	**3.67**	0.47	8	**3.76**	0.81
IT strategy committee at level of board of directors	9	**3.55**	0.5	**5**	**3.88**	1.27
Architecture steering committee	10	**3.55**	0.5	11	**3.47**	1.02
IT governance function	11	**3.25**	0.72	10	**3.53**	1.14
IT audit committee at level of board of directors	12	**3.2**	0.4	12	**3.29**	1.16

Table 15: Rankings of the IT governance practices "structures" for the perceived "ease of implementation"

ITG Practices (structures) "Ease of Implementation"						
IT Governance Practices "structures"	**Round 2**			**Round 1**		
	Ranking	**Mean**	**Standard Deviation**	**Ranking**	**Mean**	**Standard Deviation**
CIO (Chief Information Officer) on executive committee	**1**	**3.73**	0.45	**1**	**3.81**	0.95
CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	**2**	**3.64**	0.48	**2**	**3.8**	0.75
IT strategy committee at level of board of directors	**3**	**3.45**	0.5	**3**	**3.56**	1.17
IT project steering committee	**4**	**3.42**	0.49	**4**	**3.53**	0.78
Architecture steering committee	**5**	**3.27**	0.45	6	**3.4**	0.71
Security / compliance/ risk officer	6	**3.11**	0.57	8	**3.25**	1.15
IT security steering committee	7	**3.1**	0.54	9	**3.25**	1.03
IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	8	**3**	0.41	**5**	**3.47**	0.7
IT governance function	9	**2.92**	0.64	10	**3.24**	0.88
Integration of governance/ alignment tasks in roles and responsibilities	10	**2.91**	0.9	7	**3.27**	0.85
IT expertise at level of board of directors	11	**2.82**	0.94	11	**2.88**	1.27
IT audit committee at level of board of directors	12	**2.5**	0.5	12	**2.87**	1.15

5.6.1.3 The rankings of the IT governance practices "processes"

Tables 16 and 17 show the rankings of the IT governance practices "processes" for the perceived "Effectiveness" and the perceived "Ease of Implementation". Interestingly, the top five IT governance practices "processes" for the perceived "effectiveness" remained fairly stable between rounds; however, the rankings between rounds for the perceived "ease of implementation" changed substantially. In round two, four practices were perceived as highly "effective" and "easy to implement". Those practices are: 1) "*IT performance measurement", 2) "Portfolio management (incl. business cases, information economics, return on Investment, payback)" 3) "Project governance /management methodologies",* and *4) "IT governance framework COBIT"*. On the contrary, the practice *Charge back arrangements total cost of ownership (e.g. Activity based costing)* was ranked in the last place for both, the perceived *"effectiveness"* and the perceived *"ease of implementation"*. Interestingly, some studies have found this practice not very valuable in terms of the role it plays in supporting and extending the business strategy and objectives (De Haes & Van Grembergen, 2008) .

Table 16: Rankings of the IT governance practices "processes" for the perceived "effectiveness"

ITG Practices Processes "Effectiveness"						
IT Governance Practices "Processes"	**Round 2**			**Round 1**		
	Ranking	**Mean**	**Standard Deviation**	**Ranking**	**Mean**	**Standard Deviation**
Strategic information systems planning	**1**	**4.25**	0.72	**1**	**4.44**	0.7
IT performance measurement	**2**	**4.25**	0.72	**2**	**4.06**	0.9
Portfolio management (incl. business cases, information economics, Return on Investment, payback)	**3**	**3.92**	0.28	**3**	**4**	0.94
Project governance /management methodologies	**4**	**3.67**	0.47	**5**	**3.59**	0.91
IT governance framework COBIT	**5**	**3.56**	0.5	7	**3.5**	1.04
IT budget control and reporting	6	**3.5**	0.65	9	**3.47**	1.04
Benefits management and reporting	7	**3.45**	0.89	8	**3.5**	0.94
Service level agreements	8	**3.36**	0.48	6	**3.5**	1.05
COSO / ERM	9	**3.2**	0.4	10	**3.31**	0.99
IT governance assurance and self-assessment	10	**3.17**	0.69	**4**	**3.76**	0.73
Charge back arrangements total cost of ownership (e.g. Activity based costing)	11	**2.82**	0.83	11	**3.07**	0.85

Table 17: Rankings of the IT governance practices "processes" for the perceived "ease of implementation"

ITG Practices Processes "Ease of Implementation"						
IT Governance Practices "Processes"	Round 2			Round 1		
	Ranking	Mean	Standard Deviation	Ranking	Mean	Standard Deviation
IT budget control and reporting	1	**3.42**	0.49	1	**3.47**	0.92
IT performance measurement	2	**3.33**	0.85	7	**3.19**	1.33
Project governance /management methodologies	3	**3.25**	0.6	3	**3.41**	0.77
Portfolio management (incl. business cases, information economics, Return on Investment, payback)	4	**3.17**	0.55	9	**3.06**	1.16
IT governance framework COBIT	5	**3.11**	0.31	2	**3.42**	0.95
Service level agreements	6	**3.09**	0.51	6	**3.25**	0.83
IT governance assurance and self-assessment	7	**2.92**	0.49	10	**3.06**	0.66
COSO / ERM	8	**2.9**	0.3	8	**3.14**	0.91
Strategic information systems planning	9	**2.83**	0.55	11	**2.94**	1.14
Benefits management and reporting	10	**2.73**	0.75	5	**3.31**	0.92
Charge back arrangements total cost of ownership (e.g. Activity based costing)	11	**2.55**	0.78	4	**3.31**	1.04

5.6.1.4 The rankings of the IT governance practices "relational mechanisms"

Tables 18 and 19 reveal the rankings of the IT governance practices "Relational Mechanisms" for the perceived "Effectiveness" and the perceived "Ease of Implementation". As it can be observed, the top five IT governance practices "relational mechanisms" for the perceived "effectiveness" and the perceived "ease of implementation" remained fairly stable between rounds. Remarkably, in round 2, four practices *1)"Informal meetings between business and IT executive/ senior management", 2) "Co-location", 3)"Executive / senior management giving the good example" and 4) "Corporate internal communication addressing IT on a regular basis"*) were regarded as highly effective and easy to implement.

Conversely, the practice *Job rotation* was perceived as not very effective and not very easy to implement. This finding is consistent with previous research that has challenged the value of this IT governance practice (i.e. De Haes & Van Grembergen, 2008). Moreover, previous research has been found that this practice is not very useful in supporting and extending the business strategy and objectives (De Haes & Van Grembergen, 2008) .

Table 18: Rankings of the IT governance practices "relational mechanisms" for the perceived "effectiveness"

ITG Practices Relational Mechanisms "Effectiveness"						
IT Governance Practices "Relational Mechanisms"	**Round 2**			**Round 1**		
	Ranking	**Mean**	**Standard Deviation**	**Ranking**	**Mean**	**Standard Deviation**
Cross-training	**1**	**4.5**	0.5	**1**	**4.19**	1.07
Corporate internal communication addressing IT on a regular basis	**2**	**4.18**	0.57	6	**4**	0.63
Informal meetings between business and IT executive/ senior management	**3**	**4.17**	0.8	**2**	**4.15**	0.77
Executive / senior management giving the good example	**4**	**4.17**	0.37	**5**	**4**	0.76
Co-location	**5**	**4.08**	0.64	**3**	**4.07**	1
IT leadership	6	**4**	0.41	**4**	**4.06**	0.66
Knowledge management (on IT governance)	7	**3.92**	0.64	7	**3.94**	0.83
Business/IT account management	8	**3.83**	0.55	8	**3.86**	0.64
Emergency response management	9	**3.73**	1.05	_	_	_
IT governance awareness campaigns	10	**3.64**	0.48	9	**3.77**	0.8
Job-rotation	11	**3.33**	0.85	10	**3.57**	1.12

Table 19: Rankings of the IT governance practices "relational mechanisms" for the perceived "ease of implementation"

ITG Practices Relational Mechanisms "Ease of implementation"						
IT Governance Practices "Relational Mechanisms"	**Round 2**			**Round 1**		
	Ranking	**Mean**	**Standard Deviation**	**Ranking**	**Mean**	**Standard Deviation**
Informal meetings between business and IT executive/ senior management	**1**	**4**	0.71	**2**	**3.73**	1.06
Co-location	**2**	**3.83**	0.69	6	**3.5**	0.94
IT governance awareness campaigns	**3**	**3.73**	0.75	**1**	**3.87**	0.72
Executive / senior management giving the good example	**4**	**3.58**	0.49	**3**	**3.67**	1.01
Corporate internal communication addressing IT on a regular basis	**5**	**3.45**	0.66	**4**	**3.6**	0.88
IT leadership	6	**3.42**	0.64	**5**	**3.56**	0.7
Knowledge management (on IT governance)	7	**3.42**	0.64	7	**3.5**	0.79
Cross-training	8	**3.25**	0.6	10	**3.25**	0.75
Business/IT account management	9	**3.08**	0.49	8	**3.4**	0.49
Job-rotation	10	**2.75**	0.6	9	**3.29**	1.39
Emergency response management	11	**2.55**	0.89	–	–	–

The results of the *individual set analys*is have revealed the rankings of the practices and their movements between rounds in terms of their perceived "effectiveness" and "ease of implementation" when the practices are analyzed according to their set of classification. Further, the results revealed that, in general, the standard deviation values of each of the practices were smaller in round 2 than in round 1. This is true for both the perceived "effectiveness" and the perceived "ease of implementation". Such a decrease in the standard deviation values between rounds denotes a movement toward consensus between rounds one and two.

5.6.1.5 The effectiveness and ease of implementation of the individual sets of practices

Figure 3 and 4 present the results of averages calculated for all IT governance "structures", "processes", "relational mechanisms" and innovation management practices. The results revealed that the IT governance practices "relational mechanisms" are perceived as the most effective and easiest to implement of the group; followed by the IT governance practices "structures" and then the innovation management practices.

IT governance practices "processes" are perceived as the least effective and least easy to implement practices of the group. One of the reasons for this result is that three of the practices with the lowest scores in terms of "effectiveness" are involved in this classification *(i.e., "Charge back arrangements total cost of ownership (e.g. Activity based costing)"; "IT governance assurance and self-assessment";* and *"COSO / ERM")*. Furthermore, IT governance "processes" include practices that are perceived as effective but hard to implement due to their complexity and "granularity"; for example, the IT governance framework COBIT (De Haes & Van Grembergen, 2008).

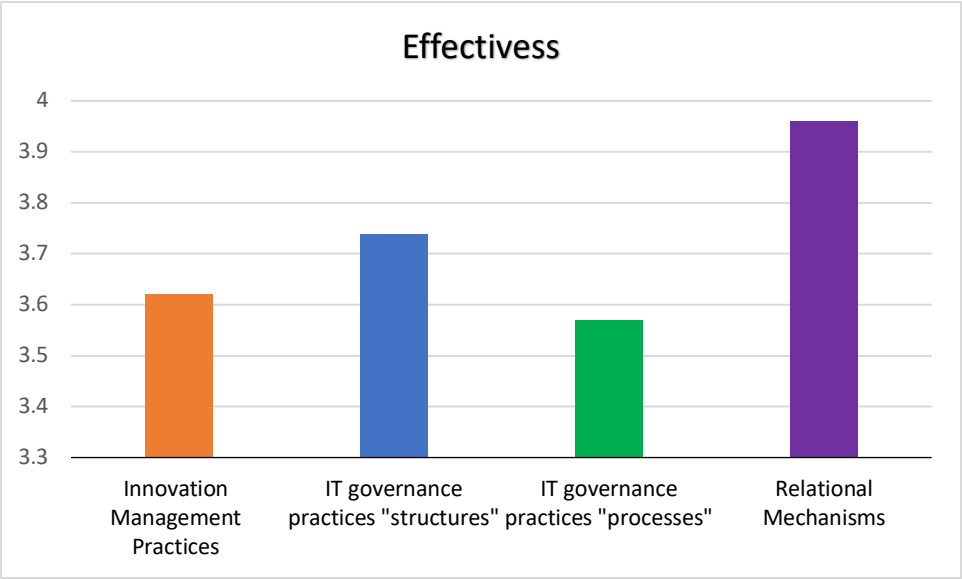

Figure 3: Averages for the perceived "effectiveness" of the IT governance and innovation management practices

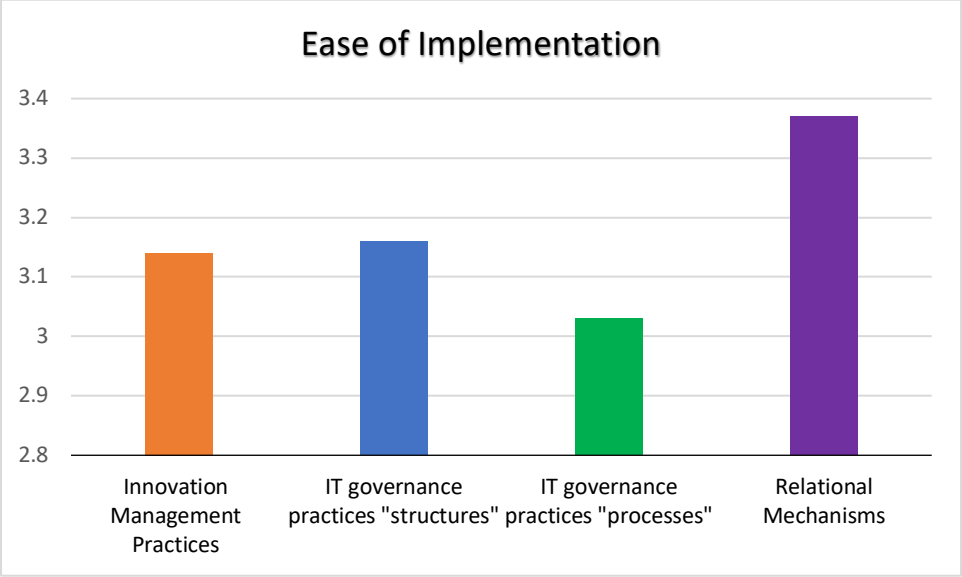

Figure 4: Averages for the perceived "ease of implementation" of the IT governance and innovation management practices

To test Propositions 5 and 6 the innovation management practices related to IT governance “structures”, ”processes”, and ”relational mechanisms” were integrated to their corresponding set and averages for the perceived “ease of implementation” were obtained. Figure 5 shows the results of this analysis. As can be noted, IT governance practices “structures” and innovation management

practices related to “structures” are perceived as easier to implement than IT governance “processes” and “relational mechanisms” and the innovation management practices related to these sets of practices. Furthermore, IT governance practices “relational mechanisms” and innovation management practices related to “relational mechanisms” are perceived as easier to implement than IT governance “processes” and the innovation management practices related to this set. Thus, *Proposition 5 and 6 are accepted*.

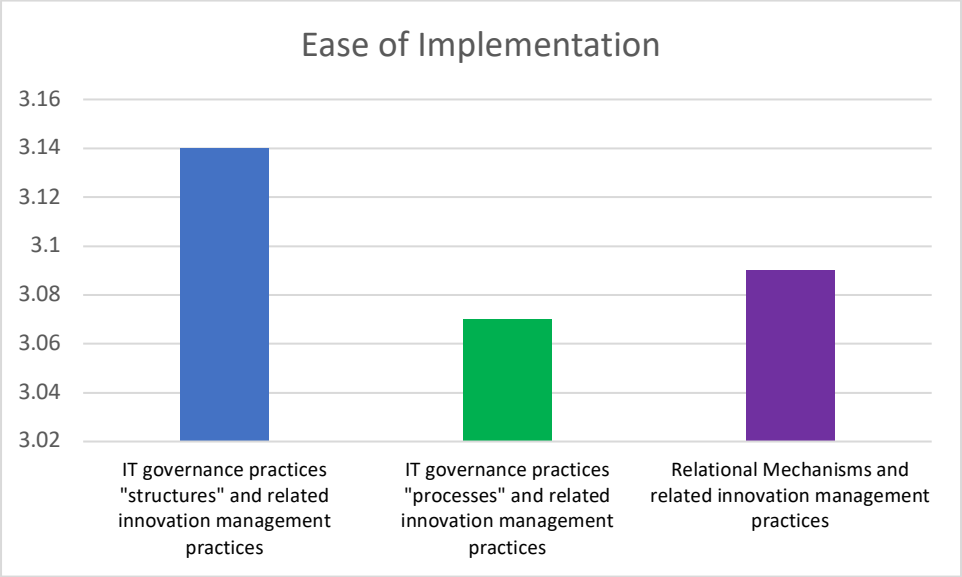

Figure 5: Averages for the perceived "ease of implementation" of the IT governance practices and their related innovation management practices

5.6.2 Overall set analysis

This part describes the rankings for the perceived “effectiveness” and perceived “ease of implementation” when the 47 practices are integrated in a single set.

5.6.2.1 The overall rankings

Figure 6 and 7 visualize the overall rankings of the practices for the perceived “effectiveness” and perceived “ease of implementation”. As can be noted, some practices are perceived as more

effective or easy to implement than others. The five practices that are perceived as most effective are:

1. Cross-training (IT governance "relational mechanisms")
2. IT performance measurement (IT governance "processes")
3. Strategic information systems planning (IT governance "processes")
4. Corporate internal communication addressing IT on a regular basis (IT governance "relational mechanisms")
5. CIO (Chief Information Officer) on executive committee (IT governance "structures")

In general, these practices are also perceived as practices easy to implement. The exception is the practice *"Strategic information systems planning"* which is located within the last 10 positions of the ranking for the perceived "ease of implementation". This finding is also supported by the experts comments: for example, one of the participants' commentaries states:

"Not easy to implement good logistics planning, especially in a supply chain management way"

Moreover, another expert mentioned the availability of resources as an element that may influence the implementation of this practice:

"Typically under resourced to complete a detailed analysis"

The overall analysis also allowed the identification of the five practices that are perceived to be the least effective, such practices are:

1. Degree of centralized structure (innovation management practices)
2. Charge back arrangements total cost of ownership (e.g. Activity based costing) (IT governance "processes")
3. IT governance assurance and self-assessment (IT governance "processes")
4. IT audit committee at level of board of directors(IT governance "structures")

5. COSO / ERM (IT governance "processes")

Remarkably the practices *"Charge back arrangements total cost of ownership (e.g. Activity based costing)"* and *"IT audit committee at level of board of directors"* are also perceived as being not very easy to implement. Furthermore, in the "individual set analysis", these practices were also perceived as not very effective and not very easy to implement in each of their respective sets. Thus, those practices are not very useful to foster innovation of logistics IIs in the upstream offshore oil and gas industry. Moreover, this finding is consistent with the experts' observations; for example, a comment concerned to the practice *"Charge back arrangements total cost of ownership (e.g. Activity based costing)"* states that this practice is:

"a difficult paper exercise that usually does not result in anything"

Finally, the two practices that were provided by participants in this Delphi study: *Sense of responsibility* and *Emergency response management* were perceived as effective but not very easy to implement as they were located within the last five positions of the ranking for the perceived "ease of implementation".

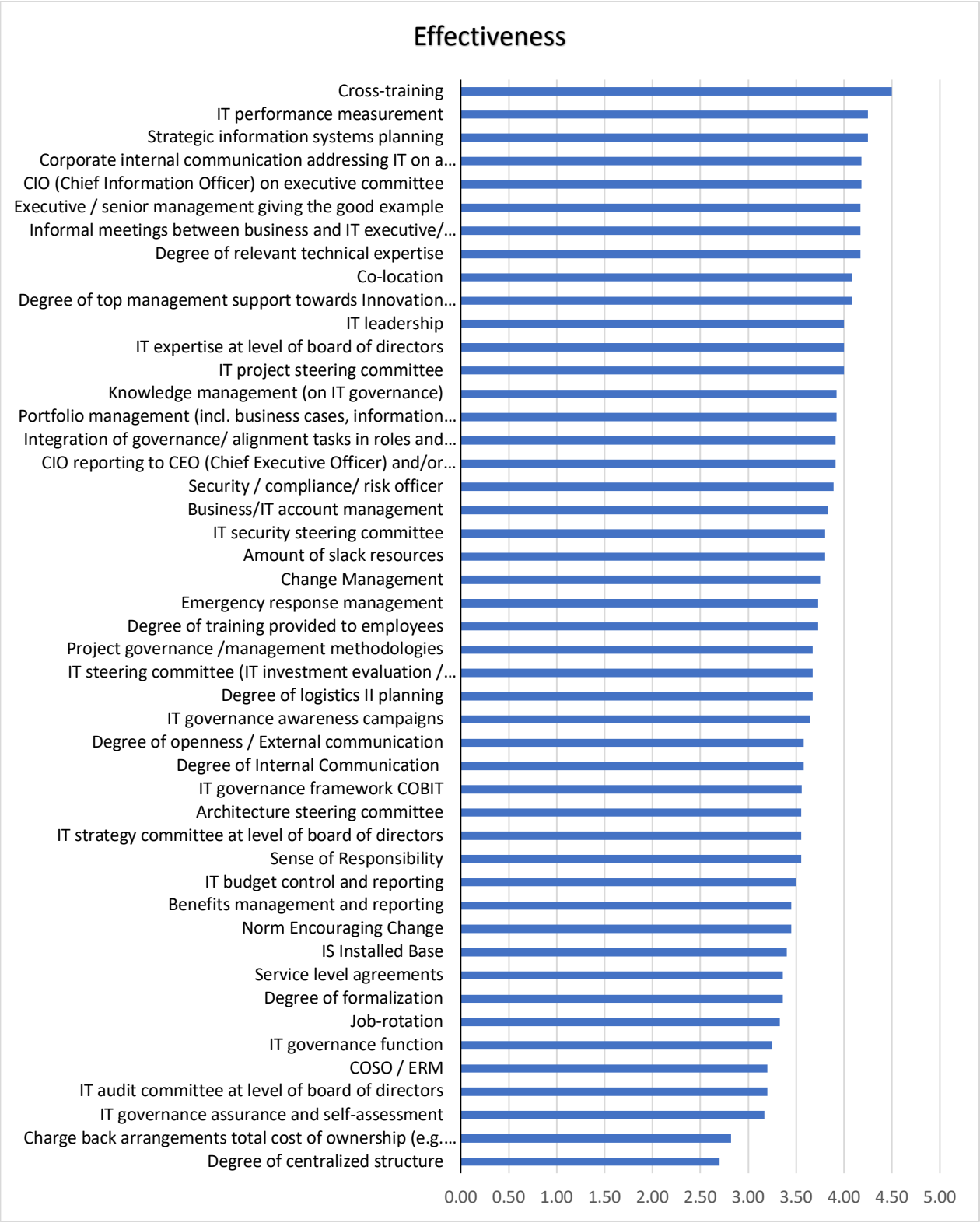

Figure 6: Perceived "effectiveness" of the IT governance and innovation management practices

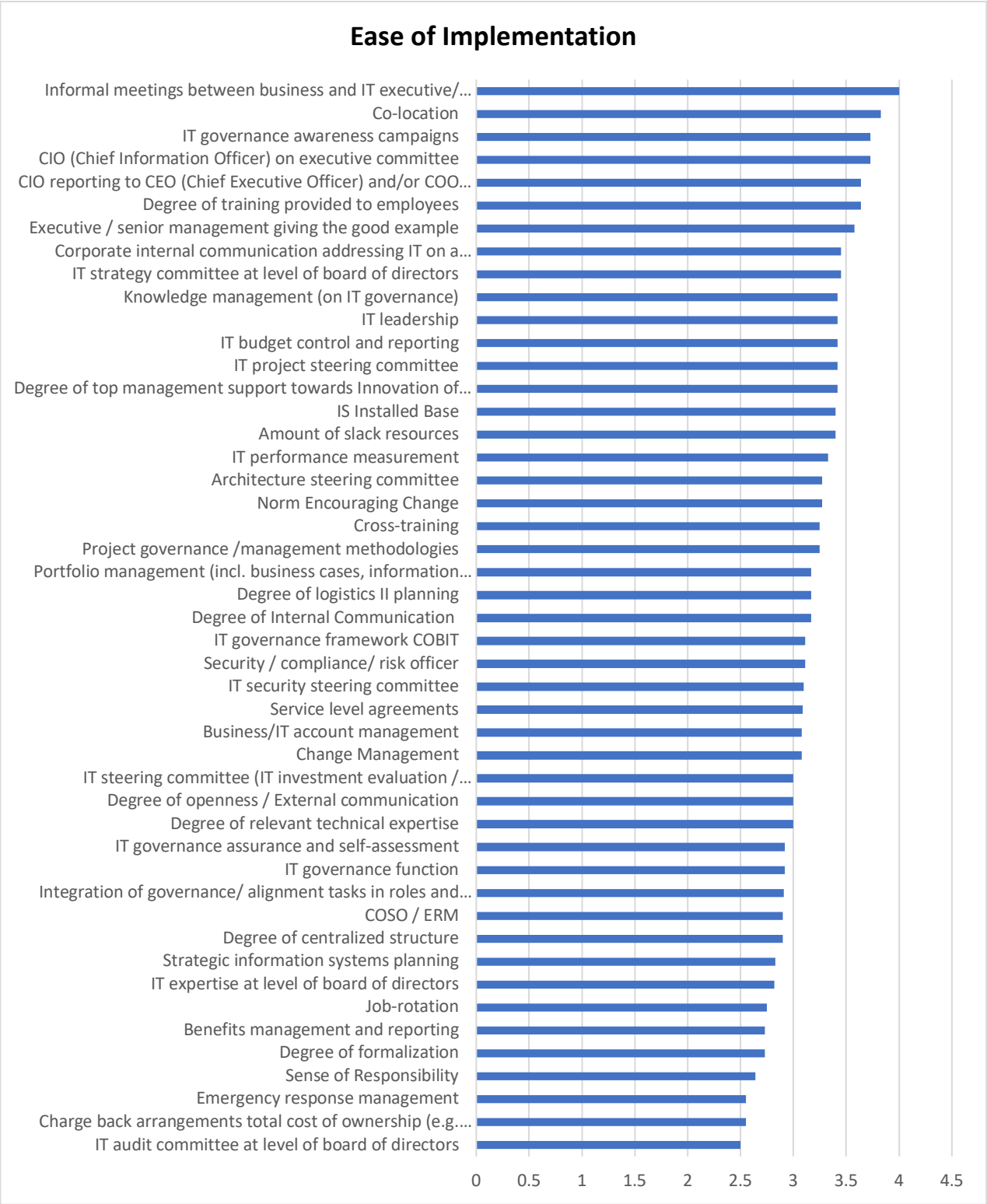

Figure 7: Perceived "ease of implementation" of the IT governance and innovation management practices

5.7 Minimum baseline of practices

This section is concerned with research question 4. The analysis revealed a list of thirteen practices, specifically for logistics IIs in the upstream offshore oil and gas industry that can be considered a minimum requirement of IT governance (structures, processes and relational mechanisms) and innovation management practices to foster innovation of logistics IIs.

This minimum baseline of practices considered the attributes of "effectiveness" and "ease of implementation". Figure 8 visualizes the minimum baseline of IT governance and innovation management practices; the vertical axe represent the effectiveness of each of the practices while the horizontal axe represent the ease of implementation of each of the practices. In general we are interested in the practices located in the top right quadrant as they are highly effective and are also easy to implement. When the standard to determine the mixture of IT governance (structures, processes, and relational mechanisms) and innovation management practices that compose this framework (i.e. practices with group means of a value greater than 3.9 for the perceived "effectiveness" and group means of a value greater than 3.0 for the perceived "ease of implementation") is applied, the practices within the green line are regarded as the minimum baseline of practices required to foster innovation of logistics IIs in the upstream offshore oil and gas sector. Table 20 indicate the thirteen practices that compose this framework.

For practical implications this framework should be complemented with other practices that the specific environment of the organization requires; thus, the practices that are within the dashed line should be first considered as additional practices as they are highly effective and easy to implement. Examples of these type of practices are: *Project governance /management methodologies; Change Management, Degree of training provided to employees, and IT governance framework COBIT.*

As it can be noted in Table 20, this framework is composed by 3 IT governance practices "structures", 2 IT governance practices "processes" and 8 practices (including both IT governance and Innovation management practices) related to "relational mechanisms". These results provide enough evidence to *reject Proposition 7* as this framework is composed by a greater number of practices (including both IT governance and innovation management practices) related to "relational mechanisms".

Table 20: Minimum baseline of IT governance and innovation management practices

	Practices	Group Averages	
		Effectiveness	**Ease of implementation**
R1	Cross-training	4.5	3.25
P2	IT performance measurement	4.25	3.33
R6	Corporate internal communication addressing IT on a regular basis	4.18	3.45
S1	CIO (Chief Information Officer) on executive committee	4.18	3.73
R2	Informal meetings between business and IT executive/ senior management	4.17	4
R5	Executive / senior management giving the good example	4.17	3.58
I1	Degree of top management support towards Innovation of Logistics II	4.08	3.42
R3	Co-location	4.08	3.83
R4	IT leadership	4	3.42
S4	IT project steering committee	4	3.42
R7	Knowledge management (on IT governance)	3.92	3.42
P3	Portfolio management (incl. business cases, information economics, Return on Investment, payback)	3.92	3.17
S2	CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	3.91	3.64

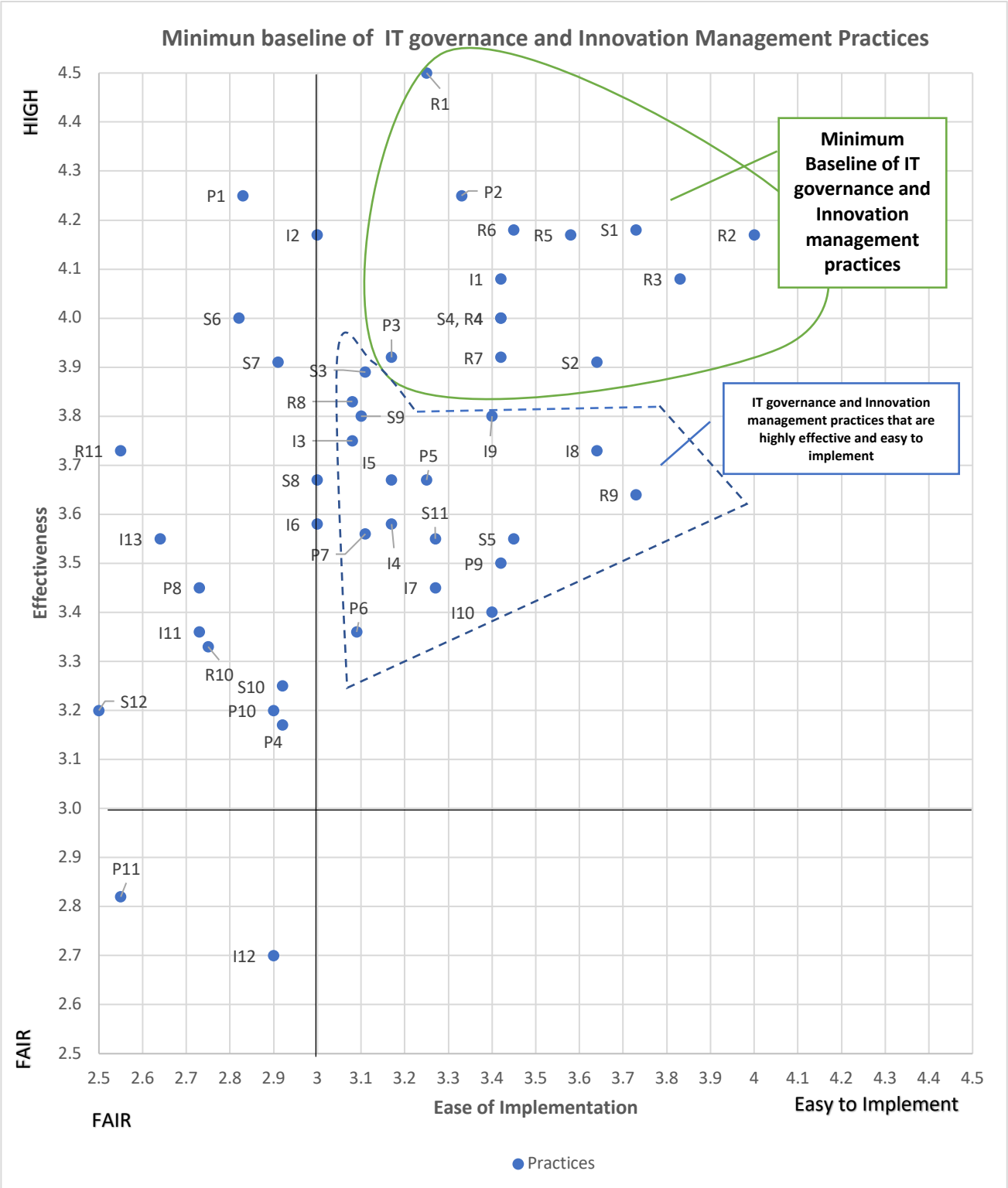

Figure 8:Minimum baseline of IT governance and innovation management practices plot

Innovation Practices		IT Governance Practices "Structure"	
I1	Degree of top management support towards Innovation of Logistics II	S1	CIO (Chief Information Officer) on executive committee
I2	Degree of relevant technical expertise	S2	CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)
I3	Change Management	S3	Security / compliance/ risk officer
I4	Degree of Internal Communication	S4	IT project steering committee
I5	Degree of logistics II planning	S5	IT strategy committee at level of board of directors
I6	Degree of openness / External communication	S6	IT expertise at level of board of directors
I7	Norm Encouraging Change	S7	Integration of governance/ alignment tasks in roles and responsibilities
I8	Degree of training provided to employees	S8	IT steering committee (IT investment evaluation / prioritization at executive / senior management level)
I9	Amount of slack resources	S9	IT security steering committee
I10	IS Installed Base	S10	IT governance function
I11	Degree of formalization	S11	Architecture steering committee
I12	Degree of centralized structure	S12	IT audit committee at level of board of directors
I13	Sense of Responsibility		
IT Governance Practices "Processes"		**IT Governance Practices "Relational Mechanisms"**	
P1	Strategic information systems planning	R1	Cross-training
P2	IT performance measurement	R2	Informal meetings between business and IT executive/ senior management
P3	Portfolio management (incl. business cases, information economics, Return on Investment, payback)	R3	Co-location
P4	IT governance assurance and self-assessment	R4	IT leadership
P5	Project governance /management methodologies	R5	Executive / senior management giving the good example
P6	Service level agreements	R6	Corporate internal communication addressing IT on a regular basis
P7	IT governance framework COBIT	R7	Knowledge management (on IT governance)
P8	Benefits management and reporting	R8	Business/IT account management
P9	IT budget control and reporting	R9	IT governance awareness campaigns
P10	COSO / ERM	R10	Job-rotation
P11	Charge back arrangements total cost of ownership (e.g. Activity based costing)	R11	Emergency response management

5.8 Summary

This chapter has described the results of the Delphi study. The results reveals 47 IT governance and innovation management practices that are perceived to influence the innovation of logistics IIs

in the upstream offshore Oil and Gas industry. The practices were perceived as important in terms of their "effectiveness" and "ease of implementation" (i.e., their group averages are equal to or greater than 2.5 for both factors); the results also revealed the positive *direction of influence* of 44 of these practices. These findings provided enough evidence to support Proposition 1 and 2, but to reject Proposition 3 and 4.

The examination of the practices in terms of their perceived "effectiveness" and "ease of implementation", were presented in two different perspectives 1) when the practices are classified in different sets and then analyzed, and 2) when all the practices are analyzed in a single set. The level of importance of each of the practices (i.e. the rankings) in terms of "effectiveness" and "ease of implementation" were presented for both perspectives. Furthermore, when all the sets were compared, the "relational mechanisms" were regarded as the most effective and easiest to implement of the sets followed by the "structures", then innovation management practices and then the "processes". When innovation management practices were classified into the IT governance domains; the "structures" were perceived as the easiest to implement followed by the "relational mechanisms" and then the "processes". This provided enough evidence to support Propositions 5 and 6.

The results also revealed a minimum baseline of thirteen IT governance and innovation management practices that can be applied in organizations to enable logistics IIs in the upstream offshore oil and gas industry. This framework resulted to be composed of 3 IT governance practices "structures", 2 IT governance practices "processes" and 8 practices (including both IT governance and Innovation management practices) related to "relational mechanisms". Thus, *Proposition 7 was not supported* as this model does not contain an equal number of practices (including both IT governance and innovation management practices) related to "structures" and

"processess". Likewise, Proposition 8 was not supported as this framework resulted in being composed of a greater number of practices (including both IT governance and innovation management practices) related to "relational mechanisms".

Figure 9 contains a summary of the propositions of this study, their relationship with the research questions and conclusions.

Figure 9: Summary of findings

Finally, the Kendall coefficient values revealed a strong level of confidence in the research results. The next chapter will discuss the conclusions, implications, and future research.

Chapter 6: Discussions, implications, limitations, future research, and conclusions

This chapter starts with a discussion of the main findings, this is followed by the theoretical and practical implications, limitations and future research. Finally, conclusions are made.

6.1 Discussions

Digital innovations represent an opportunity for more efficient logistics strategies in the oil and gas sector. Thus, it is essential to investigate the managerial practices that facilitate the integration of digital innovations into the existing IS and organizational practices (i.e. cultivation). This study has identified a list of managerial and governance practices that are perceived to impact the innovation of logistics IIs in the oil and gas industry.

There has been much examination of innovation management practices, and to a lesser extent IT governance factors, which influence IS innovation. However, there have not been any studies examining innovation with II, and it is important to do so because IS and II are different. Whereas IS have traditionally been conceived as stand-alone technology utilized within closed organizational limits (Hanseth & Monteiro, 1998), IIs' characteristics (i.e. enabling, shared, openness, heterogeneous, socio-technical, and installed base) make them different from traditional IS (Hanseth & Monteiro, 1998). This study identified IT governance and innovation practices which have been found to influence IS innovation and used a Delphi study to examine their influence on the innovation of II in the context of logistics in the oil and gas industry. IT governance is dependent to a variety of factors (e.g. size, industry, and geography) (De Haes and van Grembergen, 2006); and multiple factors shape the oil and gas sector. For example, this industry is characterized by the presence of global companies, high need for digital technologies

and advance analytics to conduct their activities, and their focuses on emergency response. Thus, it is critical to identify the appropriate mix of managerial practices that foster logistics IIs innovation in this sector, and more importantly, how those practices support and sustain the business strategies of oil and gas companies.

The study was organized according to four research questions. The first research question is concerned with the identification of IT governance and innovation management practices. The present research has revealed a total of 47 IT governance and innovation management practices. These practices are regarded as a strategy for cultivation. That is, these practices facilitate the incorporation of new technology into the existing legacy systems and organizational practices. Further, the positive *direction of influence* of 44 of these practices has been determined (P1 and P3). This is a meaningful finding because, to our best knowledge, no studies has combined the innovation management with IT governance practices and provided an integrative framework of practices that are perceived to influence the innovation of logistics IIs in the oil and gas industry.

Also, the study has contributed through identifying two practices that the experts in Delphi Study suggested impact the innovation of logistics IIs in the oil and gas industry, namely *Sense of responsibility* and *Emergency response management*. These practices are an important finding of this research since they had not been identified in previous research.

The second and third research questions address the levels of importance of the 47 IT governance and innovation management practices in terms of their "effectiveness" (P2 and P4) and "ease of implementation" (P5 and P6). For these pair of questions, this research conducted two different analyses. The first analysis divided and examined the practices into four distinctive sets (i.e., IT governance: 1) "structures", 2) "processes", 3) "relational mechanisms", and 4) innovation management practices). The second analysis examined the 47 practices as a single set.

That is, all the structures, the processes, the relational mechanisms, and the innovation management practices were examined together as an individual set. Both analyses demonstrated that certain practices are perceived as more effective and easier to implement than others. For example, some practices were perceived as highly effective and easy to implement; this is the case of the practice of including a CIO on the executive committee (IT governance "structures"). Other practices were perceived as effective but not very easy to implement; this is the case of the practice *"Strategic information systems planning"*. Furthermore, other practices were perceived as not very effective and not easy to implement; examples of that type of practices are *"Charge back arrangements total cost of ownership (e.g. Activity based costing)"* and *"IT audit committee at level of board of directors"*. These practices should be considered as less useful to facilitate innovation of logistics IIs in the upstream offshore oil and gas industry.

Interestingly, the two practices identified by the experts in this study, rather than from the literature - *Sense of responsibility* and *Emergency response management* – were perceived to be effective but not very easy to implement as they are located within the last five positions of the ranking for the perceived "ease of implementation".

This research also demonstrates that some sets of practices – structures vs. processes vs. relational mechanisms - are perceived as more effective and easier to implement than others (P5 and P6). IT governance "relational mechanisms" are perceived as the most effective and easiest to implement practices of all of the sets; followed by IT governance "structures", then innovation management practices, and finally IT governance "processes". However, when innovation management practices are incorporated into the domains of IT governance, this ranking changes and IT governance "structures" are perceived as the easiest to implement of the group, followed by the "relational mechanisms", and finally the "processes". These findings are consistent with the

study of De Haes & Van Grembergen, (2008) which found the “structures” are easier to implement than the “relational mechanisms” and the “processes”, and the “relational mechanisms” easier to implement than the “processes”.

The fourth research question proposed a minimum baseline of IT governance and innovation management practices that can be applied in practice to encourage innovation in organizations. This study has provided, specifically for logistics IIs in the oil and gas sector, thirteen IT governance and innovation management practices that constitute a minimum baseline of practices that can be applied in practice to enable innovation in organizations.

This framework of thirteen practices is composed of three IT governance “structures”, two IT governance “processes” and eight practices (including both IT governance and Innovation management practices) related to the “relational mechanisms”. This finding did not support Proposition 7 since, based on the findings of De Haes & Van Grembergen (2008), it was proposed that the “structures” and “processes” would be more “effective” than the “relational mechanisms”; and therefore this framework would be composed of more practices related to the “structures” and “processes” than practices related to the “relational mechanisms”. However, this finding is consistent with Keil, Tiwana, & Bush, (2002) who identified a list of factors related to the “relational mechanisms” that were found to be crucial to facilitate the introduction of IT applications in organizations. Furthermore, the authors posited that these “relational mechanisms” are key enablers of IT governance.

6.2 Implications

The implications are discussed from the theoretical and practical aspects, respectively.

6.2.1Theoretical implications

This research contributes to the literature by identifying an integrated framework of IT governance and management practices which enable the innovation of IIs. This is the very first time that the relationships between IT governance and innovation management practices, and cultivation of IIs have been examined in depth.

This study found that innovation management practices that previous research have found to influence IS innovation also are perceived to influence the innovation of logistics IIs in the oil and gas industry. This is a significant contribution since, to our best knowledge, no previous study has examined the impact of innovation determinants on logistics IIs in the upstream offshore oil and gas industry.

The IT governance practices (structures, processes, and relational mechanisms) that were examined in this study were perceived to influence the innovation of IIs in the upstream offshore Oil and Gas industry. This finding is consistent with the study of Heroux and Fortin (2016) which found a positive correlation between IT governance and innovation. This finding also is particularly relevant as there is limited research on the influence of IT governance on innovation.

Interestingly, the set of 33 IT governance practices for the Belgian Financial sector posited by De Haes and Van Grembergen (2008, 2009), were found to be relevant to the logistics IIs in the oil and gas sector. IT governance is contingent on multiple factors. One of these contingencies is the industry to which the organization belongs (De Haes and Van Grembergen, 2006). So, the IT governance strategy that works well for a firm does not necessarily work for another company. Thus, this research looks into particularly the oil and gas sector, and reveals how the IT governance practices can influence innovation in this sector.

To our best knowledge, no studies have presented an IT governance framework for logistics IIs in the oil and gas industry. Thus, although this research is focused on innovation, it also contributes by providing an understanding of the IT governance mechanisms that can be implemented with logistics II in the oil and gas industry.

The literature review conducted for the realization of this study revealed limited research in the field of logistics IIs. Thus, this study is important as it fills this gap in the literature of IIs by providing understanding of logistics IIs and its innovation process.

Furthermore, to our best knowledge, no study has investigated IT governance and innovation management practices as a strategy for "cultivation". Thus, this research also contributes to providing insight into the extent to which IT governance and innovation management practices facilitate the incorporation of new technology into the existing legacy systems and organizational practices.

6.2.2 *Practical implications*

Organizations must know which managerial practices can be applied to enable the incorporation of digital innovations into the existing IS and organizational practices. By combining innovation management and IT governance practices, this study has provided an integrative framework of 47 practices that provide guidance to design managerial practices that enable organizations to innovate their logistics IIs. Moreover, this research has posited a minimum baseline of practices that can be applied in practice to enable innovation in organizations. Such a baseline should be implemented in organizations in combination with other practices required by the specific environment of the organization.

The ideal IT governance framework for an organization depends upon multiple contingencies such as industry, size, and geography (De Haes and Van Grembergen, 2006). This

research focussed on logistics in the oil and gas sector and its findings are specifically for innovation of IIs in this domain. However, the oil and gas sector may have similarities with other industries. For example, other industries such as nuclear, health/medical and military may share a similar dependence upon IT to conduct their activities, a similar IT maturity, and a similar focus on emergency response. Therefore, the findings of this research may prove useful to other sectors and organizations interested in innovating digitally.

6.3 Limitations and future research

As discussed in Chapter 4 this study imposed cut-off points to determine the inclusion of practices in the study. Future studies may want to examine practices which fall outside of these cut-off points.

The directions of influences of the practices *Degree of centralization*, *Degree of formalization* and *Job rotation* were not determined in this study. The analysis revealed that *Degree of centralized structure* and *Job rotation* were considered to have a positive direction of influence by 50% of the experts and to have a negative direction of influence by the remaining 50% of the participants. Furthermore, the positive influence of the practice *Degree of formalization* was supported by 66.7% of the experts. Therefore, there is not enough evidence to establish a negative/positive *direction of influence* for these three practices. The inconclusive "direction of influence" of such practices motivates future research to investigate the role of these practices in IIs innovation.

The present analysis revealed that the practice "*Degree of centralized structure"* is regarded as effective. It is an unexpected finding as logistics IIs are charachterized by the existance of diverse stakeholders with different interest, resources and expectations; thus, it was expected that the control of logistics IIs would be dispersed. (Sanner, Manda, & Nielsen, 2014; Hanseth & Monteiro, 1998). Therefore, it was proposed that this practice would be an ineffective way of

encouraging innovation of logistics IIs in the oil and gas industry. One reason that explain this finding is that current industrial platforms with centralized control have been demonstrated to enable innovation (Eaton, 2016). Hence, this finding motivates future research on the managerial practices that permit centralized logistics IIs to enable innovation.

The present analysis revealed that the practice *"Degree of formalization"* is regarded as effective. It was proposed that this practice would be an ineffective way of encouraging innovation of logistics IIs in the oil and gas industry because "*formalization* increases complexity; accordingly less formalization means larger "*flexibility"(* (Hanseth & Monteiro, 1998, p. 155) and *"flexibility"* is essential to enable innovation of logistics IIs. One reason that may explain this finding is that formal standards are needed to successfully incorporate digital innovation into an II (Hanseth & Monteiro, 1998). Thus, this finding reveals that although "*standardization*" and "*flexibility"* are opposites (Hanseth & Monteiro, 1998), both are essential in the development of logistics IIs in the oil and gas industry. Therefore, this finding motivates future research on the relationship of *formalization/*standardization and flexibility in the innovation of logistics IIs in the oil and gas industry.

This framework of 47 practices is comprehensive as it involves two different domains (i.e., IT governance and innovation management). However other practices and factors may be relevant to this framework; thus, future research will be conducted to identify other practices and factors that may influence the logistics IIs in the upstream offshore Oil and Gas industry.

This research examined specifically the logistics IIs in the Oil and Gas industry. However, many of the findings of this research may be applicable to other sectors and domains.

6.4 Conclusions

This study bridges the gap among the IT governance, innovation management and IIs literature by integrating practices from IT governance and innovation management domains, and determining their influence on the innovation of IIs. As a result, this exploratory study has provided an integrative framework of 47 IT governance and innovation management practices that are perceived to impact the innovation of logistics IIs in the oil and gas industry. Such practices can be regarded as a strategy for cultivation as they facilitate the integration of digital innovation into the existing IS and practices. Considering the particular characteristics of IIs (i.e. enabling, shared, openness, heterogeneous, socio-technical, and installed base), the framework can be regarded as a powerful tool with practical implications by providing organizations with a group of practices to enable innovation of their IIs. While the results of this study are exploratory, this is a first step in providing insights into these practices, which lays a foundation for future research in this area.

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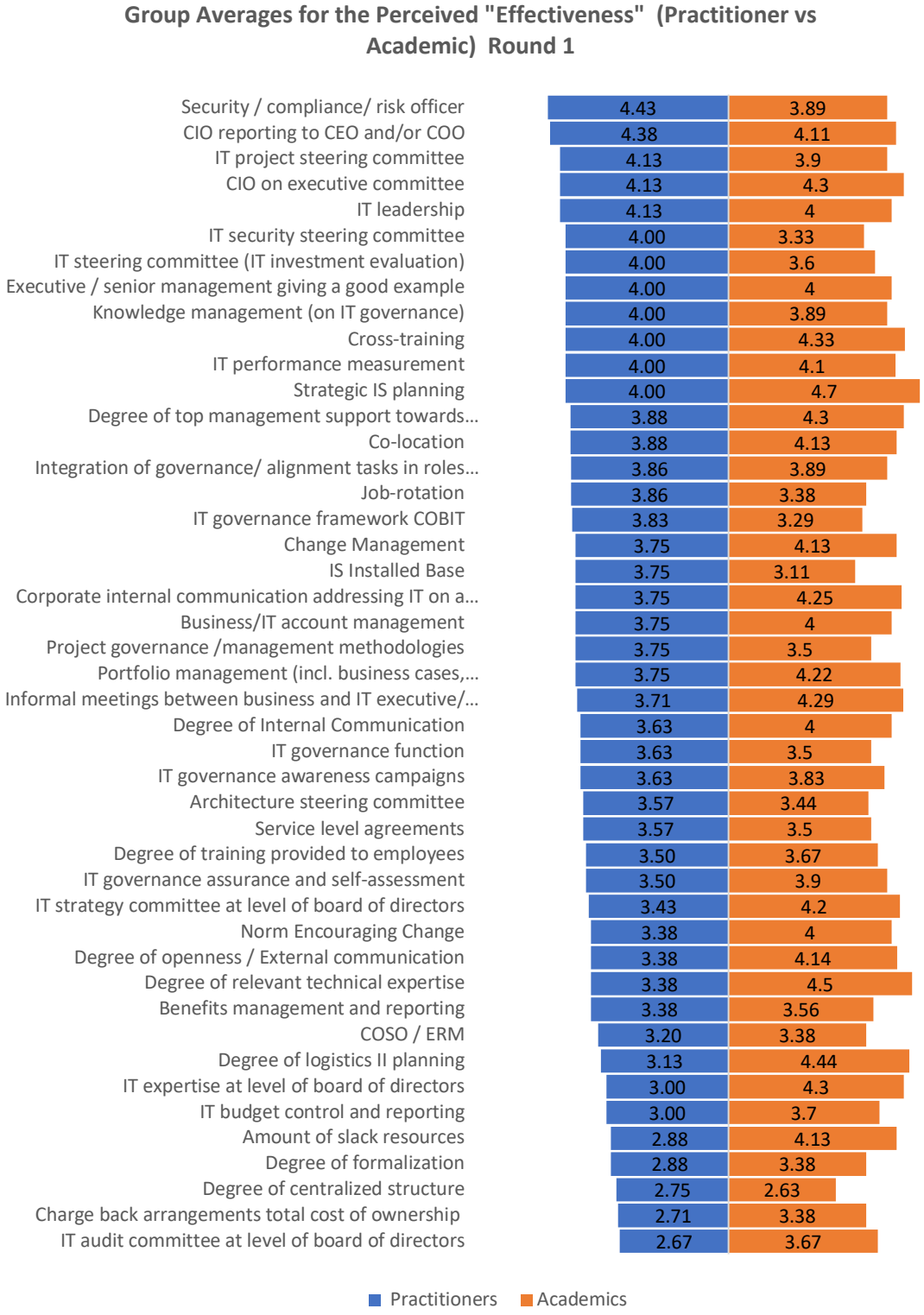
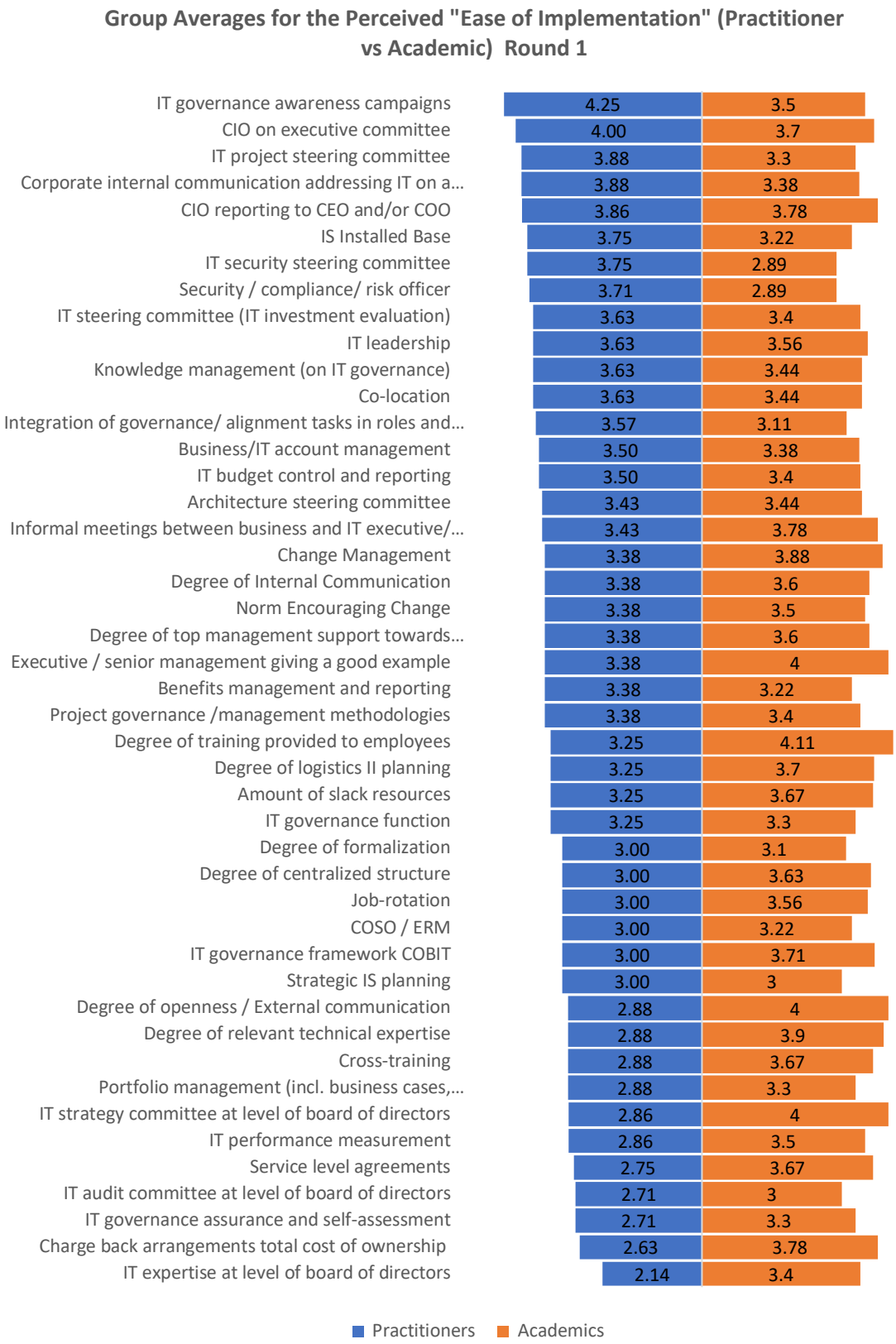
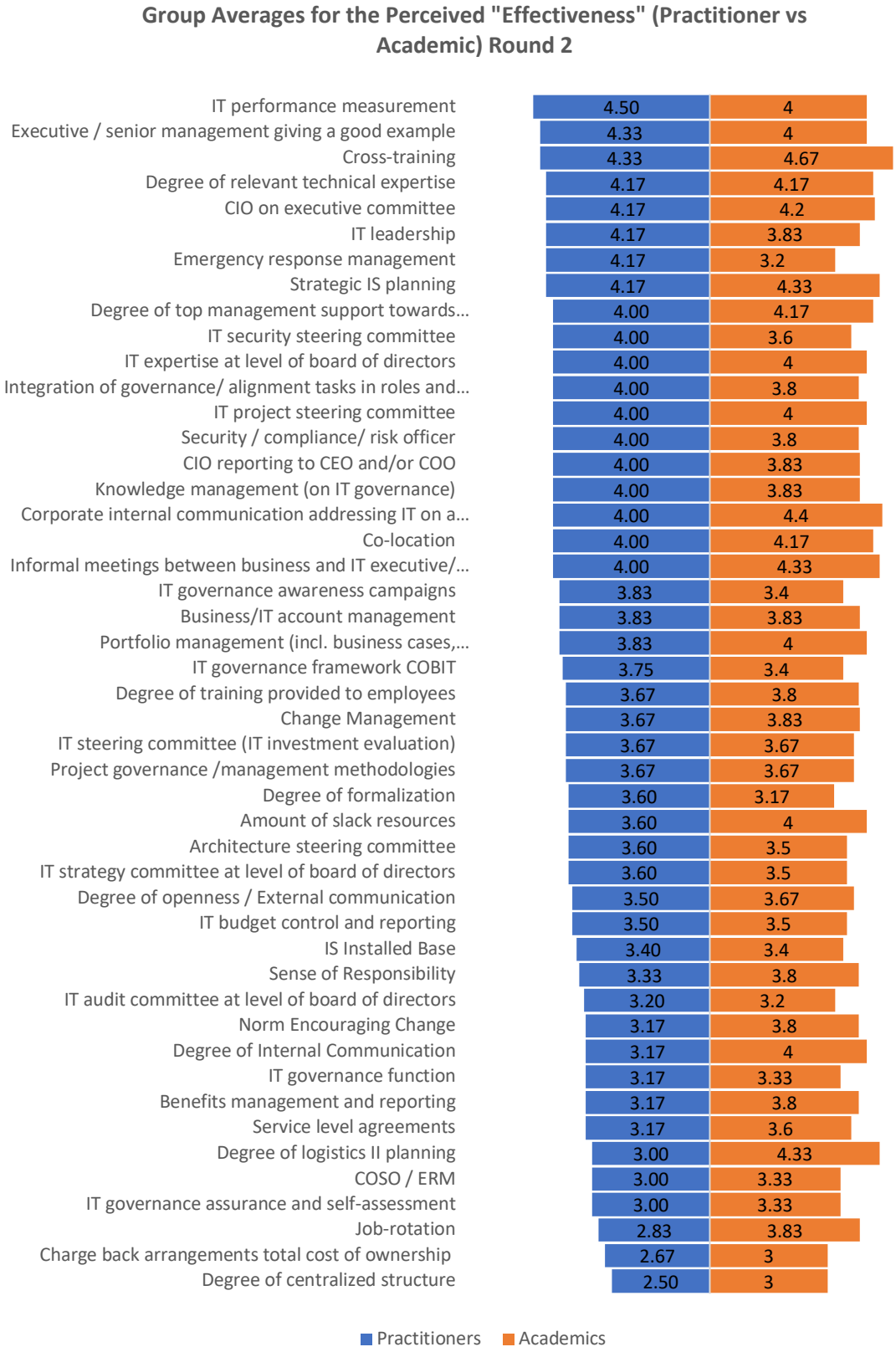
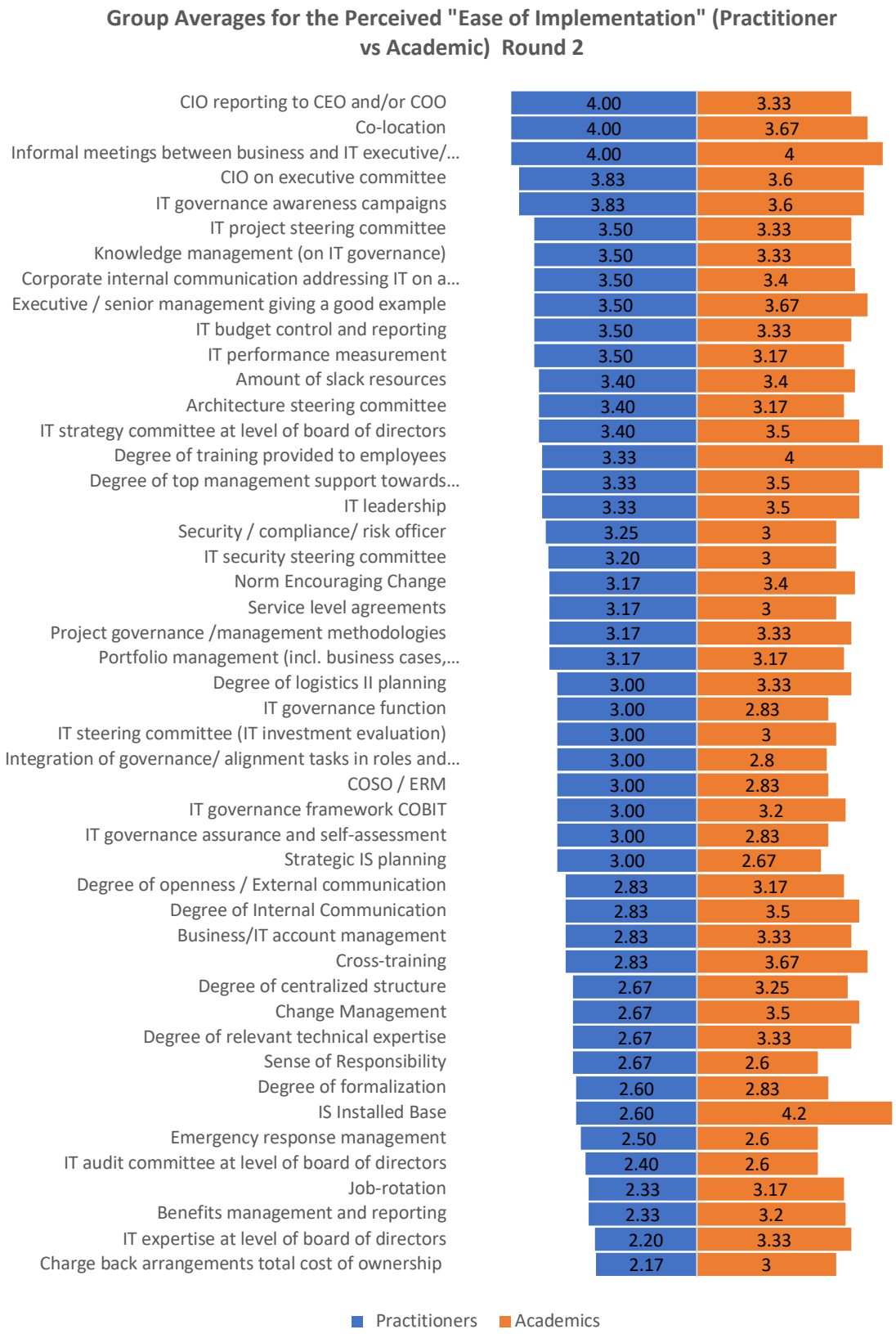
Appendix A: Sensitivity Analysis (practitioner vs academic)




Group Averages for the Perceived "Ease of Implementation" (Practitioner vs Academic) Round 1
IT governance awareness campaigns 4.25 3.5
CIO on executive committee 4.00 3.7
IT project steering committee 3.88 3.3
Corporate internal communication addressing IT on a... 3.88 3.38
CIO reporting to CEO and/or COO 3.86 3.78
IS Installed Base 3.75 3.22
IT security steering committee 3.75 2.89
Security / compliance/ risk officer 3.71 2.89
IT steering committee (IT investment evaluation) 3.63 3.4
IT leadership 3.63 3.56
Knowledge management (on IT governance) 3.63 3.44
Co-location 3.63 3.44
Integration of governance/ alignment tasks in roles and... 3.57 3.11
Business/IT account management 3.50 3.38
IT budget control and reporting 3.50 3.4
Architecture steering committee 3.43 3.44
Informal meetings between business and IT executive/... 3.43 3.78
Change Management 3.38 3.88
Degree of Internal Communication 3.38 3.6
Norm Encouraging Change 3.38 3.5
Degree of top management support towards... 3.38 3.6
Executive / senior management giving a good example 3.38 4
Benefits management and reporting 3.38 3.22
Project governance /management methodologies 3.38 3.4
Degree of training provided to employees 3.25 4.11
Degree of logistics II planning 3.25 3.7
Amount of slack resources 3.25 3.67
IT governance function 3.25 3.3
Degree of formalization 3.00 3.1
Degree of centralized structure 3.00 3.63
Job-rotation 3.00 3.56
COSO / ERM 3.00 3.22
IT governance framework COBIT 3.00 3.71
Strategic IS planning 3.00 3
Degree of openness / External communication 2.88 4
Degree of relevant technical expertise 2.88 3.9
Cross-training 2.88 3.67
Portfolio management (incl. business cases,... 2.88 3.3
IT strategy committee at level of board of directors 2.86 4
IT performance measurement 2.86 3.5
Service level agreements 2.75 3.67
IT audit committee at level of board of directors 2.71 3
IT governance assurance and self-assessment 2.71 3.3
Charge back arrangements total cost of ownership 2.63 3.78
IT expertise at level of board of directors 2.14 3.4
Practitioners
Academics


Group Averages for the Perceived "Effectiveness" (Practitioner vs Academic) Round 2
IT performance measurement 4.50 4
Executive / senior management giving a good example 4.33 4
Cross-training 4.33 4.67
Degree of relevant technical expertise 4.17 4.17
CIO on executive committee 4.17 4.2
IT leadership 4.17 3.83
Emergency response management 4.17 3.2
Strategic IS planning 4.17 4.33
Degree of top management support towards... 4.00 4.17
IT security steering committee 4.00 3.6
IT expertise at level of board of directors 4.00 4
Integration of governance/ alignment tasks in roles and... 4.00 3.8
IT project steering committee 4.00 4
Security / compliance/ risk officer 4.00 3.8
CIO reporting to CEO and/or COO 4.00 3.83
Knowledge management (on IT governance) 4.00 3.83
Corporate internal communication addressing IT on a... 4.00 4.4
Co-location 4.00 4.17
Informal meetings between business and IT executive/... 4.00 4.33
IT governance awareness campaigns 3.83 3.4
Business/IT account management 3.83 3.83
Portfolio management (incl. business cases,... 3.83 4
IT governance framework COBIT 3.75 3.4
Degree of training provided to employees 3.67 3.8
Change Management 3.67 3.83
IT steering committee (IT investment evaluation) 3.67 3.67
Project governance /management methodologies 3.67 3.67
Degree of formalization 3.60 3.17
Amount of slack resources 3.60 4
Architecture steering committee 3.60 3.5
IT strategy committee at level of board of directors 3.60 3.5
Degree of openness / External communication 3.50 3.67
IT budget control and reporting 3.50 3.5
IS Installed Base 3.40 3.4
Sense of Responsibility 3.33 3.8
IT audit committee at level of board of directors 3.20 3.2
Norm Encouraging Change 3.17 3.8
Degree of Internal Communication 3.17 4
IT governance function 3.17 3.33
Benefits management and reporting 3.17 3.8
Service level agreements 3.17 3.6
Degree of logistics II planning 3.00 4.33
COSO / ERM 3.00 3.33
IT governance assurance and self-assessment 3.00 3.33
Job-rotation 2.83 3.83
Charge back arrangements total cost of ownership 2.67 3
Degree of centralized structure 2.50 3
Practitioners
Academics


Group Averages for the Perceived "Ease of Implementation" (Practitioner vs Academic) Round 2
CIO reporting to CEO and/or COO 4.00 3.33
Co-location 4.00 3.67
Informal meetings between business and IT executive/... 4.00 4
CIO on executive committee 3.83 3.6
IT governance awareness campaigns 3.83 3.6
IT project steering committee 3.50 3.33
Knowledge management (on IT governance) 3.50 3.33
Corporate internal communication addressing IT on a... 3.50 3.4
Executive / senior management giving a good example 3.50 3.67
IT budget control and reporting 3.50 3.33
IT performance measurement 3.50 3.17
Amount of slack resources 3.40 3.4
Architecture steering committee 3.40 3.17
IT strategy committee at level of board of directors 3.40 3.5
Degree of training provided to employees 3.33 4
Degree of top management support towards... 3.33 3.5
IT leadership 3.33 3.5
Security / compliance/ risk officer 3.25 3
IT security steering committee 3.20 3
Norm Encouraging Change 3.17 3.4
Service level agreements 3.17 3
Project governance /management methodologies 3.17 3.33
Portfolio management (incl. business cases,... 3.17 3.17
Degree of logistics II planning 3.00 3.33
IT governance function 3.00 2.83
IT steering committee (IT investment evaluation) 3.00 3
Integration of governance/ alignment tasks in roles and... 3.00 2.8
COSO / ERM 3.00 2.83
IT governance framework COBIT 3.00 3.2
IT governance assurance and self-assessment 3.00 2.83
Strategic IS planning 3.00 2.67
Degree of openness / External communication 2.83 3.17
Degree of Internal Communication 2.83 3.5
Business/IT account management 2.83 3.33
Cross-training 2.83 3.67
Degree of centralized structure 2.67 3.25
Change Management 2.67 3.5
Degree of relevant technical expertise 2.67 3.33
Sense of Responsibility 2.67 2.6
Degree of formalization 2.60 2.83
IS Installed Base 2.60 4.2
Emergency response management 2.50 2.6
IT audit committee at level of board of directors 2.40 2.6
Job-rotation 2.33 3.17
Benefits management and reporting 2.33 3.2
IT expertise at level of board of directors 2.20 3.33
Charge back arrangements total cost of ownership 2.17 3
Practitioners
Academics

Appendix B: Direction of influence (response frequency (%)) of IT governance and innovation management practices

Direction of influence of IT governance practices "structures"

Direction of Influence				
IT Governance Practices "Structure"	**Round 2**		**Round 1**	
	Positive	**Negative**	**Positive**	**Negative**
CIO (Chief Information Officer) on executive committee	100.0%	0.0%	100.0%	0.0%
CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	100.0%	0.0%	100.0%	0.0%
IT strategy committee at level of board of directors	100.0%	0.0%	87.5%	12.5%
IT expertise at level of board of directors	100.0%	0.0%	93.3%	6.7%
Integration of governance/ alignment tasks in roles and responsibilities	100.0%	0.0%	92.9%	7.1%
IT security steering committee	100.0%	0.0%	92.3%	7.7%
IT governance function	100.0%	0.0%	93.8%	6.3%
IT audit committee at level of board of directors	100.0%	0.0%	81.8%	18.2%
IT project steering committee	91.7%	8.3%	93.3%	6.7%
IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	91.7%	8.3%	93.3%	6.7%
Architecture steering committee	90.9%	9.1%	86.7%	13.3%
Security / compliance/ risk officer	88.9%	11.1%	93.3%	6.7%

Direction of influence of IT governance practices "processes"

Direction of Influence				
IT Governance Practices "Processes"	**Round 2**		**Round 1**	
	Positive	**Negative**	**Positive**	**Negative**
Strategic information systems planning	100.0%	0.0%	93.8%	6.3%
IT performance measurement	100.0%	0.0%	100.0%	0.0%
Portfolio management (incl. business cases, information economics, Return on Investment, payback)	100.0%	0.0%	100.0%	0.0%
Project governance /management methodologies	100.0%	0.0%	93.8%	6.3%
COSO / ERM	100.0%	0.0%	84.6%	15.4%
IT governance assurance and self-assessment	91.7%	8.3%	93.3%	6.7%
IT budget control and reporting	91.7%	8.3%	81.3%	18.8%
Service level agreements	90.9%	9.1%	85.7%	14.3%
IT governance framework COBIT	88.9%	11.1%	90.9%	9.1%
Benefits management and reporting	81.8%	18.2%	87.5%	12.5%
Charge back arrangements total cost of ownership (e.g. Activity based costing)	72.7%	27.3%	75.0%	25.0%

Direction of influence of IT governance practices "relational mechanisms"

Direction of Influence				
IT Governance Practices "Relational Mechanisms"	**Round 2**		**Round 1**	
	Positive	**Negative**	**Positive**	**Negative**
Informal meetings between business and IT executive/ senior management	100.0%	0.0%	100.00%	0.00%
Co-location	100.0%	0.0%	92.30%	7.70%
IT leadership	100.0%	0.0%	94.10%	5.90%
Executive / senior management giving the good example	100.0%	0.0%	100.00%	0.00%
Corporate internal communication addressing IT on a regular basis	100.0%	0.0%	100.00%	0.00%
Knowledge management (on IT governance)	100.0%	0.0%	100.00%	0.00%
Business/IT account management	100.0%	0.0%	100.00%	0.00%
IT governance awareness campaigns	100.0%	0.0%	100.00%	0.00%
Cross-training	91.7%	8.3%	86.70%	13.30%
Emergency response management	91.7%	8.3%	–	–
Job-rotation	**50.0%**	**50.0%**	66.70%	33.30%

Direction of influence of innovation management practices

Direction of Influence				
Innovation Practices	**Round 2**		**Round 1**	
	Positive	**Negative**	**Positive**	**Negative**
Degree of top management support towards Innovation of Logistics II	100.0%	0.0%	94.1%	5.9%
Degree of openness / External communication	100.0%	0.0%	78.6%	21.4%
Sense of Responsibility	100.0%	0.0%		
Degree of relevant technical expertise	91.7%	8.3%	81.3%	18.8%
Change Management	91.7%	8.3%	85.7%	14.3%
Degree of logistics II planning	91.7%	8.3%	81.3%	18.8%
Degree of training provided to employees	90.9%	9.1%	64.7%	35.3%
Norm Encouraging Change	90.0%	10.0%	73.3%	26.7%
Amount of slack resources	81.8%	18.2%	60.0%	40.0%
Degree of Internal Communication	75.0%	25.0%	87.5%	12.5%
IS Installed Base	72.7%	27.3%	64.3%	35.7%
Degree of formalization	66.7%	33.3%	63.6%	36.4%
Degree of centralized structure	50.0%	50.0%	61.5%	38.5%

Appendix C: Data Analysis (Response Frequency and Descriptive Statistics of Innovation Management and IT Governance Practices)

Response frequency (%) of innovation management practices for the perceived "effectiveness" (round 1)

Response Frequency (%): Innovation Management Practices "Effectiveness"						
Ranking	**Innovation Practices**	**1 = Not Effective**	**2**	**3**	**4**	**5= Very Effective**
1	Degree of top management support towards Innovation of Logistics II	0.0%	5.9%	17.7%	29.4%	47.1%
2	Degree of relevant technical expertise	0.0%	11.8%	5.9%	41.2%	41.2%
3	Change Management	0.0%	0.0%	20.0%	53.3%	26.7%
4	Degree of internal communication	0.0%	0.0%	31.3%	43.8%	25.0%
5	Degree of logistics II planning	0.0%	12.5%	18.8%	37.5%	31.3%
6	Degree of openness / External communication	0.0%	14.3%	14.3%	50.0%	21.4%
7	Norm Encouraging Change	0.0%	0.0%	37.5%	50.0%	12.5%
8	Degree of training provided to employees	6.3%	0.0%	37.5%	31.3%	25.0%
9	Amount of slack resources	0.0%	20.0%	26.7%	33.3%	20.0%
10	IS Installed Base	6.3%	18.8%	12.5%	43.8%	18.8%
11	Degree of formalization	0.0%	26.7%	33.3%	33.3%	6.7%
12	Degree of centralized structure	13.3%	33.3%	26.7%	20.0%	6.7%

Descriptive statistics of innovation management practices for the perceived "effectiveness" (round 1)

Innovation Management Practices "Effectiveness"						
Ranking	**Innovation Practices**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	Degree of top management support towards Innovation of Logistics II	2	5	**4.18**	0.92	0.85
2	Degree of relevant technical expertise	2	5	**4.12**	0.96	0.93
3	Change Management	3	5	**4.07**	0.68	0.46
4	Degree of internal communication	3	5	**3.94**	0.75	0.56
5	Degree of logistics II planning	2	5	**3.88**	0.99	0.98
6	Degree of openness / External communication	2	5	**3.79**	0.94	0.88
7	Norm Encouraging Change	3	5	**3.75**	0.66	0.44
8	Degree of training provided to employees	1	5	**3.69**	1.04	1.09
9	Amount of slack resources	2	5	**3.53**	1.02	1.05
10	IS Installed Base	1	5	**3.50**	1.17	1.38
11	Degree of formalization	2	5	**3.20**	0.91	0.83
12	Degree of centralized structure	1	5	**2.73**	1.12	1.26

Response frequency (%) of innovation management practices for the perceived "ease of implementation" (round 1)

Response Frequency (%) : Innovation Management Practices "Ease of Implementation"						
Ranking	**Innovation Practices**	**1 = Not Easy**	**2**	**3**	**4**	**5 = Very Easy**
1	Degree of training provided to employees	0.0%	12.5%	18.8%	43.8%	25.0%
2	Change Management	0.0%	6.7%	33.3%	40.0%	20.0%
3	Degree of internal communication	5.9%	11.8%	23.5%	35.3%	23.5%
4	Amount of slack resources	0.0%	18.8%	31.3%	25.0%	25.0%
5	Degree of openness / External communication	6.3%	12.5%	18.8%	43.8%	18.8%
6	IS Installed Base	6.3%	18.8%	6.3%	50.0%	18.8%
7	Degree of top management support towards Innovation of Logistics II	0.0%	35.3%	5.9%	29.4%	29.4%
8	Degree of relevant technical expertise	5.9%	17.7%	23.5%	23.5%	29.4%
9	Degree of logistics II planning	5.9%	0.0%	47.1%	29.4%	17.7%
10	Norm Encouraging Change	0.0%	6.7%	60.0%	13.3%	20.0%
11	Degree of centralized structure	0.0%	20.0%	33.3%	33.3%	13.3%
12	Degree of formalization	5.9%	23.5%	41.2%	11.8%	17.7%

Descriptive statistics of innovation management practices for the perceived "ease of implementation" (round 1)

Innovation Management Practices "Ease of Implementation"						
Ranking	**Innovation Practices**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	Degree of training provided to employees	2	5	**3.81**	0.95	0.9
2	Change Management	2	5	**3.73**	0.85	0.73
3	Degree of internal communication	1	5	**3.59**	1.14	1.3
4	Amount of slack resources	2	5	**3.56**	1.06	1.12
5	Degree of openness / External communication	1	5	**3.56**	1.12	1.25
6	IS Installed Base	1	5	**3.56**	1.17	1.37
7	Degree of top management support towards Innovation of Logistics II	2	5	**3.53**	1.24	1.54
8	Degree of relevant technical expertise	1	5	**3.53**	1.24	1.54
9	Degree of logistics II planning	1	5	**3.53**	0.98	0.96
10	Norm Encouraging Change	2	5	**3.47**	0.88	0.78
11	Degree of centralized structure	2	5	**3.4**	0.95	0.91
12	Degree of formalization	1	5	**3.12**	1.13	1.28

Response frequency (%) of IT governance practices "structures" for the perceived "effectiveness" (round 1)

Response Frequency (%): IT governance Practices (Structures) "Effectiveness"						
Ranking	**IT Governance Practices "Structure"**	**1 = Not Effective**	**2**	**3**	**4**	**5 = Very Effective**
1	CIO (Chief Information Officer) on executive committee	0.0%	0.0%	5.9%	64.7%	29.4%
2	CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	0.0%	6.3%	12.5%	37.5%	43.8%
3	Security / compliance/ risk officer	0.0%	6.3%	18.8%	31.3%	43.8%
4	IT project steering committee	5.9%	0.0%	11.8%	52.9%	29.4%
5	IT strategy committee at level of board of directors	6.3%	12.5%	12.5%	25.0%	43.8%
6	IT expertise at level of board of directors	0.0%	13.3%	20.0%	33.3%	33.3%
7	Integration of governance/ alignment tasks in roles and responsibilities	6.7%	0.0%	13.3%	60.0%	20.0%
8	IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	0.0%	5.9%	29.4%	47.1%	17.7%
9	IT security steering committee	0.0%	18.8%	12.5%	56.3%	12.5%
10	IT governance function	5.9%	11.8%	29.4%	29.4%	23.5%
11	Architecture steering committee	6.7%	6.7%	33.3%	40.0%	13.3%
12	IT audit committee at level of board of directors	7.1%	14.3%	42.9%	14.3%	21.4%

Descriptive statistics of IT governance practices "structures" for the perceived "effectiveness" (round 1)

ITG Practices Structure "Effectiveness"						
Ranking	**IT Governance Practices "Structure"**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	CIO (Chief Information Officer) on executive committee	3	5	**4.24**	0.55	0.3
2	CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	2	5	**4.19**	0.88	0.78
3	Security / compliance/ risk officer	2	5	**4.13**	0.93	0.86
4	IT project steering committee	1	5	**4**	0.97	0.94
5	IT strategy committee at level of board of directors	1	5	**3.88**	1.27	1.61
6	IT expertise at level of board of directors	2	5	**3.87**	1.02	1.05
7	Integration of governance/ alignment tasks in roles and responsibilities	1	5	**3.87**	0.96	0.92
8	IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	2	5	**3.76**	0.81	0.65
9	IT security steering committee	2	5	**3.63**	0.93	0.86
10	IT governance function	1	5	**3.53**	1.14	1.31
11	Architecture steering committee	1	5	**3.47**	1.02	1.05
12	IT audit committee at level of board of directors	1	5	**3.29**	1.16	1.35

Response frequency (%) of IT governance practices "structures" for the perceived "ease of implementation" (round 1)

Response Frequency (%): IT governance Practices (Structures) "Ease of implementation"						
Ranking	**IT Governance Practices "Structure"**	**1 = Not easy**	**2**	**3**	**4**	**5 = Very easy**
1	CIO (Chief Information Officer) on executive committee	6.3%	0.0%	18.8%	56.3%	18.8%
2	CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	0.0%	6.7%	20.0%	60.0%	13.3%
3	IT strategy committee at level of board of directors	6.3%	12.5%	25.0%	31.3%	25.0%
4	IT project steering committee	0.0%	5.9%	47.1%	35.3%	11.8%
5	IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	0.0%	5.9%	47.1%	41.2%	5.9%
6	Architecture steering committee	0.0%	6.7%	53.3%	33.3%	6.7%
7	Integration of governance/ alignment tasks in roles and responsibilities	0.0%	20.0%	40.0%	33.3%	6.7%
8	Security / compliance/ risk officer	12.5%	6.3%	37.5%	31.3%	12.5%
9	IT security steering committee	6.3%	12.5%	43.8%	25.0%	12.5%
10	IT governance function	0.0%	17.7%	52.9%	17.7%	11.8%
11	IT expertise at level of board of directors	18.8%	18.8%	31.3%	18.8%	12.5%
12	IT audit committee at level of board of directors	13.3%	26.7%	26.7%	26.7%	6.7%

Descriptive statistics of IT governance practices "structures" for the perceived "ease of implementation" (round 1)

ITG Practices (Structures) "Ease of Implementation"						
Ranking	**IT Governance Practices "Structure"**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	CIO (Chief Information Officer) on executive committee	1	5	**3.81**	0.95	0.9
2	CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	2	5	**3.8**	0.75	0.56
3	IT strategy committee at level of board of directors	1	5	**3.56**	1.17	1.37
4	IT project steering committee	2	5	**3.53**	0.78	0.6
5	IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	2	5	**3.47**	0.7	0.48
6	Architecture steering committee	2	5	**3.4**	0.71	0.51
7	Integration of governance/ alignment tasks in roles and responsibilities	2	5	**3.27**	0.85	0.73
8	Security / compliance/ risk officer	1	5	**3.25**	1.15	1.31
9	IT security steering committee	1	5	**3.25**	1.03	1.06
10	IT governance function	2	5	**3.24**	0.88	0.77
11	IT expertise at level of board of directors	1	5	**2.88**	1.27	1.61
12	IT audit committee at level of board of directors	1	5	**2.87**	1.15	1.32

Response frequency (%) of IT governance practices "processes" for the perceived "effectiveness" (round 1)

Response Frequency (%): IT governance Practices (Processes) "Effectiveness"						
Ranking	**IT Governance Practices "Processes"**	**1 = Not Effective**	**2**	**3**	**4**	**5 = Very Effective**
1	Strategic information systems planning	0.0%	0.0%	12.5%	31.3%	56.3%
2	IT performance measurement	0.0%	6.3%	18.8%	37.5%	37.5%
3	Portfolio management (incl. business cases, information economics, Return on Investment, payback)	0.0%	6.3%	25.0%	31.3%	37.5%
4	IT governance assurance and self-assessment	0.0%	0.0%	41.2%	41.2%	17.7%
5	Project governance /management methodologies	0.0%	17.7%	17.7%	52.9%	11.8%
6	Service level agreements	7.1%	7.1%	28.6%	42.9%	14.3%
7	IT governance framework COBIT	8.3%	0.0%	41.7%	33.3%	16.7%
8	Benefits management and reporting	6.3%	6.3%	25.0%	56.3%	6.3%
9	IT budget control and reporting	5.9%	11.8%	23.5%	47.1%	11.8%
10	COSO / ERM	7.7%	7.7%	38.5%	38.5%	7.7%
11	Charge back arrangements total cost of ownership (e.g. Activity based costing)	0.0%	26.7%	46.7%	20.0%	6.7%

Descriptive statistics of IT governance practices "processes" for the perceived "effectiveness" (round 1)

ITG Practices (Processes) "Effectiveness"						
Ranking	**IT Governance Practices "Processes"**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	Strategic information systems planning	3	5	**4.44**	0.7	0.5
2	IT performance measurement	2	5	**4.06**	0.9	0.81
3	Portfolio management (incl. business cases, information economics, Return on Investment, payback)	2	5	**4**	0.94	0.88
4	IT governance assurance and self-assessment	3	5	**3.76**	0.73	0.53
5	Project governance /management methodologies	2	5	**3.59**	0.91	0.83
6	Service level agreements	1	5	**3.5**	1.05	1.11
7	IT governance framework COBIT	1	5	**3.5**	1.04	1.08
8	Benefits management and reporting	1	5	**3.5**	0.94	0.87
9	IT budget control and reporting	1	5	**3.47**	1.04	1.07
10	COSO / ERM	1	5	**3.31**	0.99	0.98
11	Charge back arrangements total cost of ownership (e.g. Activity based costing)	2	5	**3.07**	0.85	0.73

Response frequency (%) of IT governance practices "processes" for the perceived "ease of implementation" (round 1)

Response Frequency (%): IT governance Practices (Processes) "Ease of implementation"						
Ranking	**IT Governance Practices "Processes"**	**1 = Not easy**	**2**	**3**	**4**	**5 = Very easy**
1	IT budget control and reporting	5.9%	5.9%	29.4%	52.9%	5.9%
2	IT governance framework COBIT	0.0%	16.7%	41.7%	25.0%	16.7%
3	Project governance /management methodologies	0.0%	11.8%	41.2%	41.2%	5.9%
4	Charge back arrangements total cost of ownership (e.g. Activity based costing)	6.3%	12.5%	37.5%	31.3%	12.5%
5	Benefits management and reporting	6.3%	6.3%	43.8%	37.5%	6.3%
6	Service level agreements	0.0%	18.8%	43.8%	31.3%	6.3%
7	IT performance measurement	12.5%	25.0%	12.5%	31.3%	18.8%
8	COSO / ERM	7.1%	7.1%	57.1%	21.4%	7.1%
9	Portfolio management (incl. business cases, information economics, Return on Investment, payback)	11.8%	23.5%	17.7%	41.2%	5.9%
10	IT governance assurance and self-assessment	0.0%	18.8%	56.3%	25.0%	0.0%
11	Strategic information systems planning	12.5%	18.8%	43.8%	12.5%	12.5%

Descriptive statistics of IT governance practices "processes" for the perceived "ease of implementation" (round 1)

ITG Practices Processes "Ease of Implementation"						
Ranking	**IT Governance Practices "Processes"**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	IT budget control and reporting	1	5	**3.47**	0.92	0.84
2	IT governance framework COBIT	2	5	**3.42**	0.95	0.91
3	Project governance /management methodologies	2	5	**3.41**	0.77	0.6
4	Charge back arrangements total cost of ownership (e.g. Activity based costing)	1	5	**3.31**	1.04	1.09
5	Benefits management and reporting	1	5	**3.31**	0.92	0.84
6	Service level agreements	2	5	**3.25**	0.83	0.69
7	IT performance measurement	1	5	**3.19**	1.33	1.78
8	COSO / ERM	1	5	**3.14**	0.91	0.84
9	Portfolio management (incl. business cases, information economics, Return on Investment, payback)	1	5	**3.06**	1.16	1.35
10	IT governance assurance and self-assessment	2	4	**3.06**	0.66	0.43
11	Strategic information systems planning	1	5	**2.94**	1.14	1.31

Response frequency (%) of IT governance practices "relational mechanisms" for the perceived "effectiveness" (round 1)

Response Frequency (%): IT governance Practices (Relational Mechanisms) "Effectiveness"						
Ranking	**IT Governance Practices "Relational Mechanisms"**	**1 = Not Effective**	**2**	**3**	**4**	**5 = Very Effective**
1	Cross-training	0.0%	12.5%	12.5%	18.8%	56.3%
2	Informal meetings between business and IT executive/ senior management	0.0%	7.7%	0.0%	61.5%	30.8%
3	Co-location	0.0%	13.3%	6.7%	40.0%	40.0%
4	IT leadership	0.0%	0.0%	18.8%	56.3%	25.0%
5	Executive / senior management giving the good example	0.0%	7.1%	7.1%	64.3%	21.4%
6	Corporate internal communication addressing IT on a regular basis	0.0%	0.0%	20.0%	60.0%	20.0%
7	Knowledge management (on IT governance)	0.0%	6.3%	18.8%	50.0%	25.0%
8	Business/IT account management	0.0%	0.0%	28.6%	57.1%	14.3%
9	IT governance awareness campaigns	0.0%	7.7%	23.1%	53.9%	15.4%
10	Job-rotation	7.1%	7.1%	28.6%	35.7%	21.4%

Descriptive statistics of IT governance practices "relational mechanisms" for the perceived "effectiveness" (round 1)

ITG Practices Relational Mechanisms "Effectiveness"						
Ranking	**IT Governance Practices "Relational Mechanisms"**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	Cross-training	2	5	**4.19**	1.07	1.15
2	Informal meetings between business and IT executive/ senior management	2	5	**4.15**	0.77	0.59
3	Co-location	2	5	**4.07**	1	1
4	IT leadership	3	5	**4.06**	0.66	0.43
5	Executive / senior management giving the good example	2	5	**4**	0.76	0.57
6	Corporate internal communication addressing IT on a regular basis	3	5	**4**	0.63	0.4
7	Knowledge management (on IT governance)	2	5	**3.94**	0.83	0.68
8	Business/IT account management	3	5	**3.86**	0.64	0.41
9	IT governance awareness campaigns	2	5	**3.77**	0.8	0.64
10	Job-rotation	1	5	**3.57**	1.12	1.24

Response frequency (%) of IT governance practices "relational mechanisms" for the perceived "ease of implementation" (round 1)

Response Frequency (%): IT governance Practices (Processes) "Ease of implementation"						
Ranking	**IT Governance Practices "Relational Mechanisms"**	**1 = Not easy**	**2**	**3**	**4**	**5 = Very easy**
1	IT governance awareness campaigns	0.0%	6.7%	13.3%	66.7%	13.3%
2	Informal meetings between business and IT executive/ senior management	6.7%	6.7%	13.3%	53.3%	20.0%
3	Executive / senior management giving the good example	0.0%	20.0%	13.3%	46.7%	20.0%
4	Corporate internal communication addressing IT on a regular basis	6.7%	0.0%	26.7%	60.0%	6.7%
5	IT leadership	0.0%	6.3%	37.5%	50.0%	6.3%
6	Co-location	0.0%	18.8%	25.0%	43.8%	12.5%
7	Knowledge management (on IT governance)	0.0%	6.3%	50.0%	31.3%	12.5%
8	Business/IT account management	0.0%	0.0%	60.0%	40.0%	0.0%
9	Job-rotation	14.3%	21.4%	7.1%	35.7%	21.4%
10	Cross-training	0.0%	18.8%	37.5%	43.8%	0.0%

Descriptive statistics of IT governance practices "relational mechanisms" for the perceived "ease of implementation" (round 1)

ITG Practices Relational Mechanisms "Ease of implementation"						
Ranking	**IT Governance Practices "Relational Mechanisms"**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	IT governance awareness campaigns	2	5	**3.87**	0.72	0.52
2	Informal meetings between business and IT executive/ senior management	1	5	**3.73**	1.06	1.13
3	Executive / senior management giving the good example	2	5	**3.67**	1.01	1.02
4	Corporate internal communication addressing IT on a regular basis	1	5	**3.6**	0.88	0.77
5	IT leadership	2	5	**3.56**	0.7	0.5
6	Co-location	2	5	**3.5**	0.94	0.88
7	Knowledge management (on IT governance)	2	5	**3.5**	0.79	0.63
8	Business/IT account management	3	4	**3.4**	0.49	0.24
9	Job-rotation	1	5	**3.29**	1.39	1.92
10	Cross-training	2	4	**3.25**	0.75	0.56

Response frequency (%) of innovation management practices for the perceived "effectiveness" (round 2)

Response Frequency (%): Innovation Management Practices "Effectiveness"						
Ranking	**Innovation Practices**	**1 = Not Effective**	**2**	**3**	**4**	**5= Very Effective**
1	Degree of relevant technical expertise	0.0%	0.0%	16.7%	50.0%	33.3%
2	Degree of top management support towards Innovation of Logistics II	0.0%	8.3%	16.7%	33.3%	41.7%
3	Amount of slack resources	0.0%	0.0%	30.0%	60.0%	10.0%
4	Change Management	0.0%	8.3%	16.7%	66.7%	8.3%
5	Degree of training provided to employees	0.0%	0.0%	27.3%	72.7%	0.0%
6	Degree of logistics II planning	0.0%	8.3%	33.3%	41.7%	16.7%
7	Degree of Internal Communication	0.0%	16.7%	16.7%	58.3%	8.3%
8	Degree of openness / External communication	0.0%	0.0%	41.7%	58.3%	0.0%
9	Sense of Responsibility	0.0%	18.2%	18.2%	54.6%	0.1%
10	Norm Encouraging Change	0.0%	0.0%	63.6%	27.3%	9.1%
11	IS Installed Base	0.0%	20.0%	20.0%	60.0%	0.0%
12	Degree of formalization	0.0%	9.1%	54.6%	27.3%	9.1%
12	Degree of centralized structure	10.0%	10.0%	80.0%	0.0%	0.0%

Descriptive statistics of innovation management practices for the perceived "effectiveness" (round 2)

Innovation Management Practices "Effectiveness"						
Ranking	**Innovation Practices**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	Degree of relevant technical expertise	3	5	**4.17**	0.69	0.47
2	Degree of top management support towards Innovation of Logistics II	2	5	**4.08**	0.95	0.91
3	Amount of slack resources	3	5	**3.80**	0.6	0.36
4	Change Management	2	5	**3.75**	0.72	0.52
5	Degree of training provided to employees	3	4	**3.73**	0.45	0.2
6	Degree of logistics II planning	2	5	**3.67**	0.85	0.72
7	Degree of Internal Communication	2	5	**3.58**	0.86	0.74
8	Degree of openness / External communication	3	4	**3.58**	0.49	0.24
9	Sense of Responsibility	2	5	**3.55**	0.89	0.79
10	Norm Encouraging Change	3	5	**3.45**	0.66	0.43
11	IS Installed Base	2	4	**3.40**	0.8	0.64
12	Degree of formalization	2	5	**3.36**	0.77	0.6
13	Degree of centralized structure	1	3	**2.70**	0.64	0.41

Response frequency (%) of innovation management practices for the perceived "ease of implementation" (round 2)

Response Frequency (%) : Innovation Management Practices "Ease of Implementation"						
Ranking	**Innovation Practices**	**1 = Not Easy**	**2**	**3**	**4**	**5 = Very Easy**
1	Degree of training provided to employees	0.0%	9.1%	18.2%	72.7%	0.0%
2	Degree of top management support towards Innovation of Logistics II	8.3%	8.3%	25.0%	50.0%	8.3%
3	Amount of slack resources	0.0%	10.0%	40.0%	50.0%	0.0%
4	IS Installed Base	0.0%	20.0%	30.0%	40.0%	10.0%
5	Norm Encouraging Change	0.0%	9.1%	54.6%	36.4%	0.0%
6	Degree of Internal Communication	8.3%	16.7%	25.0%	50.0%	0.0%
7	Degree of logistics II planning	0.0%	25.0%	33.3%	41.7%	0.0%
8	Change Management	0.0%	16.7%	58.3%	25.0%	0.0%
9	Degree of relevant technical expertise	0.0%	25.0%	50.0%	25.0%	0.0%
10	Degree of openness / External communication	0.0%	8.3%	83.3%	8.3%	0.0%
11	Degree of centralized structure	0.0%	20.0%	70.0%	10.0%	0.0%
12	Degree of formalization	0.0%	36.4%	54.6%	9.1%	0.0%
13	Sense of Responsibility	9.1%	27.3%	54.6%	9.1%	0.0%

Descriptive statistics of innovation management practices for the perceived "ease of implementation" (round 2)

Innovation Management Practices "Ease of Implementation"						
Ranking	**Innovation Practices**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	Degree of training provided to employees	2	4	**3.64**	0.64	0.41
2	Degree of top management support towards Innovation of Logistics II	1	5	**3.42**	1.04	1.08
3	Amount of slack resources	2	4	**3.4**	0.66	0.44
4	IS Installed Base	2	5	**3.4**	0.92	0.84
5	Norm Encouraging Change	2	4	**3.27**	0.62	0.38
6	Degree of Internal Communication	1	4	**3.17**	0.99	0.97
7	Degree of logistics II planning	2	4	**3.17**	0.8	0.64
8	Change Management	2	4	**3.08**	0.64	0.41
9	Degree of relevant technical expertise	2	4	**3**	0.71	0.5
10	Degree of openness / External communication	2	4	**3**	0.41	0.17
11	Degree of centralized structure	2	4	**2.9**	0.54	0.29
12	Degree of formalization	2	4	**2.73**	0.62	0.38
13	Sense of Responsibility	1	4	**2.64**	0.77	0.6

Response frequency (%) of IT governance practices "structures" for the perceived "effectiveness" round 2)

Response Frequency (%): IT governance Practices (Structures) "Effectiveness"						
Ranking	**IT Governance Practices "Structure"**	**1 = Not Effective**	**2**	**3**	**4**	**5 = Very Effective**
1	CIO (Chief Information Officer) on executive committee	0.0%	0.0%	0.0%	81.8%	18.2%
2	IT project steering committee	0.0%	0.0%	0.0%	100.0%	0.0%
3	IT expertise at level of board of directors	0.0%	0.0%	9.1%	81.8%	9.1%
4	CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	0.0%	0.0%	18.2%	72.7%	9.1%
5	Integration of governance/ alignment tasks in roles and responsibilities	0.0%	0.0%	9.1%	90.9%	0.0%
6	Security / compliance/ risk officer	0.0%	0.0%	22.2%	66.7%	11.1%
7	IT security steering committee	0.0%	0.0%	20.0%	80.0%	0.0%
8	IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	0.0%	0.0%	33.3%	66.7%	0.0%
9	IT strategy committee at level of board of directors	0.0%	0.0%	45.5%	54.6%	0.0%
10	Architecture steering committee	0.0%	0.0%	45.5%	54.6%	0.0%
11	IT governance function	0.0%	16.7%	41.7%	41.7%	0.0%
12	IT audit committee at level of board of directors	0.0%	0.0%	80.0%	20.0%	0.0%

Descriptive statistics of IT governance practices "structures" for the perceived "effectiveness" (round 2)

ITG Practices Structures "Effectiveness"						
Ranking	**IT Governance Practices "Structure"**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	CIO (Chief Information Officer) on executive committee	4	5	**4.18**	0.39	0.15
2	IT project steering committee	4	4	**4**	0	0
3	IT expertise at level of board of directors	3	5	**4**	0.43	0.18
4	CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	3	5	**3.91**	0.51	0.26
5	Integration of governance/ alignment tasks in roles and responsibilities	3	4	**3.91**	0.29	0.08
6	Security / compliance/ risk officer	3	5	**3.89**	0.57	0.32
7	IT security steering committee	3	4	**3.8**	0.4	0.16
8	IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	3	4	**3.67**	0.47	0.22
9	IT strategy committee at level of board of directors	3	4	**3.55**	0.5	0.25
10	Architecture steering committee	3	4	**3.55**	0.5	0.25
11	IT governance function	2	4	**3.25**	0.72	0.52
12	IT audit committee at level of board of directors	3	4	**3.2**	0.4	0.16

Response frequency (%) of IT governance practices "structures" for the perceived "ease of implementation" (round 2)

Response Frequency (%): IT governance Practices (Structures) "Ease of implementation"						
Ranking	**IT Governance Practices "Structure"**	**1 = Not easy**	**2**	**3**	**4**	**5 = Very easy**
1	CIO (Chief Information Officer) on executive committee	0.0%	0.0%	27.3%	72.7%	0.0%
2	CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	0.0%	0.0%	36.4%	63.6%	0.0%
3	IT strategy committee at level of board of directors	0.0%	0.0%	54.6%	45.5%	0.0%
4	IT project steering committee	0.0%	0.0%	58.3%	41.7%	0.0%
5	Architecture steering committee	0.0%	0.0%	72.7%	27.3%	0.0%
6	Security / compliance/ risk officer	0.0%	11.1%	66.7%	22.2%	0.0%
7	IT security steering committee	0.0%	10.0%	70.0%	20.0%	0.0%
8	IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	0.0%	8.3%	83.3%	8.3%	0.0%
9	IT governance function	0.0%	25.0%	58.3%	16.7%	0.0%
10	Integration of governance/ alignment tasks in roles and responsibilities	9.1%	18.2%	45.5%	27.3%	0.0%
11	IT expertise at level of board of directors	9.1%	27.3%	36.4%	27.3%	0.0%
12	IT audit committee at level of board of directors	0.0%	50.0%	50.0%	0.0%	0.0%

Descriptive statistics of IT governance practices "structures" for the perceived "ease of implementation" (round 2)

ITG Practices Structure "Ease of Implementation"						
Ranking	**IT Governance Practices "Structure"**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	CIO (Chief Information Officer) on executive committee	3	4	**3.73**	0.45	0.2
2	CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	3	4	**3.64**	0.48	0.23
3	IT strategy committee at level of board of directors	3	4	**3.45**	0.5	0.25
4	IT project steering committee	3	4	**3.42**	0.49	0.24
5	Architecture steering committee	3	4	**3.27**	0.45	0.2
6	Security / compliance/ risk officer	2	4	**3.11**	0.57	0.32
7	IT security steering committee	2	4	**3.1**	0.54	0.29
8	IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	2	4	**3**	0.41	0.17
9	IT governance function	2	4	**2.92**	0.64	0.41
10	Integration of governance/ alignment tasks in roles and responsibilities	1	4	**2.91**	0.9	0.81
11	IT expertise at level of board of directors	1	4	**2.82**	0.94	0.88
12	IT audit committee at level of board of directors	2	3	**2.5**	0.5	0.25

Response frequency (%) of IT governance practices "processes" for the perceived "effectiveness" (round 2)

Response Frequency (%): IT governance Practices (Processes) "Effectiveness"						
#	**IT Governance Practices "Processes"**	**1 = Not Effective**	**2**	**3**	**4**	**5 = Very Effective**
1	Strategic information systems planning	0.0%	0.0%	16.7%	41.7%	41.7%
2	IT performance measurement	0.0%	0.0%	16.7%	41.7%	41.7%
3	Portfolio management (incl. business cases, information economics, Return on Investment, payback)	0.0%	0.0%	8.3%	91.7%	0.0%
4	Project governance /management methodologies	0.0%	0.0%	33.3%	66.7%	0.0%
5	IT governance framework COBIT	0.0%	0.0%	44.4%	55.6%	0.0%
6	IT budget control and reporting	0.0%	0.0%	58.3%	33.3%	8.3%
7	Benefits management and reporting	9.1%	0.0%	27.3%	63.6%	0.0%
8	Service level agreements	0.0%	0.0%	63.6%	36.4%	0.0%
9	COSO / ERM	0.0%	0.0%	80.0%	20.0%	0.0%
10	IT governance assurance and self-assessment	0.0%	16.7%	50.0%	33.3%	0.0%
11	Charge back arrangements total cost of ownership (e.g. Activity based costing)	9.1%	18.2%	54.6%	18.2%	0.0%

Descriptive statistics of IT governance practices "processes" for the perceived "effectiveness" (round 2)

ITG Practices Processes "Effectiveness"						
Ranking	**IT Governance Practices "Processes"**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	Strategic information systems planning	3	5	**4.25**	0.72	0.52
2	IT performance measurement	3	5	**4.25**	0.72	0.52
3	Portfolio management (incl. business cases, information economics, Return on Investment, payback)	3	4	**3.92**	0.28	0.08
4	Project governance /management methodologies	3	4	**3.67**	0.47	0.22
5	IT governance framework COBIT	3	4	**3.56**	0.5	0.25
6	IT budget control and reporting	3	5	**3.5**	0.65	0.42
7	Benefits management and reporting	1	4	**3.45**	0.89	0.79
8	Service level agreements	3	4	**3.36**	0.48	0.23
9	COSO / ERM	3	4	**3.2**	0.4	0.16
10	IT governance assurance and self-assessment	2	4	**3.17**	0.69	0.47
11	Charge back arrangements total cost of ownership (e.g. Activity based costing)	1	4	**2.82**	0.83	0.69

Response frequency (%) of IT governance practices "processes" for the perceived "ease of implementation" (round 2)

Response Frequency (%): IT governance Practices (Processes) "Ease of implementation"						
Ranking	**IT Governance Practices "Processes"**	**1 = Not easy**	**2**	**3**	**4**	**5 = Very easy**
1	IT budget control and reporting	0.0%	0.0%	58.3%	41.7%	0.0%
2	IT performance measurement	0.0%	16.7%	41.7%	33.3%	8.3%
3	Project governance /management methodologies	0.0%	8.3%	58.3%	33.3%	0.0%
4	Portfolio management (incl. business cases, information economics, Return on Investment, payback)	0.0%	8.3%	66.7%	25.0%	0.0%
5	IT governance framework COBIT	0.0%	0.0%	88.9%	11.1%	0.0%
6	Service level agreements	0.0%	9.1%	72.7%	18.2%	0.0%
7	IT governance assurance and self-assessment	0.0%	16.7%	75.0%	8.3%	0.0%
8	COSO / ERM	0.0%	10.0%	90.0%	0.0%	0.0%
9	Strategic information systems planning	0.0%	25.0%	66.7%	8.3%	0.0%
10	Benefits management and reporting	0.0%	45.5%	36.4%	18.2%	0.0%
11	Charge back arrangements total cost of ownership (e.g. Activity based costing)	18.2%	9.1%	72.7%	0.0%	0.0%

Descriptive statistics of IT governance practices "processes" for the perceived "ease of implementation" (round 2)

ITG Practices Processes "Ease of Implementation"						
#	IT Governance Practices "Processes"	Minimum	Maximum	Mean	Std Deviation	Variance
1	IT budget control and reporting	3	4	**3.42**	0.49	0.24
2	IT performance measurement	2	5	**3.33**	0.85	0.72
3	Project governance /management methodologies	2	4	**3.25**	0.6	0.35
4	Portfolio management (incl. business cases, information economics, Return on Investment, payback)	2	4	**3.17**	0.55	0.31
5	IT governance framework COBIT	3	4	**3.11**	0.31	0.1
6	Service level agreements	2	4	**3.09**	0.51	0.26
7	IT governance assurance and self-assessment	2	4	**2.92**	0.49	0.24
8	COSO / ERM	2	3	**2.9**	0.3	0.09
9	Strategic information systems planning	2	4	**2.83**	0.55	0.31
10	Benefits management and reporting	2	4	**2.73**	0.75	0.56
11	Charge back arrangements total cost of ownership (e.g. Activity based costing)	1	3	**2.55**	0.78	0.61

Response frequency (%) of IT governance practices "relational mechanisms" for the perceived "effectiveness" (round 2)

Rating Frequency (%): IT governance Practices (Relational Mechanisms) "Effectiveness"						
Ranking	**IT Governance Practices "Relational Mechanisms"**	**1 = Not Effective**	**2**	**3**	**4**	**5 = Very Effective**
1	Cross-training	0.0%	0.0%	0.0%	50.0%	50.0%
2	Corporate internal communication addressing IT on a regular basis	0.0%	0.0%	9.1%	63.6%	27.3%
3	Informal meetings between business and IT executive/ senior management	0.0%	8.3%	0.0%	58.3%	33.3%
4	Executive / senior management giving the good example	0.0%	0.0%	0.0%	83.3%	16.7%
5	Co-location	0.0%	0.0%	16.7%	58.3%	25.0%
6	IT leadership	0.0%	0.0%	8.3%	83.3%	8.3%
7	Knowledge management (on IT governance)	0.0%	0.0%	25.0%	58.3%	16.7%
8	Business/IT account management	0.0%	0.0%	25.0%	66.7%	8.3%
9	Emergency response management	9.1%	0.0%	18.2%	54.6%	18.2%
10	IT governance awareness campaigns	0.0%	0.0%	36.4%	63.6%	0.0%
11	Job-rotation	0.0%	16.7%	41.7%	33.3%	8.3%

Descriptive statistics of IT governance practices "relational mechanisms" for the perceived "effectiveness" (round 2)

ITG Practices Relational Mechanisms "Effectiveness"						
Ranking	**IT Governance Practices "Relational Mechanisms"**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	Cross-training	4	5	**4.5**	0.5	0.25
2	Corporate internal communication addressing IT on a regular basis	3	5	**4.18**	0.57	0.33
3	Informal meetings between business and IT executive/ senior management	2	5	**4.17**	0.8	0.64
4	Executive / senior management giving the good example	4	5	**4.17**	0.37	0.14
5	Co-location	3	5	**4.08**	0.64	0.41
6	IT leadership	3	5	**4**	0.41	0.17
7	Knowledge management (on IT governance)	3	5	**3.92**	0.64	0.41
8	Business/IT account management	3	5	**3.83**	0.55	0.31
9	Emergency response management	1	5	**3.73**	1.05	1.11
10	IT governance awareness campaigns	3	4	**3.64**	0.48	0.23
11	Job-rotation	2	5	**3.33**	0.85	0.72

Response frequency (%) of IT governance practices "relational mechanisms" for the perceived "ease of implementation" (round 2)

Rating Frequency (%): IT governance Practices (Processes) "Ease of implementation"						
#	**IT Governance Practices "Relational Mechanisms"**	**1 = Not easy**	**2**	**3**	**4**	**5 = Very easy**
1	Informal meetings between business and IT executive/ senior management	0.0%	0.0%	25.0%	50.0%	25.0%
2	Co-location	0.0%	0.0%	33.3%	50.0%	16.7%
3	IT governance awareness campaigns	0.0%	9.1%	18.2%	63.6%	9.1%
4	Executive / senior management giving the good example	0.0%	0.0%	41.7%	58.3%	0.0%
5	Corporate internal communication addressing IT on a regular basis	0.0%	9.1%	36.4%	54.6%	0.0%
6	IT leadership	0.0%	8.3%	41.7%	50.0%	0.0%
7	Knowledge management (on IT governance)	0.0%	8.3%	41.7%	50.0%	0.0%
8	Cross-training	0.0%	8.3%	58.3%	33.3%	0.0%
9	Business/IT account management	0.0%	8.3%	75.0%	16.7%	0.0%
10	Job-rotation	0.0%	33.3%	58.3%	8.3%	0.0%
11	Emergency response management	18.2%	18.2%	54.6%	9.1%	0.0%

Descriptive statistics of IT governance practices "relational mechanisms" for the perceived "ease of implementation" (Round 2)

ITG Practices Relational Mechanisms "Ease of implementation"						
Ranking	**IT Governance Practices "Relational Mechanisms"**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Variance**
1	Informal meetings between business and IT executive/ senior management	3	5	**4**	0.71	0.5
2	Co-location	3	5	**3.83**	0.69	0.47
3	IT governance awareness campaigns	2	5	**3.73**	0.75	0.56
4	Executive / senior management giving the good example	3	4	**3.58**	0.49	0.24
5	Corporate internal communication addressing IT on a regular basis	2	4	**3.45**	0.66	0.43
6	IT leadership	2	4	**3.42**	0.64	0.41
7	Knowledge management (on IT governance)	2	4	**3.42**	0.64	0.41
8	Cross-training	2	4	**3.25**	0.6	0.35
9	Business/IT account management	2	4	**3.08**	0.49	0.24
10	Job-rotation	2	4	**2.75**	0.6	0.35
11	Emergency response management	1	4	**2.55**	0.89	0.79

Appendix D: Example of Delphi Questionnaire Round 1

Delphi Study: First Round

This study is specifically interested in identifying innovation and IT governance practices of logistics IIs, not stand-alone Information Systems (IS). The following background information provides a clear definition of the distinction between IIs and IS, and information on innovation of IIs.

Background Information

Large scale-systems such as customer relationship management (CRM) systems, corporate intranets and ERP systems (e.g. SAP) have become essential parts of many businesses. Generally, SAP technology has been adopted in organizations as an information system deployment; however, overtime SAP often have evolved as it incorporates new business requirements or technical innovations. The result is the emergence of a complex large-scale system in which technical elements such as information systems and networks, and non-technical elements such as individuals, organizations and practices, interact. Such complex large-scale systems are referred to as "*Information Infrastructures*" (IIs) (Hanseth & Monteiro, 1998). Then, in this sense SAP often has evolved from a stand-alone Information System to an *Information Infrastructure*.

The evolution and innovation of such complex large-scale systems (i.e. IIs) requires new elements to be integrated and made compatible with the existing legacy systems and practices (i.e. "installed base"). Consider the example of the "*Naval Logistics Information Infrastructure*" (NLII) that was developed in the United States to support the optimization of the logistics activities. The legacy systems of the NLII were compounded by SAP-based enterprise integration solutions. However, overtime it was needed new information technology that support the optimization of the logistics activities. In response, a technical innovation was implemented into the NLII. It consisted in integrating a grid of active Radio Frequency Identification Devise (RFID) geospatial nodes interacting with microsatellites and networks of RFID devices into the existing systems (i.e. "installed base") (Farquhar, 2010).

The evolution and innovation of such large-scale integrated systems (i.e. IIs) are complex tasks that require the management of multiple interdependent social and technical factors (environment, organizations, users, practices, information systems, networks, etc.). Innovation management, and to a lesser extent, IT governance practices have been shown to influence the ability of an organization to innovate their information technology, but there have not been any studies which have examined the impact of these practices on the innovation of such large-scale integrated systems (i.e. IIs). This study investigates the influence of IT governance and innovation management practices on the innovation of logistics *IIs* in the upstream offshore oil and gas industry.

This survey comprises two sections, you will be asked to complete similar tasks for both sections:

- Section 1: Innovation Management Practices that Influence Innovation of Logistics IIs
- Section 2: IT governance Practices that Influence Innovation of IIs.

Section 1: Innovation Management Practices that Influence Innovation of Logistics IIs

The following list contains a series of Innovation Management Practices and their definitions. In this section we ask you to answer three sets of questions about the influences of innovation management practices on the innovation of logistics IIs in the upstream oil and gas industry: 1) indicate the direction of influence, 2) rate the degree of effectiveness, and 3) rate the ease of implementation.

The practices should be rated on a scale of one to five for both factors, 1) the perceived "Effectiveness", where 1 = not effective and 5 = very effective or select the option "I do not know" and the perceived "Ease of Implementation", where 1 = not easy and 5 = very easy or select the option "I do not know".

Please keep the distinction between II and IS in mind when rating each of the Innovation Management practices. Be sure to answer the questions as they pertain to logistics IIs.

Innovation Management Practices that Influence Innovation of Logistics II

Innovation Predictor	Definition	Effectiveness from (1-5)	Ease of Implementation from (1-5)	Direction of Influence (Positive /Negative)	Comments
Degree of top management support towards Innovation of Logistics II	Involvement, enthusiasm, motivation, and encouragement provided by management towards the acceptance of Logistics II innovation (Damanpour , 1991)				
Degree of relevant technical expertise	IT/II education and experience of organizational members (i.e. other than top management) (Damanpour , 1991)				
Degree of centralized structure	Degree to which II/Innovation decision-making and authority lie exclusively within the corporate IT function (centralization) versus distributed amid individual working units (decentralization) (Damanpour , 1991)				
Degree of formalization	Emphasis on following rules and procedures in conducting organizational activities (Damanpour , 1991)				
Amount of slack resources	Financial and human resources that an organization has beyond what it minimally requires to operate. Commonly, financial slack is used as sources of finance or changes in an organization`s budget (Damanpour , 1991)				
Degree of openness/ external communication	The interaction of members of a system with others who are external to the system. It includes information sharing and involvement and participation in extra organizational professional activities (Damanpour , 1991; Lai & Guynes, 1997)				
Degree of Logistics II planning	The extent to which organizations plan their Logistics IIs in terms of requirement analysis, II analysis and design, and resource control (Thong, 2001)				
Norm Encouraging Change	Employees' positive attitudes towards Logistics II innovation, including the changes that this entails in the work place and habits (Lai & Guynes, 1997)				
Degree of training provided to employees	The availability of relevant training to users of the II.				
IS Installed Base	Refers to the Existing technical components of the Logistics Installed Base such as systems, applications, nodes, networks, etc.				
Degree of internal communication	Communication among different business units involved in logistics activities. It includes organizational integration mechanisms such as the degree to which these business units share decisions and the number of contacts (face-to-face and others) among their people (Damanpour , 1991)				
Change Management	Presence of continuous improvement practices such as the identification of new requirements or availability of new technical opportunities.				

Are there any other innovation management practices that influence the innovation of logistics II in the upstream oil and gas industry? If so, please specify below.

Innovation Predictor	Definition	Effectiveness from (1-5)	Ease of implementation from (1-5)	Direction of Influence (Positive/Negative)	Comments

Section 2: IT Governance Practices that Influence Innovation of Logistics II

What is IT Governance?

IT Governance is:

> an integral part of corporate governance and addresses the definition and implementation of processes, structures and relational mechanisms in the organization that enable both business and IT people to execute their responsibilities in support of business/IT alignment and the creation of business value from IT-enabled investments" (De Haes & Van Grembergen, 2009, p. 61).

- "Structures" refer to the allocation of decision-making authority,
- "Processes" addresses the management and implementation of IT procedures,
- "Relational Mechanisms" refers to the collaborative relationship amid corporate executives, business and IT management and include IT leadership, partnerships, informal meetings and Information Systems (Hèroux & Fortin, 2016).

The following list contains a series of IT governance practices and their definitions. In this section we ask you to answer three sets of questions about the influence of IT governance practices on the innovation of logistics IIs in the upstream oil and gas industry:

1. Indicate the direction of influence.
2. Rate the degree of effectiveness.
3. Rate the ease of implementation.

The practices should be rated on a scale of one to five for both factors, 1) the perceived "Effectiveness", where 1 = not effective and 5 = very effective or select the option "I do not know" and the perceived "Ease of Implementation", where 1 = not easy and 5 = very easy or select the option "I do not know".

IT Governance Practices that Influence Innovation of Logistics II adapted from De Haes & Van Grembergen (2008)

IT Governance Practices Structure	Definition	Effectiveness from (1-5)	Ease of Implementation from (1-5)	Direction of Influence (Positive/Negative)	Comments
IT strategy committee at level of board of directors	Committee at level of board of directors to ensure IT is regular agenda item and reporting issue for the board of directors				
IT expertise at level of board of directors	Members of the board of directors have expertise and experience regarding the value and risk of IT				
IT audit committee at level of board of directors	Independent committee at level of board of directors overviewing IT assurance activities				
CIO (Chief Information Officer) on executive committee	CIO is a full member of the executive committee				
CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	CIO has a direct reporting line to the CEO and/or COO				
IT steering committee (IT investment evaluation / prioritisation at executive / senior management level)	Steering committee at executive or senior management level responsible for determining business priorities in IT investments.				
IT governance function/	Function in the organisation responsible for promoting, driving and managing IT governance processes				
Security / compliance/ risk officer	Function responsible for security, compliance and/or risk, which possibly impacts IT				
IT project steering committee	Steering committee composed of business and IT people focusing on prioritising and managing IT projects				
IT security steering committee	Steering committee composed of business and IT people focusing on IT related risks and security issues				
Architecture steering committee	Committee composed of business and IT people providing architecture guidelines and advise on their applications				
Integration of governance/alignment tasks in roles and responsibilities	Documented roles and responsibilities include governance/alignment tasks for business and IT people				

IT Governance Practices Processes	Definition	Effectiveness from (1-5)	Ease of Implementation from (1-5)	Direction of Influence (Positive/Negative)	Comments
Strategic information systems planning	Formal process to define and update the IT strategy				
IT performance measurement	IT performance measurement in domains of corporate contribution, user orientation, operational excellence and future orientation				
Portfolio management (incl. business cases, information economics, Return on Investment, payback)	Prioritisation process for IT investments and projects in which business and IT is involved				
Charge back arrangements total cost of ownership (e.g. Activity based costing)	Methodology to charge back IT costs to business units, to enable an understanding of the total cost of ownership				
Service level agreements	Formal agreements between business and IT about IT development projects or IT operations				
IT governance framework COBIT	Process based IT governance and control framework				
IT governance assurance and self-assessment	Regular self-assessments or independent assurance activities on the governance and control over IT				
Project governance /management methodologies	Processes and methodologies to govern and manage IT projects				
IT budget control and reporting	Processes to control and report upon budgets of IT				
Benefits management and reporting	Processes to monitor the planned business benefits during and after implementation of the IT investments / projects				
COSO / ERM	Frameworks for internal control				

IT Governance Practices Relational Mechanisms	Definition	Effectiveness from (1-5)	Ease of Implementation from (1-5)	Direction of Influence (Positive/Negative)	Comments
Job-rotation	IT staff working in the business units and business people working in IT				
Co-location	Physically locating business and IT people close to each other				
Cross-training	Training business people about IT and/or training IT people about business				
Knowledge management (on IT governance)	Systems (intranet…) to share and distribute knowledge about IT governance framework, responsibilities, tasks, etc.				
Business/IT account management	Bridging the gap between business and IT by means of account managers who act as in-between				
Executive / senior management giving the good example	Senior business and IT management acting as "partners".				
Informal meetings between business and IT executive/ senior management	Informal meetings, with no agenda, where business and IT senior management talk about general activities and directions.				
IT leadership	Ability of CIO or similar role to articulate a vision for IT's role in the company and ensure that this vision is clearly understood by managers throughout the organisation				
Corporate internal communication addressing IT on a regular basis	Internal corporate communication regularly addresses general IT issues.				
IT governance awareness campaigns	Campaigns to explain to business and IT people the need for IT governance				

Are there any other IT governance practices that influence the innovation of Logistics II in the upstream oil and gas industry? If so, please specify below.

IT Governance Practice	Definition	Effectiveness from (1-5)	Ease of Implementation from (1-5)	Direction of Influence (Positive/Negative)	Comments?

Please click < Next > to submit your responses

Thank you for completing this questionnaire. The responses of all experts will be analyzed and the results will be included in the second questionnaire.

Appendix E:Example of PDF report of results of Round 1

Report: Questionnaire Round 1

This individual report comprises two sections:

- **Section 1:** Innovation Management Practices that Influence Innovation of Logistics IIs
- **Section 2:** IT governance Practices (Structure, Processes and Relational Mechanisms) that Influence Innovation of IIs.

In each section, you will find the ranking, the group averages/percentages and your scores/response of each of the practices in the first round. For each practice, this report shows the results of Round 1 in terms of: 1) Direction of influence 2) The degree of effectiveness, and 3) The ease of implementation.

Section 1: Innovation Management Practices

Question: Please indicate the *direction of Influence* (positive / negative) of the following Innovation Management practices on innovation of logistics IIs in the upstream oil and gas industry

Direction of Influence			
Innovation Practices	**Group Percentages**		**Your response Round 1**
	Positive	**Negative**	
Degree of top management support towards Innovation of Logistics II	94.1%	5.9%	
Degree of relevant technical expertise	81.3%	18.8%	
Degree of centralized structure	61.5%	38.5%	
Degree of formalization	63.6%	36.4%	
Amount of slack resources	60.0%	40.0%	
Degree of openness / External communication	78.6%	21.4%	
Degree of logistics II planning	81.3%	18.8%	
Norm Encouraging Change	73.3%	26.7%	
Degree of training provided to employees	64.7%	35.3%	
IS Installed Base	64.3%	35.7%	
Degree of internal communication	87.5%	12.5%	
Change Management	85.7%	14.3%	

Question: Rate the *Effectiveness*, of each of the following Innovation Management practices in terms of the influence they play in the ability of organizations to innovate their logistics II in the upstream oil and gas industry

Effectiveness			
Rank	**Innovation Practices**	**Group Averages (Mean)**	**Your score Round 1**
1	Degree of top management support towards Innovation of Logistics II	**4.2**	
2	Degree of relevant technical expertise	**4.1**	
3	Change Management	**4.1**	
4	Degree of internal communication	**3.9**	
5	Degree of logistics II planning	**3.9**	
6	Degree of openness / External communication	**3.8**	
7	Norm Encouraging Change	**3.8**	
8	Degree of training provided to employees	**3.7**	
9	Amount of slack resources	**3.5**	
10	IS Installed Base	**3.5**	
11	Degree of formalization	**3.2**	
12	Degree of centralized structure	**2.7**	

Question: Rate the *Ease of Implementation* of each of the following Innovation Management practices in terms of the influence they play in the ability of organizations to innovate their logistics II in the upstream oil and gas industry

Ease of Implementation			
Rank	**Innovation Practices**	**Group Averages (Mean)**	**Your score Round 1**
1	Degree of training provided to employees	**3.8**	
2	Change Management	**3.7**	
3	Degree of internal communication	**3.6**	
4	Amount of slack resources	**3.6**	
5	Degree of openness / External communication	**3.6**	
6	IS Installed Base	**3.6**	
7	Degree of top management support towards Innovation of Logistics II	**3.5**	
8	Degree of relevant technical expertise	**3.5**	
9	Degree of logistics II planning	**3.5**	
10	Norm Encouraging Change	**3.5**	
11	Degree of centralized structure	**3.4**	
12	Degree of formalization	**3.1**	

Section 2: IT Governance Practices
Structures

Question: Please indicate the *direction of Influence* (positive / negative) of the following IT Governance Practices "Structure" on innovation of logistics IIs in the upstream oil and gas industry

Direction of Influence			
IT Governance practices "Structure"	**Group Percentages**		**Your response Round 1**
	Positive	**Negative**	
IT strategy committee at level of board of directors	87.5%	12.5%	
IT expertise at level of board of directors	93.3%	6.7%	
IT audit committee at level of board of directors	81.8%	18.2%	
CIO (Chief Information Officer) on executive committee	100.0%	0.0%	
CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	100.0%	0.0%	
IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	93.3%	6.7%	
IT governance function	93.8%	6.3%	
Security / compliance/ risk officer	93.3%	6.7%	
IT project steering committee	93.3%	6.7%	
IT security steering committee	92.3%	7.7%	
Architecture steering committee	86.7%	13.3%	
Integration of governance/ alignment tasks in roles and responsibilities	92.9%	7.1%	

Question: Rate the *Effectiveness* of each of the following IT Governance practices "Structure" in terms of the influence they play in the ability of organizations to innovate their logistics II in the upstream oil and gas industry

Effectiveness			
Rank	**IT Governance practices "Structure"**	**Group Averages (Mean)**	**Your score Round 1**
1	CIO (Chief Information Officer) on executive committee	**4.2**	
2	CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	**4.2**	
3	Security / compliance/ risk officer	**4.1**	
4	IT project steering committee	**4.0**	
5	IT strategy committee at level of board of directors	**3.9**	
6	IT expertise at level of board of directors	**3.9**	
7	Integration of governance/ alignment tasks in roles and responsibilities	**3.9**	
8	IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	**3.8**	
9	IT security steering committee	**3.6**	
10	IT governance function	**3.5**	
11	Architecture steering committee	**3.5**	
12	IT audit committee at level of board of directors	**3.3**	

Question: Rate the *Ease of Implementation* of each of the following IT Governance practices "Structure" in terms of the influence they play in the ability of organizations to innovate their logistics II in the upstream oil and gas industry.

Ease of Implementation			
Rank	**IT Governance practices "Structure"**	**Group Averages (Mean)**	**Your score Round 1**
1	CIO (Chief Information Officer) on executive committee	**3.8**	
2	CIO reporting to CEO (Chief Executive Officer) and/or COO (Chief Operational Officer)	**3.8**	
3	IT strategy committee at level of board of directors	**3.6**	
4	IT project steering committee	**3.5**	
5	IT steering committee (IT investment evaluation / prioritization at executive / senior management level)	**3.5**	
6	Architecture steering committee	**3.4**	
7	Integration of governance/ alignment tasks in roles and responsibilities	**3.3**	
8	Security / compliance/ risk officer	**3.3**	
9	IT security steering committee	**3.3**	
10	IT governance function	**3.2**	
11	IT expertise at level of board of directors	**2.9**	
12	IT audit committee at level of board of directors	**2.9**	

Processes

Question: Please indicate the *direction of Influence* (positive / negative) of the following IT Governance Practices "Processes" on innovation of logistics IIs in the upstream oil and gas industry

Direction of Influence			
IT Governance practices "Processes"	**Group Percentages**		**Your response Round 1**
	Positive	**Negative**	
Strategic information systems planning	93.8%	6.3%	
IT performance measurement	100.0%	0.0%	
Portfolio management (incl. business cases, information economics, Return on Investment, payback)	100.0%	0.0%	
Charge back arrangements total cost of ownership (e.g. Activity based costing)	75.0%	25.0%	
Service level agreements	85.7%	14.3%	
IT governance framework COBIT	90.9%	9.1%	
IT governance assurance and self-assessment	93.3%	6.7%	
Project governance /management methodologies	93.8%	6.3%	
IT budget control and reporting	81.3%	18.8%	
Benefits management and reporting	87.5%	12.5%	
COSO / ERM	84.6%	15.4%	

Question: Rate the *Effectiveness* of each of the following IT Governance practices "Processes" in terms of the influence they play in the ability of organizations to innovate their logistics II in the upstream oil and gas industry

Effectiveness			
Rank	**IT Governance practices "Processes"**	**Group Averages (Mean)**	**Your score Round 1**
1	Strategic information systems planning	4.4	
2	IT performance measurement	4.1	
3	Portfolio management (incl. business cases, information economics, Return on Investment, payback)	4.0	
4	IT governance assurance and self-assessment	3.8	
5	Project governance /management methodologies	3.6	
6	Service level agreements	3.5	
7	IT governance framework COBIT	3.5	
8	Benefits management and reporting	3.5	
9	IT budget control and reporting	3.5	
10	COSO / ERM	3.3	
11	Charge back arrangements total cost of ownership (e.g. Activity based costing)	3.1	

Question: Rate the *Ease of Implementation* of each of the following IT Governance practices "Processes" in terms of the influence they play in the ability of organizations to innovate their logistics II in the upstream oil and gas industry

Ease of Implementation			
Rank	**IT Governance practices "Processes"**	**Group Averages (Mean)**	**Your score Round 1**
1	IT budget control and reporting	3.5	
2	IT governance framework COBIT	3.4	
3	Project governance /management methodologies	3.4	
4	Charge back arrangements total cost of ownership (e.g. Activity based costing)	3.3	
5	Benefits management and reporting	3.3	
6	Service level agreements	3.3	
7	IT performance measurement	3.2	
8	COSO / ERM	3.1	
9	Portfolio management (incl. business cases, information economics, Return on Investment, payback)	3.1	
10	IT governance assurance and self-assessment	3.1	
11	Strategic information systems planning	2.9	

Relational Mechanisms

Question: Please indicate the *direction of Influence* (positive / negative) of the following IT Governance Practices "Relational Mechanisms" on innovation of logistics IIs in the upstream oil and gas industry

Direction of Influence			
IT Governance practices "Relational Mechanisms"	Group Percentages		Your response Round 1
	Positive	Negative	
Job-rotation	66.7%	33.3%	
Co-location	92.3%	7.7%	
Cross-training	86.7%	13.3%	
Knowledge management (on IT governance)	100.0%	0.0%	
Business/IT account management	100.0%	0.0%	
Executive / senior management giving the good example	100.0%	0.0%	
Informal meetings between business and IT executive/ senior management	100.0%	0.0%	
IT leadership	94.1%	5.9%	
Corporate internal communication addressing IT on a regular basis	100.0%	0.0%	
IT governance awareness campaigns	100.0%	0.0%	

Question: Rate the *Effectiveness* of each of the following IT Governance practices "Relational Mechanisms" in terms of the influence they play in the ability of organizations to innovate their logistics II in the upstream oil and gas industry

Effectiveness			
Rank	IT Governance practices "Relational Mechanisms"	Group Averages (Mean)	Your score Round 1
1	Cross-training	4.2	
2	Informal meetings between business and IT executive/ senior management	4.2	
3	Co-location	4.1	
4	IT leadership	4.1	
5	Executive / senior management giving the good example	4.0	
6	Corporate internal communication addressing IT on a regular basis	4.0	
7	Knowledge management (on IT governance)	3.9	
8	Business/IT account management	3.9	
9	IT governance awareness campaigns	3.8	
10	Job-rotation	3.6	

Question: Rate the *Ease of Implementation* of each of the following IT Governance practices "Relational Mechanisms" in terms of the influence they play in the ability of organizations to innovate their logistics II in the upstream oil and gas industry

Ease of Implementation			
Rank	**IT Governance practices "Relational Mechanisms"**	**Group Averages (Mean)**	**Your score Round 1**
1	IT governance awareness campaigns	**3.9**	
2	Informal meetings between business and IT executive/ senior management	**3.7**	
3	Executive / senior management giving the good example	**3.7**	
4	Corporate internal communication addressing IT on a regular basis	**3.6**	
5	IT leadership	**3.6**	
6	Co-location	**3.5**	
7	Knowledge management (on IT governance)	**3.5**	
8	Business/IT account management	**3.4**	
9	Job-rotation	**3.3**	
10	Cross-training	**3.3**	