The concept of modularity in the context of IS/IT project outsourcing : an empirical case study of a Belgian technology services company

The Concept of Modularity in the Context of IS/IT Project Outsourcing

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ABSTRACT

Information systems and information technology (IS/IT) services are often outsourced to external partners for multiple reasons. The outsourcing literature is persistently reporting high failure rates in IS/IT project outsourcing. Literature suggests that the IS/IT project outsourcing is a complex maneuver but unfortunately, none of the proposed remedies (mitigating actions) have considered to address the complexity related issue in IS/IT project outsourcing. This paper explores the relationship between the concept of modularity and IS/IT outsourcing, as the concept of modularity has been applied in many other fields in order to manage complexity and enhance agility/flexibility. In order to understand and identify the relationship between the concept of modularity and outsourcing, a case study conducted at a Belgian organization involved in technology services and is part of a research project consisting of four cases. A newly developed systematic approach illustrates, how the concept of modularity can be applied in identifying 'couplings' which may be responsible for increasing complexity to IS/IT project outsourcing. This study is a first attempt to gain insight into this phenomenon.

Keywords: IS/IT Outsourcing, Modularity, Design Rules, Case Study Research

INTRODUCTION

Globalization of the world economy has accelerated the advancements of IS/IT and due to many reasons outsourcing of IS/IT projects became a common practice among contemporary organizations in developed and in emerging economies. The global market of IS/IT project outsourcing is predicted to be nearly $445 billion in 2020 (Monitor Deloitte – 2019, *"outsourcing and shared services 2019-2023"*) and over 94% of '*Fortune 500*' companies are outsourcing at least one major business function (Modarress, Ansari, & Thies, 2014). Despite the prevalence and long experiences of CIO's in IS/IT project outsourcing, the failure of such projects is very common. The literature suggests that at least one in three projects was considered a failure and many projects were delayed, ran over budget, and were not able to meet their pre-defined targets (table 1).

Many suggestions have been uttered by both scholars and practitioners on how these problematic outsourcing initiatives can be improved. Peterson and Carco (1998) suggested *streamlining operation* and *fixing the problem* before outsourcing. Other management-oriented suggestions included the *partnership model* (Lambert, Emmelhainze, & Gardner, 1999), the *seven steps to successful outsourcing* (Greaver, 1999), *knowledge sharing* (Lee, 2001), *knowledge transfer* (Rottman, 2008), high quality *service level agreements (SLA)* (Harris, Herron, & Iwanicki, 2008), and the *reconfiguration of organizational resources* (Zheng & Abbott, 2013). The objective of this study is mainly to focus on the high percentage of failure in IS/IT project outsourcing, indicating the potential usefulness of or need for a different lens or approach than the mainstream, management-oriented research which mostly comes from the traditional domains (i.e., Economics, Management Sciences, and Organization Sciences). Indeed, several authors already pointed out inherent complexity and weaknesses in the current IS/IT outsourcing approach. Although IS/IT project outsourcing is considered by many scholars as a complex business strategy (e.g., Beulen & Ribbers, 2003; Jacques, 2006), many customer organizations do not even fully consider the risks associated with IS/IT project outsourcing and often fail to make decisions systematically and rigorously (Oshri, Kotlarsky, & Willcocks, 2015). Aron, Clemons, and Reddi (2005) suggest that the complexity of processes plays a significant role in IS/IT project outsourcing decisions. Cohen and Young (2006) argue that *ad hoc* sourcing approaches of yesteryears are ineffective in today's complex world. Findings from the research of *British Computer Society* indicates that complexity is the most common attribute to the failed outsourced IS/IT projects (Nauman, Aziz, & Ishaq, 2009). The findings from aforesaid studies further strengthen the argument in literature that IS/IT project outsourcing is a complex maneuver and inherent complexity is one of the main reasons for high failure rate of IS/IT outsourced projects. IS/IT project outsourcing is often considered from a non-

technical, IT-management point of view. But this study is using a different lens (the concept of modularity) to look at the high failure rate. The reason of using the lens of the concept of modularity is its successful use in addressing the complexity in system sciences, design sciences, manufacturing, engineering, and in many other domains (Baldwin & Clark, 2000; Schilling, 2000; Simon, 1962 & 1996). Simon (1996) asserts that systems complexity can be better managed using the concept of modularity as it offer greater flexibility and agility. This study contributes to the efforts being made in formulating a newly developed systematic approach illustrating, how the concept of modularity can be applied in identifying 'couplings' which may be responsible for increasing complexity to IS/IT project outsourcing. In the following literature review section, the term 'IS/IT outsourcing' and 'modularity' in the context of this paper is briefly explained.

Table 1. IS/IT project outsourcing: success and failure in literature.

DISCRIPTION	AUTHOR/S
60% of the customer organizations were not able to meet their pre-defined targets.	Schmidt, Zoller, & Rosenkranz (2016)
78% of the customer organizations discontinued either by switching vendors or terminating the projects	Gorla & Lau (2010)
78% of cases demonstrate, in long term the relationship between customer and vendor reaches the point of failure	Mehta & Mehta (2010)
44% failed projects: either cancelled prior to completion or delivered but never used 32% challenged projects: late, over-budget, and / or with less than the required features & functions 24% projects were success	Cric & Rakovic (2010)
24% projects brought back in-house (back-sourced)	Tadelis (2007)
35% projects failed	Gay & Essinger (2000)

LITERATURE REVIEW

In order to conduct the research project which consists of four cases, an exhaustive literature review was performed but, in this paper, due to space limitations, a brief description about IS/IT outsourcing and the concept of modularity has been provided.

IS/IT Outsourcing

In general, 'outsourcing' is a very common term used in many fields (i.e., Design, production systems, engineering, agriculture, services, etc.) including IS/IT. In last three decades, outsourcing became an essential part of the contemporary business model and is referred to an agreement in which an organization (customer) hires an external organization (vendor) to be

responsible for a planned or existing activity that is or could be done internally. Sometimes, outsourcing agreement involves transferring employees and assets from one organization to another. There are many forms of outsourcing exist, for instance, offshore outsourcing, captive off-shoring, near-shoring, and on-shoring, etc. This study is using *'outsourcing or IS/IT project outsourcing'* as a key term which includes all form of outsourcing arrangements. Among many services, IS/IT project outsourcing may include application development, application support, systems integration, data management, data center management, distributed computing services, and telecommunications-network management (Lacity, Yan & Khan, 2017).

The Concept of Modularity

The modularity concept originated in systems science and is generally used in design, manufacturing, and engineering domain, where it is used, amongst others, to control complexity and provide flexibility/agility to products and production processes. Besides domain-specific theories, also general, domain-independent research has been conducted, for example by Baldwin and Clark at Harvard Business School (Baldwin & Clark, 2000). Modularity is defined as a property of a complex system, whereby the system is decomposed into several subsystems or in modules (Baldwin & Clark, 2000). Simon (1962) explains modularity as *"nearly decomposable systems, in which the interactions among the subsystems (modules) are weak, but not negligible"* (p.474). A complex system, whether it is a product design, organization structure or business process, consists of parts that interact and are interdependent to some degree (Sanchez & Mahoney, 2013). Therefore, in a good modular design, modules are as independent as possible; however, some degrees of dependencies are necessary so that the system functions together as a whole. Modules are less complex than the larger system as modules are the decomposed and nearly independent parts of a larger complex system. The decomposition of a larger system into modules allows breaking apart or splitting up the complexities into smaller pieces (modules). The split modules are still mutually compatible as they work together as a whole towards a common goal. The modules' compatibility logically follows the adoption of specific 'design rules' using an interface as a connector (Baldwin & Clark, 2000; Langlois, 2002). The concept of modularity places great emphasis on the interface and suggests that the characteristics of a good interface are that it should be well-defined, exhaustive, and unambiguous (Benazeer, S., De Bruyn, P., & Verelst, J., 2017). The interface describes the inputs required by a module to perform its part of the functionality, and the output that a module will provide to its external environment (which includes the other modules embedded in the system). The amount of dependent design parameters between different modules determines their coupling. An ideal modular design requires low coupling as a low coupling enables design parameters of the

modules to remain stable, that is, any change in the design parameter of one module has no or limited impact on the design parameters of other modules. A good modular design, therefore, exhibits the following two properties: (a) if the design of one module needs to be changed, the change will have no or only a limited impact on the design of other modules, and (b) the function of one module can be studied more or less in isolation from the functionality of the rest of the system. In order for inter-modular dependencies to work adequately, all inter-modular dependencies should be clearly defined/made explicit *ex-ante* so that no hidden dependencies are allowed for (Benazeer, S., De Bruyn, P., & Verelst, J., 2017). If all inter-modular dependencies in a system are clearly defined, a set of prescriptive rules are obtained, which all the modules of the system need to adhere to. This set of rules is referred as the 'modular architecture' (Benazeer, S., De Bruyn, P., & Verelst, J. 2017).

METHODOLOGY AND DATA COLLECTION PROCESS

As this study is intended to get better insights of a new phenomenon using the lens of the concept of modularity, an interview-based descriptive, qualitative, case study research approach has been adopted. This qualitative approach was deemed more suitable, as in this context, the goal is to gain an in-depth understanding of the manifestations (the "how") of modularity (Yin, 2009). Moreover, little theoretical knowledge on modularity within outsourcing is currently available, making a more descriptive case study appealing. It is undeniable that the single case approach presented in this paper limits the generalizability of the findings. It is however important to note that this case is embedded within a larger research project, in which four case studies were performed. This should allow applying the perspective within various situations and within different contexts that reflect on the generalizability of the findings in a more informed way. In order to enhance the external validity, in addition to a thematic analysis, a cross-case analysis is also conducted (described in detail in a following section).

The case was analyzed using primary data collected in 2018 through open-ended, semi-structured and exploratory interviews from a senior executive of a Belgian customer organization 'Omega' who was also one of the lead persons for their IS/IT outsourcing project. According to Myer and Newman (2007), the qualitative interview has been used extensively in IS research, is a powerful research tool and an excellent means of gathering data. The open-ended, semi-structured and exploratory interview format allows the researcher maximum flexibility in exploring any topic in depth and in covering new topics as they arise. Furthermore, Mintzberg (1979) asserts that *"semi-structured interviews provide a controlled framework which facilitates analysis but also allows for the collection of 'soft' anecdotal data"* (p. 587). It is intended to allow the informants as much freedom in the interviews as

possible as it is crucial to ensure that the interviewer does not in any way prejudges the evidence offered by them. Informant in the organization was selected using key informant method (Yin, 2014). Informant needed to satisfy two conditions: i) having sufficient knowledge about the concept of modularity and being experienced in working with an external partner; and ii) should be willing to participate in the study (Campbell, 1985).

In the case of modularity and IS/IT project outsourcing, generally top executives are involved in decision-making process. Therefore, the aim was to interview the most senior executive of the organization. The data was collected from multiple sources, for instance, semi-structured onsite interviews of six sessions (with each session lasting for two hours), direct observations during four onsite visits by three investigators, online archival records, documentation & presentations by the informants, and media outlets. Data triangulation was performed by comparing coded data from different sources (i.e., interview, direct observations, online archival records, documentation and presentations by the informants, and media outlets). During the primary data collection process, three persons were directly involved in conducting the onsite visits and conducting onsite interviewing processes. Among these three persons, the first person was a senior university professor and a theorist from the IS/IT field, the second person was a postdoctoral researcher, and the third person was the Ph.D. candidate. Data was collected and matched with the previously collected qualitative data from other three cases, and finally, after analyzing these data, a conclusion was derived. The presence and active participation of three investigators assured investigators triangulation and at the same time addressed some of the concerns generally linked to case study research (Flyvbjerg, 2006); for instance, researcher's intentional or unintentional bias and misleading interpretation (Fields & Kafai, 2009), the influence of personal lens (Jackson, 1990).

THEORETICAL BACKGROUND AND RESEARCH QUESTION

The findings from the literature review suggest that in software development and/or business applications the use of modularity is prevalent. For instance, some modularity aspects such as 'interface', 'encapsulation' or 'information hiding', 'separation of concerns', and loose coupling, etc. are widely used in software development projects. The IS/IT project outsourcing is often dealing with the software and/or business application developments. These relationships between complexity, modularity, and IS/IT project outsourcing and the insights from the literature guided the authors to think about the potential use of the concept of modularity as an ideal theoretical lens in the context of IS/IT project outsourcing. In order to study the application of the modularity concept in the context of IS/IT outsourcing, a broad, exploratory investigation has been conducted to look for

the phenomena in the context of IS/IT outsourcing that can be interpreted as modular structures. These phenomena could be instances, examples or counter-examples of modularity in a wide-variety of aspects of IS/IT-outsourcing, both product- and process-oriented, both at the technical and/or at the non-technical (organizational) level. Product-oriented refers to the artefacts under production in the context of IS/IT-outsourcing, and could include software and software specifications, and modularity aspects such as coupling and interfaces. Process-oriented refers to the production process of artefacts, where IS/IT-outsourcing could be interpreted as modularity in terms of tasks shifting between two teams (resources) and organizations. The technical level refers to modular structures in software (from specifications to the programming code), whereas the non-technical (organizational) technical level refers to the possibility of interpreting 'IS/IT outsourcing' as *'organizational modularity'* in the sense that two organizations collaborate and communicate based on an SLA (interface).

In addition to identifying instances, examples and counter-examples of modularity, this study strives in obtaining indications of their relevance or importance in terms of the IS/IT outsourcing project. This relevance or importance can be derived in multiple ways, including: first, instances/examples/counterexamples could be unimportant in the sense that they have little or no impact on the efficiency, effectivity, success or failure of the project. On the other hand, they could be linked to known issues or success/failure factors in the project, which makes their relevance or importance more likely. Second, if instances/examples/counterexamples are related to design rules, design principles or theories regarding modularity, they could derive relevance from these theoretical foundations. For example, a known violation of a modularity design rule is likely to have, based on its theoretical grounding, an a priori negative impact on the modularity aspects of the products and processes that it is a part of. In this sense, the theoretical grounding establishes a certain measure of relevance or importance of the instance/example/counter-example. In order to pursue the abovementioned research goal, the research questions are formulated as follows:

RQ1: *Which instances (examples, counter-examples) of the use of modularity in the context of IS/IT outsourcing can be identified?*

RQ2: *How can the relevance and/or importance of these instances (examples, counter examples) for IS/IT outsourcing project be assessed?*

CASE INTRODUCTION

The selected case deals with a vendor organization referred to as *'Alpha'*, and a customer organization referred to as '*Omega*'. '*Alpha*' was regarded as a competent service provider. *'Alpha'* has been on a long-term contract with one of the competitors of '*Omega*'. '*Omega*' was one of the biggest technological services companies in its sector in Belgium. The IS/IT outsourcing project involved managing and maintaining the entire IS/IT systems of '*Omega*'. The total number of employees of '*Omega*' was 'x', of which 'y' numbers were highly skilled employees who were managing and maintaining the IS/IT systems since long *(Due to confidentiality reasons and to maintain anonymity, some information was masked as requested by the informant)*. However, recently it was decided to outsource the entire IS/IT systems to '*Alpha*'. The main motivation of the IS/IT outsourcing was cost reduction. As part of this outsourcing contract, almost all of the IS/IT headcounts were transferred from the '*Omega*' organization to the '*Alpha*' organization with job guarantees for a certain period. Those people were highly skilled IS/IT experts and were well paid due to their long experience. The contract period was of medium terms (5-10 years) and at the time of the interviews a 2nd year was running. Since a decade, '*Omega*' has also outsourced some of its vital activities (non-IS/IT) to another vendor.

FINDINGS

Analyzing the case, it has been revealed that some decisions had been taken by the customer organization that might have led to the difficulties of the IS/IT outsourcing project. Concerning the service level agreement (SLA), the informant stated that: *"The contents of the deal (SLA) are determinant of whether the outsourcing goes well or not"*. Even though the statement is a valid one, it does not facilitate an understanding of why (some) decisions were made, or why the problematic consequences occurred. In order to investigate in depth and to find the root causes, it is worthwhile to analyze the SLA from a modularity perspective. In analyzing the case, some flaws regarding the SLA were identified. For instance, incongruent with modularity, the SLA contained 'hidden dependencies'. In addition to the SLA, other violations of the principles of modularity were found as well. The analysis of the case, therefore, follows two recurring steps. First, to adequately identify a modular structure in a certain part of the case and then, requirements suggested by the concept of modularity for that structure, are described in a subsection *'Identifying the modular structure and requirements'*. Second, the description of the presented case illustrates how violations or non-conformance to the modularity requirements occurred under a subsection *'Assessing the modularity*

requirements'. Obviously, any violation or non-conformance of modular design principles may, at least partially, contribute to the underperformance of IS/IT outsourcing initiatives.

ANALYSIS # 1: IS/IT SYSTEMS

D*ependency* is the degree to which a module relies on other modules in order to function and *coupling* is a measure of the dependencies between modules (Benazeer, S., De Beuckelaer, A., Verelst, J., Mannaert, H., & Huysmans, P., 2012).

Identifying the Modular Structure and Requirements

From a modularity perspective, the 'system in scope' is the 'IS/IT system' of organization '*Omega'*, and within aforementioned system, different 'IS/IT services' are conceived as modules. The configuration earlier described about the conceived 'system' and its 'modules' is referred to as *modular structure 'MS1'* and the focus is on the '*coupling'* aspect of the concept of modularity. As Simon (1962, 1996) asserts that an ideal modular design should consist of *'low/loosely coupled'* modules which he called as *'nearly decomposable systems'*. A low/loosely coupled modular system facilitates agility, flexibility, and evolvability in a changing environment (Sanchez & Mahoney, 2013). A non-agile and non-flexible highly/tightly coupled system inhibits change and therefore is a violation of the modularity requirements. Hence, a loosely coupled modular system that facilitates agility and flexibility is referred to as *modularity requirement 'MR1'*.

Assessing the Modularity Requirements

The presence of undefined/undocumented (hidden) inter-modular dependencies was one of the reasons that the informant during the interview labeled the IS/IT systems of '*Omega*' as '*spaghetti*', '*cobweb*' and '*usine à gaz*'. In one occasion the informant expressed the following: *"In our cobweb, everything works with chains. A task starts with one machine, processed by 2nd, 3rd, and will end in the 'n' machine. If a problem occurs in any one of these chains (machines), the entire process is blocked"*.

The above excerpt draws a picture of tightly coupled systems. The informant further said that: *"Our (IS/IT) systems are not independent (loosely coupled) of one another, it is like a cobweb or 'usine à gaz'*. While explaining the IS/IT outsourcing contract, the informant said that: *"It was a complete 'usine à gaz' and at the technical level, it was almost impossible to split. There are too many connections which are dependent on one another"*. These excerpts in the above paragraphs confirm

that the IS/IT system of '*Omega*' was tightly coupled, hence it can be concluded that *modularity requirement 'MR1'* mentioned above was not met.

ANALYSIS # 2: SLA

Modules should communicate with one another through interfaces (Langlois, 2002). An interface is a common boundary where direct contact between two modules occurs and where these two modules communicate with each other. The interface is a virtual or physical document where the rules of interaction among modules are exhaustively and unambiguously documented. The interface describes the inputs required by a module to perform its part of the functionality, and the output it will provide to its external environment (which includes other modules in the system). In the context of IS/IT project outsourcing, the SLA can be considered as an interface between two modules, the vendor and the customer (*'Alpha'* and *'Omega'*). The importance of an ideal SLA relating to the success of the IS/IT project is recognized and understood by the informant.

Identifying the Modular Structure and Requirements

'The outsourcing collaboration' is the 'system in scope' and within aforementioned system the organization '*Alpha*' and the organization '*Omega*' are conceived as modules. The configuration earlier described about the conceived 'system' and its 'modules' is referred to as *modular structure 'MS2'* and the focus is on the '*interface (SLA)'* aspect of the concept of modularity. The SLA serves as the interface connecting both organizations. To function adequately, the interaction between modules '*Alpha*' and '*Omega*' should be exhaustively and unambiguously documented in the interface. As far as the SLA is concerned, responsibilities of each module, rights of each module, and the relationships between modules are to be described in detail. In the context of IS/IT project outsourcing, the SLA essentially provides an interface between the vendor and the customer. Hence, all the interactions and settlements between modules '*Alpha*' and '*Omega*' should be conducted through the interface (SLA) and aforementioned requirement is referred to as *modularity requirement 'MR2'*.

Assessing the Modularity Requirements

As long as the highly skilled former employees of '*Omega*' were working for '*Alpha*', no major problems were reported but since '*Alpha*' started replacing those highly skilled people, problems started to surface. Although it was stated in the SLA that the '*Omega*' would get similar services as it was used to get from the in-house team, the actual situation seems to be different. The following

excerpts are highlighting the actual situation: *"It was stated (in the SLA) that we would get similar services". The informant further said that: "Probably, there is something behind. Why they are not delivering, why? Are they not capable or is it something financially not interesting for them to deliver in time"?* The '*Omega*' team did not include several items in the SLA and as a result, they have to ask for extra services from the '*Alpha*' team for which the '*Alpha*' team charges them extra. As a result, the cost reduction motivation was overshadowed. An example can be given about the incomplete SLA from the following excerpt: *"We have to ask for extra things (services), it was not calculated in the predicted cost reduction".* The service delivery situation became so uncertain that the service managers from the '*Omega*' team had to travel regularly to the site of the '*Alpha*' organization in order to explain the priorities of '*Omega*' team, and to explain the '*Alpha*' team what they needed to do in order to deliver in time. At some point, it seems that the urgency and frustration triggered to ignore the SLA which is reflected in the following excerpt: *"Our service managers are physically travelling 2-3 times a week to the vendor in order to explain to them what the priorities are and what they need to do, jamais-vu"*. Later the informant added that: *"I don't think that the SLA is important right now, it just has to work"*. Although the importance of a well-defined SLA is recognized by the informant, probably, this realization came too late. The above excerpts illustrate that the interface (SLA) was weak, vague, ambiguous, incomprehensive, inexplicit, and not well defined; therefore, the *modularity requirement 'MR2'* mentioned above was not met.

ANALYSIS # 3: CHANGING THE TEAM COMPOSITION

Change is inevitable within organizations and accommodating change poses a challenge. The following discussion is about highly skilled IS/IT experts who were transferred to the '*Alpha*' organization. In analysis #3, non-technical root causes of failure are dealt with. The team's composition can be interpreted and explained in terms of modular structures (Benazeer, S., Huysmans, P., De Bruyn, P., & Verelst, J., 2018; Huysmans, P., De Bruyn, P., Benazeer, S., De Beuckelaer, A., De Haes, S., & Verelst, J., 2014). Furthermore, Terlouw (2011) states that, *"modules can comprise humans and/or software systems"* (p. viii), and in addition, Dietz (2006) proposed a method to identify modular actor role structures and thereby asserts that *"an enterprise is constituted by the activities of actor roles, which are elementary chunks of authority and responsibility, fulfilled by subjects"* (p. 81). The main purpose of transferring IS/IT experts from '*Omega*' to '*Alpha*' were cost savings. The IS/IT experts had had long experience of working in blue-chip companies and as a result, they were very expensive people. '*Alpha*' replaced those highly skilled and expensive people by younger and less experienced people in order to reduce cost. '*Alpha*' succeeded in cost savings

but failed to deliver the services, although it had been mentioned in the SLA that '*Omega'* would get at least the same level of services as it used to get by in-house experts.

Identifying the Modular Structure and Requirements

From a modularity perspective, the 'system in scope' is the group of highly skilled IS/IT experts that once belonged to the '*Omega*' organization, but which was transferred to the '*Alpha*' organization with job guarantees for a certain period. Within aforementioned modular structure, 'a highly skilled individual employee' is conceived as a module. The configuration earlier described about the conceived 'system' and its 'modules' is referred to as *modular structure 'MS3'*. The focus of the analysis is on the '*substitution*' operator which is part of the modularity concept (i.e., a modular operator). In the following, some examples from modularity literature explain that substituting a module with another should guarantee improved or at least same functioning of the system. For instance, literature suggest that, *"substituting an older version of a module with the newer version should ameliorate the overall performance of the system"* (e.g., Huysmans, P., De Bruyn, P., Benazeer, S., De Beuckelaer, A., De Haes, S., & Verelst, J. 2014; p. 4418). Baldwin and Clark (2000) state that *"The substitution operator allows a designer (or user) to swap one module of the system for a better version of the same module"* (p. 262). Furthermore, Terlouw (2011) asserts that *"the modular operators are the actions that may change existing structures in a well-defined way in order to enhance the efficiency of the system"* (p. viii). The substitution modular operator can be applied successfully and relatively easily if all module versions adhere to the same interface and no undocumented or hidden inter-modular dependencies are present. If the interface is changed, or the dependencies of the modules are not made explicit, the application of the substitution modular operator is not without risk; one risk is that applying the substitution operator disrupts the working of the system and may trigger couplings and ripple effects. In a well-designed modular system, applying the modular operator '*substitution*' should not impact the existing structure negatively and aforementioned requirement is referred to as *modularity requirement 'MR3'*.

Assessing the Modularity Requirements

As mentioned earlier, the conditions to successfully replace a module are 'same interface' and 'no unidentified or undocumented dependencies'. Replacing modules in a system with undocumented/hidden dependencies is a risky maneuver and success in IS/IT project outsourcing may not be guaranteed. As it has been observed, the IS/IT system of '*Omega'* consisted of many undocumented dependencies (shadow IT) and the knowledge about undocumented dependencies was inherent in the older versions of modules (former '*Omega*' employees). When the modules were

replaced, the knowledge of the undocumented dependencies was also lost. As a result, substituting modules with newer versions was negatively affecting the efficiency of the project, which can be observed from the following excerpt: *"Now the circumstances have changed. Now when I contact 'Alpha' organization, I can't find my ex-colleagues anymore. Change of people triggers changing the circumstances. The level of knowledge and working practices of new incoming people are inferior comparing to my ex-colleagues"*. Furthermore, the informant said that: *"Our contract with 'Alpha' has just passed more than a year and most of our highly skilled colleagues were replaced by the younger and less experienced people"*. Change of people not only caused delays in delivering services but in some cases, it was much more complex as the knowledge of the outgoing peoples was not retained. The following excerpt briefly explains the situation: "Alpha *took the entire spaghetti of* 'Omega' *intact and they do not have adequate knowledge about the legacy of* 'Omega'. *The team of* 'Alpha' *does not know how to decouple it as some parts of this legacy is recorded in specs and manuals, but some parts are 'shadow IT'. The problem becomes more complex as many authors of that shadow IT have left the organizations of* 'Alpha' *and* 'Omega'. *Some systems are still working but people don't know how they work"*. The above excerpt illustrates that applying the modular operator *'substitution'* resulted in problems. This led to delays in deliveries and the service managers of '*Omega*' have to visit the '*Alpha*' site in order to explain what to do and how to do. Therefore, in this situation and in the context of this case, it can be concluded that the *modularity requirement 'MR3'* was not met.

Table 2. Summary of the findings.

MODULAR STRUCTURE ('System in scope' in CAPITAL letters)	MODULARITY ASPECTS	MODULARITY REQUIREMENTS (EX ANTE)	CONFORMANCE
(Configuration MS1) THE IS/IT SYSTEM *The IS/IT services of IS/IT systems conceived as modules.*	Coupling	A loosely coupled modular system facilitates agility and flexibility.	Not met
(Configuration MS2) OUTSOURCING COLLABORATION *Organization 'Alpha' and Organization 'Omega' are conceived as modules.*	Interface/SLA	Interface should be exhaustive, explicit, unambiguous, and well defined.	Not met
(Configuration MS3) THE IS/IT DEPARTMENT OF OMEGA *Individual IS/IT employees are conceived as modules.*	Modular operator 'substitution'	The substitution operator can be applied successfully if adhere to the same interface without any unidentified or undocumented dependencies.	Not met

CROSS CASE ANALYSIS

This 'cross case analysis' section has been added to illustrate the true essence of the findings as the results from the present analyzed case (a single case study) may not be enough convincing for many readers. Cross-case analysis is a research method that facilitates the comparison of commonalities and differences in the events, activities, and processes that are the units of analyses in case studies (Khan & Van Wynsberghe, 2008). In multiple case study research, commonalities across multiple instances of a phenomenon may contribute to conditional generalizations or in other words, the findings may be applicable to other contexts as well (Miles, Huberman, & Saldana, 2013). But the purpose of this study is not to seek a generalization of any form, instead this study strives to find the instances of modularity and its relevance or importance to the IS/IT project outsourcing. Hence, the aim is to demonstrate that the outcomes in the selected cases are in fact enough alike to be treated as instances of the same thing. The following table 3 illustrates in what ways the cases are alike which may deepen understanding and explanation about the relevance of the concept of modularity. The IS/IT literature suggests that there are three steps to follow while conducting the cross-case analysis (e.g., Cruzes, Dybå, Runeson, & Höst, 2015). These steps are, data reduction, data display, conclusion drawing and verification. The first step, 'data reduction' is accomplished by table (2) at the end of the analysis section. The second step, 'data display' is done by illustrating all the instances of modularity found in four cases in a single table (3). Finally, the third step, 'conclusion drawing and verification' is accomplished by illustrating a refined table (4) where instances of modularity are categorized in two different levels of modularity (i.e., organizational modularity and technical modularity).

Table 3. Cross case analysis of the findings.

MODULARITY ASPECTS	CASE1	CASE2	CASE3	CASE4	RESULTS
Interface / SLA	X	X	X	X	4
Modular Architecture	X	X		X	3
Modular Operator		X	X		2
Cohesion	X			X	2
Dependencies		X			1
Coupling			X		1
Separation of Concerns	X				1
Design Rules		X			1
Encapsulation					0
Standards					0

Table 3 illustrates the result of cross-analysis using replication logic approach. In this analysis, it can be observed that some modularity aspects have emerged multiple times illustrating the level of relevance in analyzed four cases. For instance, 'Interface/SLA' as the most relevant modularity aspect has emerged in all four cases. The second most relevant modularity aspect 'modular architecture' has emerged in three cases. The third most relevant modularity aspects 'cohesion' and 'modular operator' have both emerged in two cases and the least relevant modularity aspects 'design rule', 'dependencies', 'coupling', and 'separation of concerns' have emerged in one case. It is pertinent to mention that the level of relevancy is a context specific factor. The above illustrated results in table 3 are relevant in the context of four analyzed cases. In other contexts, the outcome may differ, but the contribution of this cross-case analysis at least facilitates in broadening the understanding about the weight to each aspect are attributed.

RESEARCH RESULTS

Answering the first research question, this study provides instances or examples of the role of modularity in the context of IS/IT outsourcing, at two levels; technical and organizational (table 4). Answering the second research question, these instances or examples can be linked to several theoretical frameworks, design principles and success/failure factors, providing further indications of their importance in IS/IT outsourcing projects. These instances or examples in the case can be interpreted as violations of, or at least insufficient attention to, well-known design principles on modularity, thereby providing indications that they likely negatively impact aspects such as complexity and project success. The global impression resulting from this study is that IS/IT outsourcing projects deal with several types of modular structures (technical, organizational) and their implications (knowledge, communication). This implies that the aspects of these modular structures actually do play a role in IS/IT outsourcing, and could be studied not only at the high, abstract level that is already dealt with in management- and IT management-research. In the following, the identified instances of modularity at two levels are briefly described.

Organizational Modularity

The term '*organizational modularity'* refers to the application of modularity not to technical artefacts, but to artefacts like organization structures, departments, projects, teams and others. In this context, an IS/IT outsourcing project can be considered as a modular structure consisting of two (or more) organizations, i.e., the vendor and customer organization, transferring a number of responsibilities for IS/IT-systems under a collaboration defined in an SLA. The SLA can then, in

terms of modularity, be considered as the interface of the modules. Even though the importance of an SLA is universally recognized in the literature, the point of view of modularity taken in this study resulted in interesting observations. In this case on total IS/IT outsourcing by a Belgian Service organization, the replacement of formerly in-house IS/IT staff by new hiring's, led to a loss of knowledge. This also exposed incompleteness in the SLA with the customer organization asking for supposedly additional services from the vendor organization which led to additional financial claims, as well as frequent and costly visits to the vendor organization in order to clarify uncertainties in the priorities and setup of the IS/IT outsourcing project. Many sources stress the importance of completeness of an SLA. However, it remains interesting nonetheless that these recommendations can be related to a (technical or systems theoretic) concept such as modularity, which prescribes that interfaces should not contain hidden dependencies, which implies completeness. The fact that the insights based on modularity correlate with insights from other sources, still constitute an indication of the relevance of the role of modularity in the context of IS/IT project outsourcing, even if they are not new.

Table 4. Identified instances of modularity.

Instances of Modularity	MODULAR SYSTEMS * (Modularity Aspects) *
Organizational Modularity (Coupling)	OUTSOURCING COLLABORATION (Interface/SLA)
	HIGHLY SKILLED IS/IT TEAM (Modular operator "substitution")
Technical Modularity (Coupling)	IS/IT SYSTEMS (Low/loose coupling)

* 'Modular Systems' in capital letters; 'Modularity Aspects' in brackets

Technical Modularity

Even though this study was not specifically oriented at the technical or software level, it is interesting to see how relevant technical coupling was in this case. Although mostly absent, or at best present only implicitly or at high levels of abstraction in many studies in the management- and IT management-literature, this case provided instances or examples of the role of technical coupling and modularity in IS/IT outsourcing projects. In this case, the contract was only in its second year running at the time of the case, but already issues were reported as personnel changes by the vendor organization crucially implied loss of technical knowledge about the complex IS/IT systems

involved. This complexity was clearly related to modularity, as the highly coupled nature of the IS/IT systems was described as a 'cobweb', 'usine a gaz', and 'spaghetti', leading to a dependency on the knowledge of previously in-house IT-staff of these specific highly coupled systems. Hence, it is clear that in this case, the modularity aspects of technical coupling play a considerable role in the IS/IT outsourcing projects. On the one hand, this is to be expected in the sense that several cases are concerned with systems of significant size and complexity in terms of modular structures in the software. On the other hand, as pointed out before, recently, there has been considerable optimism in the software engineering world that recent technological advances such as service-oriented architectures and micro-services have resulted in 'plug-and-play'-like IT landscapes in enterprises. This view would suggest that modularity causes minimal technical issues in outsourcing projects, and actually enables strategies such as multi-vendor IS/IT outsourcing and even back sourcing. The issues observed in this case seem to support the first point of view. This also implies that one cannot hope that merely outsourcing IS/IT systems, makes the issues in their modular structures disappear. In fact, it is more likely that they will resurface in the context of the IS/IT outsourcing project, and at that point, the only instrument or steering mechanism the customer organization has (sometimes limited) to deal with these issues, is the SLA. Summarizing, this case provides indications of the importance of technical modularity, and both the scholars and the practitioners should pay more attention to these issues.

REFLECTION

One of the main motivations of IS/IT project outsourcing is to concentrate more in the core competency and outsource the noncore activities. But by outsourcing the noncore activities, organizations intend to forget those activities and anticipate that those noncore activities should work as a '*black box*' or as *'plug and play'* with minimum interventions. When a system is commoditized as a result of good modular architecture, a few skilled people are required to run or to maintain it. Moreover, it is possible to avoid the risk of *'vendor lock-in'* when a system is commoditized, and it gives greater agility and flexibility in choosing or switching vendors. Otherwise when the system is like '*usine à gaz*', or a *'white box'*, the organization becomes dependent on skilled peoples to run or maintain it. This implies the relationship underlying between the concept of modularity, IS/IT outsourcing, and knowledge. For instance, in this case the main purpose of IS/IT project outsourcing was to reduce cost. But in order to provide services at low cost, the vendor 'Alpha' needs to replace knowledgeable (who has good knowledge about the system) people who were inherited from the customer organization '*Omega*'. As the system was not commoditized, remained as '*usine à gaz*',

replacing those knowledgeable and expensive people was not possible. Since '*Alpha*' replaced those highly skilled people by under qualified persons, everything went wrong.

Following the reasoning from the modularity point of view, in this case, there was a contradiction in the initial setup. The goal is to cut cost, which is directly associated with commoditization, but this was never possible in the first place because the underline products/services were not commoditized. The following excerpt from the informant confirms this assertion: *"Although the purpose was cost reduction but at the end it is becoming very expensive"*. As many skilled people left the new organization (*Alpha*) after transferring from '*Omega*', the organization '*Omega*' became an empty company in terms of knowledge. In this emerging situation organization '*Omega*' finds itself in a *'vendor lock-in'* scenario where reversibility or back-sourcing was no more possible. The following excerpts from the informant confirm this assessment: *"We cannot do rollback (vendor lock-in)"*. Applying the concept of modularity in the context of IS/IT project outsourcing implies that in a good modular architecture the outsourcing contract should be reversible employing low efforts (Sako, 2003) but, in this case, it was not possible as the organization *'Omega'* has lost the required knowledge to trigger 'back-sourcing'.

DISCUSSION AND CONCLUSION

This study provides interpretations of phenomena in IS/IT outsourcing projects based on the concept of modularity, as instances or examples of modular structures with indications of their importance based on links to theoretical frameworks, design principles or success/failure factors. These interpretations provide better insights to IS/IT project outsourcing researchers and can contribute to a richer understanding about the reasons why they are (not) successful. Table 2 illustrates how some requirements of the concept of modularity were not met. There are many aspects of the concept of modularity (e.g., cohesion, coupling, interface, modular operators, separation of concerns etc.) that should be considered while designing a modular architecture. In each case analysis, case specific relevant aspects of the concept of modularity have been used. Interestingly, when this case observed with an open mind, it was difficult to understand precisely what went wrong and how it is relevant to the concept of modularity. But when the glasses have been changed and the lenses of modularity were put on, slowly the violations of the concept of modularity started to emerge. Aspects of this contribution include the wide range of areas where modularity can be applied and the variety of ways in which modularity influences IS/IT outsourcing projects (including organizational and technical), as well as the significant influence technical modularity issues seem to play, even though IS/IT outsourcing is often considered from a non-technical, IT-management point of view. This case

indeed illustrates many violations against modularity (as well-known modularity design principles are not applied), or a lack of 'attention' to modularity aspects of IS/IT outsourcing projects. As a consequence, this study implies for the addition of modularity aspects as a complement to the current insights and practices regarding IS/IT outsourcing, both in theory and practice. The following section briefly describes for scholars and practitioners to consider the concept of modularity in any future research.

FUTURE RESEARCH DIRECTION

This study provides indications of the role that modularity plays in IS/IT project outsourcing, in a wide range of domains, from organizational to technical, with implications on areas such as knowledge management and communications. In order to build on these indications and maximize the insights that can be gained from modularity in this context, a call for future research to provide more detail on the role of modularity and its potential to address the issues that are currently causing IS/IT outsourcing projects to fail. In other words, a call for the addition of modularity aspects as a complement to the current management-approaches to IS/IT project outsourcing, providing a combination of more management-oriented and more structure-oriented (i.e., modularity-oriented) approaches to provide a richer view of factors influencing the success of IS/IT outsourcing projects.

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