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Enhancing and enabling management control systems through information technology: The essential roles of internal transparency and global transparency

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1. Introduction

Information technology (IT) is a tool that is increasingly being developed to operate as a control technology that enacts and enforces management controls (MC[1]) (Granlund, 2011). How IT is designed and configured can have long-term impacts and restrictions on the effectiveness of MC on firms (Grabski et al., 2011). Furthermore, IT utilization appears to be an important deciding factor for IT success as under-utilization, especially in the immediate post-implementation period, often leads to IT failure (Chou et al., 2014). "*IT implementations produce complex stories about the consequences of integration, standardization, transparency, and real-timeliness, along-side concerns about complexity in designing, implementing, and using IT-embedded MCS*[2]" (Granlund et al., 2013, p.275–276). Yet, we hold limited knowledge about IT usage in the post-implementation phase (Chou et al., 2014), or the impacts of IT in limiting or facilitating desirable MC (Grabski et al., 2011). Many studies also claim IT, in particular ERP systems, has had little to moderate impact on MC (Berry et al., 2009; Granlund et al., 2013) even though IT has been envisaged to bring substantial effects on and for MC (Dechow and Mouritsen, 2005). For example, IT has the ability to improve communication among organizational units and project teams (Corsi et al., 2017), monitor and scrutinise employee work activities (Liew, 2015), thereby enabling MC and monitoring of objectives including employee performance. Calls have been made for more studies that better understand the managerial effects of how control technology actually works, or does not work, in practice (Granlund and Mouritsen, 2003; Granlund, 2011) as well as to identify the critical success factors of using IT for MC aims (Corsi et al., 2017).

The purposes of this article are to explore how IT actually works, or does not work, for MC reasons and how IT can be utilised to produce favourable effects on and for MC. To capture the true effects of IT requires understanding how the two elements, MC and IT, are practiced together across the firm (Dechow and Mouritsen, 2005). It is the "togetherness" of these two elements that

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[1] MC are used for directing employee activities and influencing employee behaviours (Merchant and van der Stede, 2007; Malmi and Brown, 2008). They have the potential to guide employees in completing their designated tasks including making intelligent choices to deal with inevitable contingencies (Ahrens and Chapman, 2004).

[2] Management control systems (MCS) "*include all the devices or systems [that] managers use*" to monitor and ensure employees are acting in the firm's best interest aligning with the firm's objectives and strategies (Merchant and van der Stede, 2007, p.5).

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explains the underlying infrastructure of a control technology in operation. How MC are structured and enforced through IT remains an under-researched topic both empirically and theoretically (Granlund and Mouritsen, 2003; Berry et al., 2009; Granlund, 2011). Understanding how IT-structured MCS actually works, or does not work, in practice is not necessarily about which specific system features of IT are selected for use, but rather about how the entirety of the IT is being brought to use. This can be accomplished by examining the intended and unintended outcomes from actual use of IT post-implementation (Jordan and Messner, 2012). How to make IT works in practice plays an important role given that firms tend to purchase ready-made commercial IT solutions (Granlund, 2011). Nonetheless, firms assume these modern solutions can readily replace existing systems and provide for MC (Dechow and Mouritsen, 2005). They ignore the social effects IT solutions give rise to, such as integration issues, managerial concerns and control implications from competing systems within the firms (Granlund and Mouritsen, 2003; Dechow et al., 2007; Berry et al., 2009; Granlund, 2011; Granlund et al., 2013). The ways in which management control systems (MCS) are designed, implemented and organised determine whether they are enabling or coercive (Free, 2007; Chapman and Kihn, 2009; Jørgensen and Messner, 2009; Jordan and Messner, 2012). An enabling MCS helps increase the chances of system success as well as improve firm performance (Chapman and Kihn, 2009). A coercive MCS fixates on tasks completion and rules compliance without room for judgment calls (Ahrens and Chapman, 2004). There are four design principles (Adler and Borys, 1996) that distinguish whether a MCS is enabling or coercive (Free, 2007), namely repair, flexibility, internal transparency and global transparency. On the contrary, there are mixed findings about whether all four design principles are needed to determine if a MCS is enabling (Chapman and Kihn, 2009; Dowling and Leech, 2014). Particularly, which design principles play leading/subordinate roles in determining whether a MCS is enabling, as well as in deciding how substantial an impact IT provides on and for MC. This study uses new product development as a context to address this research question.

New product development (NPD) is a process of developing and producing a new product to market. The level of newness may simply be the result of minor modifications to an existing product (known as incremental innovations), or a new product that has never been introduced in the firm or the industry (known as radical innovations). NPD practices often employ MCS to reduce uncertainty (Davila, 2000) and manage risk (Barczak et al., 2007). Radical innovations tend to have higher amount of uncertainty and risk than incremental innovations. There are two particular MC that are commonly used to "*create the needed structure for managing projects, supporting coordination between different functional groups, and reducing uncertainty and error*" (Schultz et al., 2013, p.1). Although independent, these two controls, known as project management and Stage-Gate™ Product Innovation Process (hereafter referred to as the Stage-Gate process), are often employed together to complement each other rather than as substitutes (Cooper, 2008). However, these two controls *"have different aims and are carried out at different hierarchical levels*" (Schultz et al., 2013, p.4).

The Stage-Gate process is a conceptual and operational roadmap that was developed from best practice (Cooper, 1990). It is a process designed to recommend certain activities and tasks to be undertaken at specific times of each project and to direct individuals involved to advance NPD projects from idea inception through to product launch (Cooper, 1990; Cooper, 1994). It is a widely adopted NPD practice for managing the progress of individual projects (Griffin, 1997) but not in managing resource allocation across multiple projects (Cooper, 1994). The structure helps bring discipline and efficiency to NPD (Cooper, 2008) and aids in the management of individual NPD projects (Griffin, 1997). The Stage-Gate process alternates between a "stage" and a "gate". "Stages" are investigation and development activities conducted by the project teams throughout the NPD process. "Gates" are meetings held at specific points in time within the NPD process to discuss, consider and decide on the advancement of NPD projects. The more complicated the innovation, the more "stages" and "gates" there are for the project. Radical innovation is considered as the most complex innovation consisting of the full six "stages[3]" and five "gates", as depicted in Table 1 below. The newness in a radical innovation may simply be an innovation that has never been produced by the firm. The less complicated and/or simple innovation will consist of fewer "stages" and "gates". There is also an optional sixth "gate" Post Launch Review, not shown in Table 1 below, that reviews and assesses whether to continue or discontinue the production of launched products.

The administration of Stage-Gate conventions can be carried out manually through human efforts (commonly known as paper-based) or mechanically through the use of IT. Jørgensen and Messner (2009) presented a seminal MC case study that examined the administration and adherence of Stage-Gate conventions carried out and maintained through human coordination efforts. Nonetheless, we know little about the use and effectiveness of IT for managing an NPD process (Sarin, 2009; Kawakami et al., 2011) even though firms are progressively adopting IT solutions to manage their NPD process (Barczak et al., 2007). Granlund et al. (2013) argue that more research is needed to better understand the relations between modern IT, decision making and MC. In particular, the use of ready-made commercial IT solutions (Granlund, 2011), and the use of IT to solicit, elaborate and match information for better collaboration, decision making and MC (Corsi et al., 2017).

A case study approach (Silverman, 2010) was adopted to examine the use and workings of an IT-structured MCS through the interactions of individuals. In this study, the use of an IT for MC purposes is about how the entirety of the IT is used in a case, that is, how IT actually works, or does not work, in practice. This is a different approach to that of Dowling and Leech (2014) who interpreted "use" through specific system features. The study in this article follows Jordan and Messner's (2012) two recommendations. First, interpreting MC "*as the outcome of an on-going interaction between different actors involved, i.e. top management and operational managers*" (p. 546). Second, identifying the intended and unintended outcomes resulting from actual use of MCS. The ongoing interactions allow us to see the original intention of the enforcers and the resulting outcomes of the receivers reacting to the MCS that was designed to influence and monitor them. The interactions, between enforcers and receivers of MCS, provide rich

[3] The full six stages comprise of stages from discovery (at the start) to launch. The post launch review (at the end) is an optional stage that should be completed to evaluate the lessons learnt from the launch.

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Table 1
The Stage-Gate process as embedded in the information technology.

Embedded Stage-Gate Process		Descriptions for each stage and gate
Stage	Discovery Stage	*The stage where ideas are discovered, captured, and submitted for consideration at first gate*
Gate	Idea Screen	*Where ideas are screened to assess strategy fit and viability for the firm*
Stage	Capture Idea and Scoping	*Collecting more information about the ideas for further evaluation at next gate*
Gate	Second Screen	*Where approved ideas are screened (again) but with more information*
Stage	Build Business Case	*Devise detailed plans, financial analysis and explore legal compliances before NPD activities commence*
Gate	Go to Development	*Where firm assesses and decides whether to invest substantial financial commitment into the business case*
Stage	Development	*Produce prototypes to confirm if ideas can be converted into reality*
Gate	Go to Testing	*Where firm evaluates and determines if worthy of proceeding further with additional resources*
Stage	Testing and Validation	*Provide customers with prototypes and conducting trial productions for exact sales orders and production rates*
Gate	Go to Launch	*Where firm closely scrutinises sales and financial projections*
Stage	Launch	*Projects are manufactured and launched as new products in the market*

and practical insights into how the Stage-Gate MCS actually works, or does not work, when administrated through IT at the case site. The analysis of how MCS was administered through IT involved examining the ongoing interactions of individuals from three managerial levels over an extended period of 21 months, that is, between the enforcers (top management) and receivers (middle and lower management) of MCS. Three specific NPD projects that eventuated to product launch were observed and followed during this period. These three projects are mentioned and included as illustrations throughout this article. General descriptions on each of the projects and their associated produced products are presented in Appendix 1.

Adler and Borys' (1996) enabling control framework is used in the analysis of how MCS actually works in the post IT-implementation period. The four design principles (repair, flexibility, internal transparency and global transparency) are defined and described as a sub-section separately later in Section 3. An enabling system guides "*committed employees*" to complete tasks in an efficient and flexible manner (Adler and Borys, 1996, p.83) and make intelligent choices when faced with unforeseen events (Ahrens and Chapman, 2004). A coercive system dictates how employees should complete their tasks and prevents them from making any intelligent choices (Ahrens and Chapman, 2004). It is "*a foolproof system*" (Ahrens and Chapman, 2004, p.279) that forces "*recalcitrant or irresponsible*" employees to comply (Adler and Borys, 1996, p.62). Adler and Borys' (1996) theoretical lens has been attracting much interest in recent years in the MC literature since its first application to MC (Ahrens and Chapman, 2004). The application was originally restricted to considering only the intended outcomes from the MCS, but has since been widened to include unintended outcomes beyond those that were originally designed in the MCS (Jordan and Messner, 2012). This article follows Jordan and Messner's (2012) approach and examines both original intention and actual outcomes of MCS use in the post IT-implementation period.

Lukka and Mouritsen (2002, p.88) urge different in-depth case studies to "*talk to each other*", which this article follows suit. The case study from this article and that of Jørgensen and Messner's (2009) described the use of MCS strongly shaped by the Stage-Gate process. Both studies use the same theoretical lens of Adler and Borys' (1996) four design principles of enabling control to analyse the case data. The major difference between the two is the administration of MCS. The MCS in Jørgensen and Messner's (2009) case study was administered through human coordination efforts. The MCS in this article was administered through IT.

Findings from this case study reveal that IT provides the most impact for MCS when the design principles of internal transparency and global transparency are raised and enhanced through the formal channels of the MCS. Individuals are able to make use of the formal communication channels to communicate issues they have identified because they have been coached to recognise issues within their local processes. Individuals gain a better and fuller understanding of how their work contributes and fits with the firm when these identified issues are communicated and shared. This means internal transparency must be strong in order for global transparency to be realised. In other words, global transparency is dependent on the strength of internal transparency.

The study contributes as follows. It extends the existing literature on MC (Chapman and Kihn, 2009; Jørgensen and Messner, 2009; Dowling and Leech, 2014) by demonstrating how IT can enhance two design principles that are critical for producing an effective and enabling MCS. Internal transparency and global transparency are two deciding design principles that determine how substantial an impact IT provides for MCS. The study also shows that, in an IT-structured MCS, the four design principles are not of equal importance when determining whether the MCS is enabling. The importance of a design principle depends on the role in which it plays: a leading role (e.g. internal transparency and global transparency), or a subordinate role (e.g. repair and flexibility). Moreover, global transparency is dependent on internal transparency and operates best when internal transparency is strong. The study also differentiates between the design intention and actual outcomes from IT use through the ongoing interactions of different managerial levels who enforce the MCS or are on the receiving end of the MCS. The study also furthers our limited understanding on how different systems in accounting and NPD processes operate in collaboration with each other (Moll, 2015).

This article is organised into four sections. The second section describes the research design and methods used in conducting and analysing the study. The third section starts with a quick literature overview on studies relating to IT-structured MCS as well as MCS for NPD that adopted Adler and Borys' (1996) four design principles. The third section continues with a lengthy analysis and discussion of the case study drawing upon the four design principles. The last section concludes with limitations of the research and suggestions for future research.

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2. Research design and methods

An in-depth case study (Silverman, 2010) was carried out at a food company to understand how MC were structured and enacted through IT within the context of NPD. The IT mentioned in this case study is a ready-made commercial software tool that comes embedded with the widely used best-practice developed NPD process called the Stage-Gate Process (Griffin, 1997). This tool functions as a formal MC mechanism to help senior management manage the NPD process and project team leaders coordinate the project teams including assigning team members the necessary tasks to be carried out on each project in accordance to Stage-Gate conventions. The IT tool is neither an artificial intelligent agent nor an enterprise resource planning system (commonly known as ERP system).

2.1. Research site selection

Big Fish[4] is a vertically integrated seafood company which employs more than 400 employees, and produces 7300 t of fish and $100 million of turnover annually. It rears, farms, develops, and processes its own branded sea-farmed fish products in New Zealand and is considered a medium size firm in the country. *Big Fish* was chosen for this study because it purchased a ready-made commercial software and used it extensively to manage and coordinate its NPD processes and tasks. Such extensive usage matched the research purpose of this study.

2.2. Data sources

Data were collected over a period of 21 months between 2009 and 2010 using multiple methods: interviews, observations, and stored data from the IT system. The data collection period of 21 months was divided into two periods: seven months of active observation period with interviews leading to the market launch and 14 months of follow-up period with interviews following the market launch. A lengthy 14-month was chosen as the follow-up period because many new food products are known to last no more than 12 months from their first introduction (Benner et al., 2003). The remainder of this sub-section details the data sources and each of the data collection methods used.

A semi-structured interview approach was adopted. 19 interviews totalling almost 20 h were conducted with 12 individuals over the data collection period. The semi-structured interviews specifically enquired and touched upon the interactions observed in various NPD meetings.[5] All interviews were audio recorded and subsequently transcribed. Since this article focuses on employee behaviours and how these individuals make appropriate use of the IT to complete their NPD tasks, only the perspectives of those individuals who were directly involved in making NPD decisions (five individuals) as well as engaged in carrying out NPD activities (seven individuals) during the data collection period are included in the analysis and discussion. These individuals are categorised into three managerial groups based on their responsibilities and contributions in NPD: senior management (five individuals), middle management (four individuals) and NPD technologists[6] who are the lower management (three individuals). Even though the Chief Executive Officer (CEO) was interviewed, his perspective was disregarded in the analysis of this article because he had purposely removed himself from making NPD decisions to prevent further occurrence of pet projects. Furthermore, the CEO believed his surrendering of this NPD decision right would uplift the morale of his senior management team and make them more accountable for the NPD decision making process. A list of interviews undertaken excluding that with the CEO is provided in Appendix 2.

Observations were carried out during passive participation at various NPD meetings and by the same researcher who interviewed the 12 individuals. Eight observations totalling 10 h were carried out over the initial seven months of the total 21 months of data collection period. Two types of meetings that took place during “stages” and “gates” in the NPD process were observed. “Stages” are investigation and development activities conducted by the project teams throughout the NPD process, and include functional team meetings. “Gates” are meetings held at specific points in time within the NPD process to discuss, consider and decide on the advancement of NPD projects and where most observations were conducted. These meetings are held at specific times within the NPD process. Senior management at *Big Fish* maintained that these gate meetings were held in accordance with the Stage-Gate Process. The researcher noticed a laminated meeting manual which consisted of meeting rules and protocols that all members of the senior management had agreed upon and signed.

In this study, five gate meetings[7] and three functional team meetings[8] were observed. None of the meetings were audio recorded because of the sensitive discussions on potential products that could eventuate in the market. The researcher observed the speakers and attendees in the gate meetings and took notes of the remarks, responses and mannerisms of the individuals. These observations presented valuable insights into the contextual settings of NPD at the firm, and were used to cultivate and develop dialogues with the interviewees, as well as verify their responses. Six NPD projects and 21 newly submitted ideas were considered and discussed at the five gate meetings during the active observation period. Three of these NPD projects

[4] No names are mentioned throughout this article to protect the privacy of those entities and individuals involved. *Big Fish* is a fictional company name used throughout for ease of referring to the firm.

[5] These NPD meetings are referred as gate meetings and functional team meetings. More information to follow in next two paragraphs.

[6] NPD technologists play the roles of project managers and “food scientists” who are dedicated to working on assigned NPD projects on a full-time basis.

[7] Totalling seven hours where average length of the gate meeting was 84 min.

[8] Totalling three hours where average length of the functional team meeting was 60 min.

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were commercially launched at the end of the active observation period[9] and were the focal discussion points in the three functional team meetings observed. The three projects launched are referred to as Projects X, Y and Z throughout this article, and the general descriptions of them and their associated produced products are provided in Appendix 1. Project Z was considered the most radical[10] new product ever released by the firm. This project was discussed in two out of the five gate meetings and all three functional team meetings observed[11]; the other two projects, Projects X and Y, were discussed in two other gate meetings but only in the last functional team meeting. General descriptions on each of the projects and their associated produced products are presented in Appendix 1.

NPD activities were significantly reduced after the three NPD projects were launched. Hence, no further gate meetings were scheduled or observed in later months. The reduction in subsequent NPD activities was because senior management wanted to ensure all efforts were put into the product launches, continuous production, and sales beyond the unveiling period on these three projects. That was why no gate meetings were scheduled for many months following the product launches.

Besides interview and observation data, the researcher was also provided with documents of what was presented and used for discussions at the gate meetings. These documents were generated from collated data stored in the IT and were useful for understanding the discussion points at the gate meetings and the information which senior management were given for their making the necessary NPD decisions.

2.3. Data analysis

The interview transcripts were coded in NVivo. Coding was carried out in two stages. The initial coding organised the interview transcripts into common discussion topics. The subsequent coding re-classified the interview data according to Adler and Borys' (1996) four design principles of an enabling control framework. The reclassification was completed to facilitate easy access and retrieval of data. The case data were analysed through a process of iterating between literature reflection and data coding, while the findings were written in reflection of how individuals of different managerial levels interacted and made use, or avoided making use, of the IT according to four design principles of repair, flexibility, internal transparency and global transparency. Such reflection was carried out following Jordan and Messner's (2012) recommendations on examining MCS through the interactions of individuals from different management levels and distinguishing between the original intention and actual outcomes of IT use post-implementation.

3. Theory, analysis and discussion

Management control system (MCS) is about "*the formal, information-based routines and procedures managers use to maintain or alter patterns in organizational activities*" (Simons, 1995, p.5). Managers use as many devices and systems to help them direct and influence employees to act in a manner that aligns with their firm's objectives and strategies (Merchant and van der Stede, 2007). The ways in which MCS are designed, implemented and organised would determine whether they are enabling or coercive (Free, 2007; Chapman and Kihn, 2009; Jørgensen and Messner, 2009; Jordan and Messner, 2012). Numerous studies have applied this Adler and Borys' (1996) enabling control framework to investigate the enactment of MCS in practice: the operations of restaurant chain (Ahrens and Chapman, 2004), supply chains (see Free, 2007), new product development (NPD) (see Jørgensen and Messner, 2009), and information technology (IT) (Chapman and Kihn, 2009; Dowling and Leech, 2014). This article also follows this trend.

Using Adler and Borys' (1996) four design principles, this section describes how an IT-structured MCS operates in practice for developing new food products in a company referred to as *Big Fish* and does so by connecting to some of these prior studies. In particular, the Jørgensen and Messner's (2009) case study which follows the Stage-Gate conventions in its MCS and thus provide us with a good comparative study. However, there are a number of limitations that need to be considered when understanding Jørgensen and Messner's (2009) study. Firstly, their case study was confined to a paper-based Stage-Gate MCS that provided limited ability for senior management to readily monitor their employees. Secondly, their study focused on the adaptation of an existing control system to the introduction of a new strategy in NPD, but ignored the occurrences when control systems promoted strategy change as a result of the recursive relationship between strategic change and control systems (Skærbæk and Tryggestad, 2010). Thirdly, they have applied the design principles strictly by focusing on the intended use and ignored the actual use of the MCS. These three limitations are the three contextual areas that the study in this article differs from that of Jørgensen and Messner's (2009) study.

The case study under examination here in this article was an IT-structured MCS entrenched with Stage-Gate conventions and came with facilities for those concerned to monitor employee performances including progress, or lack of. The previous MCS for NPD was superseded by the newly purchased IT-structured MCS entrenched with Stage-Gate conventions. Behavioural change occurred because new procedures were purposely put in place to cultivate new behaviours. The new procedures were done to entice employees to make use of the new IT-structured MCS if they wanted resources to be granted for their NPD projects.

[9] All three NPD projects were commercially launched together in the seventh month after data collection began.

[10] Radical innovation occurs when the new products are made and delivered in ways where no prior knowledge existed at the firm in both technology and business models.

[11] All three functional team meetings were held within the final month leading to the product launches.

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Table 2
The Various Stage-Gate Project Models implemented at Big Fish.

Full Classic		**Fast-Track**		**Super Fast-Track**		**Express**	
- designed for Radical Innovations		*- designed for Semi-Radical Innovations*		*- designed for Incremental Innovations of nontrivial changes*		*- designed for Incremental Innovations of trivial changes*	
Stage	Discovery Stage	Stage	Discovery Stage	Stage	Discovery Stage	Stage	Discovery Stage
Gate	Idea Screen	Gate	Idea Screen	Gate	Idea Screen	Gate	Idea Screen
Stage	Capture Idea and Scoping	Stage	Capture Idea and Scoping	Stage	Capture Idea and Scoping	Stage	Capture Idea and Scoping
Gate	Second Screen	Gate	Second Screen	Gate	Second Screen	Gate	Second Screen
Stage	Build Business Case	Stage	Build Business Case	Stage	Development and Testing	Stage	Launch
Gate	Go to Development	Gate	Go to Development and Testing	Gate	Go to Launch		
Stage	Development	Stage	Development and Testing	Stage	Launch		
Gate	Go to Testing	Gate	Go to Launch				
Stage	Testing and Validation	Stage	Launch				
Gate	Go to Launch						
Stage	Launch						

Furthermore, both intended and unintended outcomes from the actual use of the IT-structured MCS were considered and included in the case analysis as recommended by Jordan and Messner (2012).

For many years, all four design principles were recognised as necessary in designing an enabling MC structure that allows individuals to flexibly resolve uncertainties, contingencies or breakdowns when circumstances arise. However, a few recent studies that focus on IT-structured MCS are challenging this fallacy that the four design principles hold equal importance. These researchers believe an enabling approach to control can still transpire if either one of the two design features of repair or flexibility is weak or missing. Chapman and Kihn (2009) find information system integration does not require the flexibility element to exist in order to decide if a MCS is enabling. Dowling and Leech (2014) on the contrary find that the weak or missing repair element does not deter a MCS from being concluded as enabling. It is up to the users to decide whether the MCS constrained their ability to act or respond. They are the ones who decide whether to view the MCS as enabling when it can be used coercively (Chapman and Kihn, 2009; Dowling and Leech, 2014).

The rest of this section is organised in four sub-sections according to these four design features and in the order of repair, flexibility, internal transparency and global transparency. A synopsis of the four design principles of an enabling MCS is provided here in Table 3, while a summary of the analysis on each of the four design principles across each of the three managerial levels is presented at the end of this section in Table 4.

3.1. Repair

Repair refers to the ability and autonomy of employees to develop solutions and make necessary alterations to the prescribed rules and procedures when completing tasks. It does, however, assume that employees understand why company standards and procedures are important to the firm as a whole (Ahrens and Chapman, 2004). "*The premise underlying repair is that events and tasks are not entirely programmable. The difference between enabling and coercive repair is how the system supports actors to resolve uncertainties, contingencies or breakdowns*" (Dowling and Leech, 2014, p. 15). Employees have the autonomy to develop solutions and/or make necessary changes to prescribed rules and procedures to help them complete their designated tasks. However, there may be circumstances where they are unable to resolve the uncertainties, contingencies or breakdowns by their own repair efforts. They desire intervention from the enforcers of the MCS, the senior management (Jørgensen and Messner, 2009). An enabling system gives employees the permission to use their own intellectual judgements to prevent the uncertainties, contingencies or breakdowns from transpiring. They can also seek intervention and guidance from senior management on which direction they should pursue. A coercive system prescribes employees with strict rules and procedures to follow without any room to alter them. Under a coercive system, employees have no say and no choice except follow set rules and procedures that are programmed in the system to complete their designated tasks. "*Repair requires managers to analyse control process. Analysis in turn depends on internal transparency*" (Ahrens and Chapman, 2004, p.293).

Table 3
A Synopsis of the Four Design Principles of an Enabling MCS.

Repair	Enabling individuals to have the autonomy to develop solutions and/or make necessary changes to the specifications of the MCS to resolve uncertainties, contingencies, or breakdowns
Flexibility	Enabling individuals to have the discretionary power to decide when, and when not, to adopt or adhere to the MCS
Internal Transparency	Enabling individuals to recognise issues within their local processes and to communicate on these identified issues
Global Transparency	Enabling individuals to understand and communicate the upstream and downstream implications of their work and obtain a big picture of the matter on hand

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Table 4
An Analysis of How IT was Used for MC Purposes at Big Fish.

Panel A: Repair	Enabling individuals to have the autonomy to develop solutions and/or make necessary changes to the specifications of the MCS to resolve uncertainties, contingencies, or breakdowns
Senior Management [intention]	• Wanted to assist employees complete the necessary tasks so that they could respond to the concerns and/or questions senior management had on NPD projects
Middle Management [outcomes]	• Did not feel empowered with any repair efforts to resolve matters
Lower Management [outcomes]	• Performed self-repair on IT by changing the project model type when needed to which they had been able to do so for Project Z • Seek repairs from senior management to inject further capital expenditure into Project Z
Panel B: Flexibility	Enabling individuals to have the discretionary power to decide when, and when not, to adopt or adhere to the MCS
Senior Management [intention]	• Did not want employees to become system bound when circumstance required them to be creative. Wanted rules to act as guidance for employees
Middle Management [outcomes]	• Felt obliged to abide by the rules and treated IT as a reporting mechanism (which they must adhere to) instead of seeking resolution to resolve the low sales predicted for Project X
Lower Management [outcomes]	• Recognised the need to diverge from rules when necessary and performed prototyping ahead of process to persuade and rally support from senior management on Project Y. Prototyping is usually used to address and manage market uncertainty (to convince customers); but they used prototyping here to address food handling and safety issues (to convince senior management)
Panel C: Internal Transparency	Enabling individuals to recognise issues within their local processes and to communicate on these identified issues
Senior Management [intention]	• Wanted to encourage employees to participate and share their knowledge
Middle Management [outcomes]	• Felt they were given more work to do (which they were unable to ignore without being noted) but admitted the meticulous process did push them to ruminate and produce information that was more extensive and dependable
Lower Management [outcomes]	• Gave them suggestions and directions to conduct the necessary background work to discover and convey barriers early on in the NPD process. These barriers could significantly affect the financial viability and/or technical feasibility of converting working projects into reality
Panel D: Global Transparency	Enabling individuals to understand and communicate the upstream and downstream implications of their work and obtain a big picture of the matter on hand
Senior Management [intention]	• Wanted to facilitate better communication across the firm, and at both upper and lower levels. Felt that better communication would assist in the making of more suitable decisions
Middle Management [outcomes]	• IT required them to share key information which they previously kept to themselves • Exposed how uncooperative they were in providing and sharing necessary information about their local processes • Doubted senior management gave enough thought to individual ideas and working projects to recognise the potentials in each of them (but they changed their perceptions if they had observed some gate meetings)
Lower Management [outcomes]	• Received the same information as senior management through the IT and immediately and appreciated obtaining the big picture of the firm's NPD • Learnt what elements senior management were looking for and what strategic plans the firm was trying to pursue and accomplish

Like many firms in the food industry, many of *Big Fish*'s new products were slight variations or adjustments to their existing products, such as changing the packaging size, volume or flavour. This type of innovation is classified as incremental innovation. However, the default project model which senior management chose to have in the IT was the full classic stage-gate model that came with the full six stages and five gates designed for radical innovation. Senior management initially had a sense that they should adhere closely to the prescribed Stage-Gate Process. Furthermore, NPD technologists were also fearful that they might fail to conduct some important investigation activities if they hadn't followed the full classic project model.

> "… We put everything into [the default] classic [project model] to begin with, because […] Cooper said well this is what you do and we didn't know where our baseline was [at the time …] as we went through some of those early projects we learnt that […] perhaps we don't need all these stages for most of what we do". (Senior Manager #5)

Nevertheless, as time progressed, both NPD technologists and senior management became familiar and confident with the Stage-Gate Process and the IT. More project models were subsequently added to accommodate the varying levels of innovations to suit the needs of the firm. Table 2 depicts the four project models used at *Big Fish* including the full classic project model for radical innovations. The fast-track project model, with reduced five stages and four gates, was added for semi-radical innovations where the innovation involves substantial change in either its technology or its business model but not both like radical innovations do. Two additional project models with even fewer stages and gates were added for incremental innovations. The deciding factor between the two project models depends on whether the changes are trivial allowing the innovations to be introduced to market without delay (named as express project model), or the changes require a bit more work to their existing products before releasing to market (named as super fast-track project model). The express and super fast-track are the two project models most commonly used at *Big Fish*.

> "At the start I guess we were frightened to take out too much information in case we were missing different things. But as we've gone through and got the confidence of […] taking out all the stuff that we don't' need". (NPD Technologist #1)

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Individuals at *Big Fish* did not need to be concerned about a project being set up incorrectly with an unsuitable project model. As project team leaders, NPD technologists were given permission to change the model type whenever a project became more complicated than first anticipated. This was an important self-repair function for the NPD technologists so that they could ensure proper and more fitting investigation and development work was carried out on the projects. However, there is much uncertainty associated with each NPD project, as witnessed in one of the working projects and reflected by the team leader for that project, Project Z. More description of Project Z is provided in Appendix 1.

> "… you do not know what a project's going to be like until you get started. The easiest project can turn out to be an absolute nightmare". (NPD Technologist #3)

When the scope for Project Z unexpectedly became bigger than first anticipated, the team leader involved elevated the model type in the IT and notified senior management of the change in model type in the subsequent gate meeting for Project Z. Senior management were never consulted nor concerned with the change. If senior management had to be consulted for approval on such a change, the project would have to be put on hold unnecessarily until the next gate meeting could be scheduled to take place. The NPD system administrator explained arranging meeting times with a full panel of five senior management had not been an easy task, particularly when one of them resides in another office and town two hours by car.

Recommendations and decisions are made according to the facts and information gathered at the time. Having wrong information or assumptions could be costly in making the right assessment about the true prospects of NPD projects. NPD technologists considered it is the project team's job to make recommendations, but it is senior management's job to make the ultimate decisions. Therefore, senior management might need to ask the "right questions" to better understand and address their NPD concerns. There had been occasions when project teams became baffled by the uncertainties, contingencies or breakdowns. They could not perform any self-repair. They desired interventions about which direction they should pursue so that they could proceed and resolve the uncertainties, contingencies or breakdowns. This occurred in both Project Z and Project X where project teams desired interventions from senior management to proceed further. However, it could be challenging getting a consensus direction from senior management when each one of them hold different thoughts on the same matter. Therefore, having scheduled discussions with the full panel of senior management made it possible to get an agreed intervention from senior management. Such interventions meant NPD technologists were able to seek repair from senior management when they were not able to conduct self-repair.

> "The thing about [the information technology] is that […] the hard decisions are made based on the best information [we] have at the time. And it's up to us [NPD technologists] to give that best information to them [the senior management]. And if I gave them information that was grossly wrong or deliberately altered, then my head's on the chopping block, but [I] have to be foolish to do that [… senior management] are the decision-makers, [I] give them the facts and the figures, they make the call". (NPD Technologist #3)

On one occasion, the project team leader for Project Z was uncertain how he should proceed with the project. He had encountered numerous technical complications while trying to achieve consistent portion size and extended shelf-life across the sample parcels. The resolutions required purchasing additional fixtures for the laser-sensor automated cutting machine to achieve consistent portion size and for the automated packing machine to double the packaging product shelf-life. The project was at a risk of being put on hold. Further capital expenditure was necessary for the project team leader to proceed and complete the NPD tasks. These complications and the need for further capital expenditure were reported to senior management. Injecting further capital expenditure was a big decision that could not be made by any single member of the senior management team. Senior management even asked the project team leader as to how confident he was in resolving the technical complications with the injection of further capital expenditure. After debating among themselves senior management agreed on the spot to inject further capital expenditure into Project Z and to do so without delay. This intervening decision enabled the project team leader to continue with the project with minimal disruption and complete his NPD tasks. The project would have been terminated without further capital injection.

> "… yeah they ask [me] what [I] think. An example […] is the 45 degree angle [cut]. It's never been programmed before [on] that machine to get accurate enough. And they asked me if I thought I could do it. And I was confident I could do it and I said yes, so they said proceed". (NPD Technologist #3)

In Project X, the project team leader explained there had since been changes to the financial calculations previously relayed to the senior management. These changes were caused by the lateness of sales information provided by middle management. Further description of Project X is provided in Appendix 1. When this lateness was communicated, all members of senior management who were in the meeting room turned their heads and looked at the senior manager responsible for that middle manager. Their body language showed their dismay at the lateness of information supplied by that middle manager. Even though no words were said, they had intervened in the situation and demanded action from the respective senior manager. The immediate response of that senior manager "*I will have a word with my staff*" confirmed the unspoken pressure he received from his peers. The IT had achieved the MC aim by imposing deadlines on uploading of data, but individuals could choose to ignore and disrespect the deadlines. The capacity to respect deadline for uploading of data is an important MC aim when adopting IT for MC purposes (Corsi et al., 2017). Some individuals might have chosen to ignore the IT and its reminders, but IT still assisted in the process of "shaming" the responsible senior manager by publicising who had been disrespectful of the deadlines.

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The IT supported the NPD technologists in their roles as project team leaders in resolving uncertainties, contingencies or breakdowns as encountered in Project Z and Project X. Through their own self-repair efforts the NPD technologists were able to subsequently change the model type of individual projects to reflect the degree of complexity uncovered while working on the projects. They also sought out repair efforts through the intervention and guidance of senior management enabling them to continue completing the NPD tasks that were assigned to them. However, middle management did not feel they were empowered to make any self-repair or seek intervention as project team members to resolve matters and continue completing their tasks. They felt senior management were particularly critical with them and gave them specific instructions on how they should complete their tasks, rather than empowering them with repair efforts to resolve the matter. Even though senior management had intended to provide employees with a MCS that assisted employees in completing their assigned NPD tasks, middle management did not perceive they were empowered nor have the autonomy to develop solutions and/or make any changes to the IT like the NPD technologists did. The liberal training and background which middle management received in sales and marketing might have contributed to their interpretation that rules and procedures were to be strictly enforced and followed. Panel A of Table 4 summarises the intention and outcomes for each of the three managerial levels in relation to the design principle repair.

Repair is about enabling individuals to have the autonomy to develop solutions and/or make necessary changes to the specifications of the MCS to resolve matters on hand. Individuals at *Big Fish* were given the autonomy to perform self-repair by modifying the specifications and instructions of the project models in the IT when needed. For example, incorporating terminologies and dimensions commonly used in the seafood industry to prompt and help individuals better describe how the raw materials (e.g. fresh fish) are supposed to be processed, cut, and/or treated. The ability to deal with unexpected matters is not restricted to individuals carrying out self-repair, but is extended to providing them with the formal opportunities to seek management guidance or intervention. Such formal opportunities were made accessible to them even if they did not feel they could make the necessary self-repairs. This formal avenue was scheduled into the NPD process through gate meetings. Dowling and Leech (2014) demonstrated an enabling approach to control can still transpire when repair is either weak or missing. Not all individuals at *Big Fish* thought repair is weak, thereby explaining why an enabling approach to control can still transpire with a mixture of responses.

3.2. Flexibility

Flexibility is largely about the rigidity of a "bureaucratic" system rather than the specifications of the system with which repair is concerned. Flexibility "*refers to the organizational members' discretion over the use of control systems*" (Ahrens and Chapman, 2004, p.277) whether it be of strict compliance or outright avoidance (Free, 2007). It is "*desirable whenever it is not precisely clear ex ante how a particular objective should be reached or how a certain activity is to be carried out*" (Jørgensen and Messner, 2009, p. 103). An enabling MCS with flexibility provides employees with the freedom to decide how strictly they are to follow the rules and procedures, including "*to the extent that they can even turn them off*" (Ahrens and Chapman, 2004, p.277). Without flexibility, the MCS disallows employees to deviate from, or ignore, the rules and procedures and this may make it difficult for employees to progress through their list of designated tasks.

In the case study of Jørgensen and Messner (2009), employees were observed to be given permission to make flexible adjustment to the MCS when needed. This flexibility was part of the company culture and written in the company task manual that was prepared in accordance to the Stage-Gate Process. However, flexibility could only be achieved if there had been a certain degree of transparency. "*At the gates, it is global transparency that management seek to achieve; during the stage, engineers and managers use the same tools (budgets, profitability calculation tools) [with add-on spreadsheets which they created] to achieve mainly internal transparency regarding their local practice*" (Jørgensen and Messner, 2009, p. 115). Furthermore, Chapman and Kihn (2009) find information system integration only has direct positive associations with three of the design principles, namely repair, internal transparency and global transparency, but no relationship with flexibility. In other words, a MCS can still be deemed enabling even if flexibility is weak or missing.

Senior management at *Big Fish* were adamant about giving employees the necessary flexibility to complete their designated NPD tasks. They did not want employees to become system bound when circumstance required them to be creative to meet customer and/or market needs. They wanted rules to act as guidance for their employees.

> "… one of the dangers of a system such as this [process-embedded information technology] is that you become system bound. And fortunately [there's] people like me [in the senior management team…] and [within] the sales and marketing team [… who] are front-facing [the] customers and we don't allow [the] systems to bind us.[…] You can't stand there in front of a customer and deny what they want because your system won't allow it […] You'll lose that business to your competitor…" (Senior Manager #1)

Middle management did initially feel they were obliged to abide by the rules, but they later realised they were allowed to leave out any working files that were not applicable to the projects on hand.

> "… I think the system in its own right is okay at the moment … It also gives us the flexibility so that if we don't believe it's relevant, we don't fill in the forms [… except] to say that it's not applicable". (Middle Manager #2)

However, middle management were still following the rules and procedures specified by the IT to the letter, rather than its essence. For example, they should have recognised the sales orders placed for Project X were far from their initial prediction and estimate. Instead of seeking resolution and negotiating with the supermarket chain, they simply reported the sales

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breakdown as requested to the project team leader without making any mention or recommendation on how the firm could improve on the low sales. They treated the IT as a reporting mechanism which they must adhere to.

Conversely, NPD technologists realised that they might need to diverge slightly from the rules and procedures to resolve some barriers. Project Y was a good illustration about how they took initiative and produced prototype samples to show the senior management the packaged product. Project Y was a simple idea that combined numerous existing seafood products together on a pre-packaged platter. Further description of Project Y is provided in Appendix 1. Majority of senior management thought the project was a simple yet lucrative product idea of providing samples of their existing products on a platter. There was one senior manager who was strongly opposed against this project citing it was technically impossible to package differently treated food products from two isolated production plants into the same parcel. His concern on food handling was warranted given that this was never attempted at the firm nor locally in any seafood firms in the wider market. This negativity and opposition was also experienced in his subordinate middle manager.

> "I thought [Project Y] was a […] really good idea but we had one gatekeeper particularly against it just because of the process of getting cold-smoke into a hot-smoke packing room. And because of his negativity [the middle manager under him] was also negative about it." (NPD Technologist #2)

The project team leader knew she must convince senior management that Project Y was a worthwhile product to be introduced to market. Otherwise the project would be at risk of being terminated from progression. The team leader proceeded to experiment and produce prototype samples ahead of the prescribed schedule within the Stage-Gate Process in an attempt to persuade senior management that Project Y was a visually attractive and lucrative idea.

> "[We had to show] them what it would look like on a platter and doing the costings and proving that it wasn't actually going to be that difficult … [That senior manager] didn't want to go through with it because he thought the costs were too high and the process of getting cold-smoke [products] to hot-smoke [production plant] was too difficult. The rest of [senior management] loved it so they actually put that on hold until I re-costed it…" (NPD Technologist #2)

Senior management were delighted to see the packaged platter presented at one of the gate meetings. They were particularly impressed that the team leader understood the purpose of this prototyping exercise and kept the prototyping cost low. The purpose of the prototyping exercise was demonstrating the samples to internal audience rather than to key customers. The samples were unrefined products, which helped to keep costs low. The exercise was a success. The senior manager who was opposed to the idea was persuaded and agreed for the project to be re-costed and to proceed forward to the next gate meeting. Project Y had a successful commercial launch and remained on the supermarket shelves with little competition even after five years.

> "… even though the structure of Stage Gate is such that you should be doing certain things in certain stages and not getting ahead [of] yourself by producing samples at say the [earlier] scoping stage. I guess rules are meant to be broken or bent and depending on the opportunity and whether it's something that's going to enhance a project or not […] you should really take it. It's just instinct really [to break the rules and produce samples ahead of the specified time]". (NPD Technologist #2)

Prototyping is an approach useful for proof-of-concept. It is often used in NPD to address and manage market uncertainty to convince customers to place orders for the upcoming market launch (Davila, 2000). Nonetheless, the project teams at *Big Fish* used prototyping early on in the NPD process to address food handling and safety issues in order to persuade and rally internal support from senior management. Panel B of Table 4 summarises the intention and outcomes for each of the three managerial levels in relation to the design principle flexibility.

Flexibility is about enabling individuals to have the discretionary power to decide when to adopt, or adhere to, the MCS, and when not to. It is also about encouraging employees not to be overly system bound in adhering to the rules and procedures stated in the MCS but to be creative when circumstances warrant. The use of prototyping at *Big Fish* is a good illustration of how employees at *Big Fish* had the discretionary power to adopt prototyping outside of the predetermined process and for a different purpose.

3.3. Internal transparency

Internal transparency, also known as local transparency, is about "*an understanding and mastery of local processes*" (Free, 2007, p.923). It is difficult to "repair" the control processes unless individuals have a good understanding of how their local processes operate (Ahrens and Chapman, 2004). Local processes may be defined as business units (Chapman and Kihn, 2009), groups of individuals or working projects (Dowling and Leech, 2014). An enabling system enables individuals to develop a better understanding of their local processes that leads to internal transparency; while a coercive system discourages individuals to develop an understanding of their local processes and thus inhibits internal transparency (Ahrens and Chapman, 2004). Identified issues can then be communicated when individuals recognise and understood these issues from within their local processes.

In this study, business units were classified as the local processes because individuals from respective business units were selectively chosen to partake at each level according to their working knowledge. The enforcer level of the MCS consisted of a team of gatekeepers representing senior managers from each business unit. Besides NPD technologists acting as project team leaders, the receiver level also consisted of project team members representing middle managers from each business unit's sub-units, such as specific factories, or areas of responsibility. These project team members usually had good working knowledge

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about their respective business units and the existing products produced. However, they needed to reflect and apply their existing knowledge to working projects that had not been commercialised and enter their professional opinions according to what the IT asked them. An enabling system would facilitate the discovery of foreseeable pitfalls by providing individuals with suggestions about what local aspects they could methodically contemplate for the ideas and projects. A coercive system would order individuals to respond according to a predetermined list of known pitfalls without any room to think beyond what was asked. Middle management certainly felt the IT had brought them more work, but admitted the meticulous process had driven them to ruminate on possible pitfalls and produce information that was more extensive and dependable.

> "… there's definitely more work involved; but with the more work there also comes more information to […] get it right. So they're actually doing more work before launching the product to actually validate that this is […] going to be successful ... And I think it has helped, we've definitely ended up with more, more rigorous processes around getting the products costed". (Middle Manager #4)

NPD technologists believed it was vital to conduct more background work for the approved ideas earlier in the NPD process so that recognisable barriers could be discovered and conveyed. These barriers could significantly affect the financial viability and/or technical feasibility of converting working projects into reality. They truly believed the IT had given them the necessary directions with which to complete their designated NPD tasks, including leading their project teams.

> "What we've tried to do is try and bring out any issues or […] roadblocks […] earlier on in the process really… [because otherwise] when it's actually going to happen they […] raise all kinds of roadblocks or issues … but [the information technology] forces [them] to deal with those at the start so you can […] get over them before you get there really". (NPD Technologist #1)

> "[The information technology] sets out [a] platform and says at this stage [what] work you need to do […] So I know exactly what I have to do. … It gives you confidence to know that you've done what you need to do, [and] that […] everything's been covered. So it gives you that peace of mind […] that nothing gets forgotten". (NPD Technologist #3).

> "[The information technology] places huge structure around projects which I think is important … and it makes [us] accountable for certain things that have to be done within that stage." (NPD Technologist #2).

Some of the words that were chosen and conveyed by NPD technologists during the interviews might suggest a coercive MCS. For example, "forces them to deal with", "what you need to do", "places huge structure around projects" appear in the interview quotes above. However, the context that NPD technologists were describing portrayed a rather different picture. This lower management group was suggesting how the MCS was enabling them to improve upon the success rate of the market launch, and did so by playing the roles of coaching and reminding the NPD technologists of various action plans. The IT did not constrain them but gave them the option and ability to act or respond accordingly.

Like many firms, *Big Fish* had limited NPD resources to invest in. They could only select some ideas to proceed as working projects for further investigations and thereafter for commercial launches. It would also have been unwise to continue investing in projects that were assessed to be loss-making unless there were compelling reasons to do so. The IT provided the individuals with a built-in systematic approach to find and convey foreseeable difficulties within their respective business units should the working projects be commercialised. *Big Fish* endured many launch failures in the past that the NPD technologists and senior management believed could have been avoided if they have had more complete information about their local processes. That was why senior management was keen to encourage employees to identify issues and share their knowledge to help improve the success rates of new product launch. The IT provided them with a methodological approach to consider as many local aspects as possible so that a more complete picture of production or launch outcome could be constructed based on the capabilities they had at that time.

> "I think it was because we've put these processes in place, that we've got better performance, better profitability. … [it helps] make sure [we've] got the supply of raw materials right and [our] packaging is audited properly so [we] don't have packaging failures… make sure [our] training is done properly […] all these things we do now we've learned to do. […] we've learned to design all these things into the new product whereas previously we didn't bother. … Yeah, it [has] disciplined [us and our employees] into better design practices". (Senior Manager #1)

Internal transparency is about enabling individuals to recognise issues within their local process and to communicate on these identified issues. The knowledge of local processes is a requirement in communicating knowledge across the firm and in achieving global transparency. The way in which individuals were coached to recognise issues suggested the IT came disguised in the form of an electronic colleague (Arnold and Sutton, 1998; Liew, 2015) who is a counterpart and a personal trainer that can be relied upon. This is a form of "knowledge sharing" assisting individuals to resolve obstacles while using the IT, as well as in enabling and encouraging them to make better use of IT (Chou et al., 2014). Furthermore, if IT is not featured in the MCS, there remains a need to have human colleagues who can readily coach individuals to recognise issues. The minute an individual views the electronic colleague as a superior, that individual will perceive the IT is being used coercively. Panel C of Table 4 summarises the intention and outcomes for each of the three managerial levels in relation to the design principle internal transparency.

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3.4. Global transparency

Global transparency is about "visibility of the overall context in which organizational members perform their specific duties" (Free, 2007, p.923). It occurs when employees "understand the up- and downstream implications of their work" (Jørgensen and Messner, 2009, p. 101). It is about communication across the firm, whether across different local processes or hierarchical levels. Research shows that employees often focus too much on the detailed operations of their local processes without understanding or realising how their "local processes fit into the organisation as a whole" (Ahrens and Chapman, 2004, p. 277). It helps when employees are informed of the firm's business strategies or operation policies so that they can better assist the firm in completing tasks that are aligned with the firm's strategic and operation plans at the time. An enabling system would therefore facilitate better communication of the firm's business strategies and local processes across the firm. This would help employees gain a more profound understanding of what the firm was trying to accomplish as well as to ascertain how their work contributed to the overall wellbeing of the firm. A coercive system would impede that communication and preclude employees from learning of the firm's business strategies as well as from appreciating the implications of their work at the firm.

Ever since the implementation of the IT in *Big Fish*, individuals were unable to escape responsibilities once they had been assigned to complete specific NPD tasks. This was because their names were listed against each assigned tasks, enabling their peers and superiors to closely scrutinise their completion progress and submitted work. Many of these assigned tasks fostered internal transparency as these tasks were about identifying the potential issues and pitfalls of working projects in the local processes. Once identified, individuals would enter these potential issues and pitfalls into the IT so that the information could be communicated. All individuals received the same information and details through the IT without delays. There was no distinction based on which managerial level an individual belonged to, as long as that individual was assigned to the NPD projects. Nevertheless, the information could only be communicated if it was read.

> "[NPD is] not just about the idea, it's about the communication through the business, dotting the i's, crossing the t's. Making sure that all the systems work when you come to launch, and that you've checked all the things, like your wastage, yields, cost, all that sort of thing is covered off". (Senior Manager #5)

The lack of communication across different local processes in the past has been a major contributing factor for *Big Fish* in making many unsuitable NPD decisions and in launch failures. Global transparency effectively operated in conjunction with, as well as enhanced, internal transparency in NPD. The IT exposed how uncooperative middle management were in providing and sharing the necessary information about their local processes, particularly to senior management, who had been unaware of this. The IT acted as the bad colleague who goes around, and possibly repeatedly, highlighting and broadcasting an individual's wrongdoing and underperformance. The involvement of IT meant that middle management were required to share key information about their respective local processes, which they previously could keep to themselves. Their uncooperative behaviour demonstrated their reluctance in adopting the IT and completing their designated tasks. As a result of the MCS, senior managers became wary that any unsatisfactory actions or collaborations of their respective middle managers could cast doubt on their personal leadership and reputation. Such doubt was observed in one incident due to an "unacceptable" lateness of sales information provided on Project X. This doubt was conveyed through unspoken pressure exhibited in the room during a gate meeting. Despite the negativity and uncooperativeness, senior managers did not purposely change the NPD process or the MCS to accommodate the different middle managers.

> "We know that for example the sales guys are often pretty slack at doing their bit of the project. I don't think we would have known that without a system. … [The NPD technologists] have been [complaining] saying they've been waiting and waiting and waiting for [one of the middle managers] to provide his one little bit of information. And we get it in the morning of the gate meeting for goodness sake. And then we have to change things in a big rush. It's his fault that we've had to delay the gate meetings, because he just hasn't done it". (Senior Manager #3)

Gate meetings facilitated much global transparency. Even senior management learnt more about other local processes for which they were not responsible. Such knowledge helped individuals understand the capabilities and limitations of their firm beyond their own local process. The perceptions individuals held could change radically if they had been informed of the potential difficulties or pitfalls in producing specific working projects. That was why the lack of communication would contribute to unsuitable decisions being made.

> "Yeah, I think that [the idea mentioned in this morning's meeting was great and] might fly [when I was reading and scoring the idea before today's meeting. But the Processing Senior Manager's] comments about technical feasibility were interesting – 'actually we don't have any equipment to make that'. It changes my view a lot." (Senior Manager #3)

Gate meetings also allowed project teams to see and hear the many discussions and debates among senior management. This allowed project teams to learn by osmosis what elements senior management were looking for in the NPD ideas and working projects and what strategic plans the firm was trying to pursue and accomplish through them. Team leaders were usually at these meetings whenever their assigned projects were scheduled for discussions at the gate meetings. They learnt from the meetings and took notice of the types of queries and concerns frequently brought up by the senior management. Middle management who were the team members were not required and therefore rarely attended these meetings unless they were asked by their

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respective senior management to attend as deputy. The reactions and support from middle management for the IT differed considerably between those team members who had attended the gate meetings and those who had not. Those who never attended the meetings continued to doubt if senior management gave enough thought to the ideas and working projects to even recognise the potentials in these ideas and projects.

> "Sometimes you'll do the project and the financials might not stack up, but for strategic reasons, it's a bigger count – we really should be doing this from a political point of view". (Middle Manager #1)

Those who had attended were pleasantly surprised at how thoroughly senior management argued over each idea and project, including the resource implications and market priority on each of them. Therefore, global transparency played an important role in influencing employee acceptance of the IT at *Big Fish* to help them complete their designated NPD tasks.

> "[… I thought the gate meetings are interesting] because each of the [senior manager] at the table come from quite different avenues. They attack things different ways. … [It was interesting] just seeing how they interrelate in terms of making those sort of decisions and testing each other [… and] seeing [how] everybody […] see [and debate how the new ideas] will fit, or not fit, with the whole business. Because I think it probably used to be more driven from one [functional] area or the other […] and pushed it through, whereas [now there appears to be] a lot more interrelationships between the decision". (Middle Manager #4)

Transparency was established not only at the gate meetings but also throughout the NPD process at *Big Fish* for both internal transparency and global transparency. This differed from Jørgensen and Messner's (2009) case study where transparencies were "*mainly established at the gates*" (p.111) and "*produced rather organically through lateral coordination efforts*" among project teams throughout the stages (p. 120). The paper-based MCS did not come with any built-in avenue or functionality to collate and communicate the task findings and progresses to all individuals involved in NPD. This weakness is where IT could add value by either replacing the inefficient paper-based processes with an automated IT process (Sopheon, 2010), or employing IT as an electronic colleague that facilitate transparencies (Arnold and Sutton, 1998; Liew, 2015), or both. The IT acted as a regular mediator and informant recording information coming from different colleagues and communicating between them throughout the firm. The inclusion of IT led *Big Fish* to transparency being established throughout the NPD process, rather than established mainly at the gate meetings.

Since individuals were entering their completed NPD tasks into the IT, they were able to login to the IT to study more about the working projects they were involved with, learn of the potential issues and pitfalls found in other local processes, and read the remarks and outcomes that resulted from the gate meetings. Such communication helped individuals increase their knowledge about the capabilities and limitations of their firm above and beyond their own local process. Without the IT, project teams would have continued to receive global transparency only through attending gate meetings. The IT allowed each individual to receive the same findings and comments about the completed NPD tasks. Although IT helped produce considerable global transparency, individuals need to make use of the IT in order to receive the benefits offered by the IT. NPD technologists received more benefits than middle management because they made more use of the IT than middle management.

> "I need to personally work the system harder. And understand how it all fits together etc [for the company]. Rather than just sort of doing my bit [in feeding the marketing relevant information …] and [then] go to a project team [meeting and that's it]". (Middle Manager #2)

One of the advantages of IT in *Big Fish* was that even if individuals were presented with a summary figure, they could immediately locate how that summary figure was derived by examining the completed work stored in the IT. In one particular gate meeting, senior management were seen to be puzzled by a low total sales figure shown on Project X. Since the data were stored in the IT senior management were able to examine on the spot how that sales figure was derived without postponing the meeting. Senior management realised straightaway that the low sales figure had resulted from the lack of placed orders by a specific large supermarket chain. Senior management knew it was an obstacle that must be resolved if they wanted a successful launch. Project X was actually at its last "go to launch" gate seeking final approval to continue to commercially launch in six weeks' time. Timing was crucial because Project X was a seasonal product designed to welcome a particular festive season. Putting the project on hold in search of more information or clarification would have jeopardised the launch of this new food product in time for the festive season, which could have deferred it by a whole year. The IT had sped up the enquiry and communication, allowing senior management to make an informed decision on this project instantly. Senior management essentially instructed the project team to extend the time availability of this seasonal product in order to attract this particular supermarket chain to place orders for the product and thus boost sales. Sales could not be drastically increased if they had not extended the time availability. Senior management would have no choice but to terminate their support for Project X even though the project had progressed so far down the NPD process.

Global transparency was not only about project teams providing the necessary insights and findings into the working projects for their teams and senior management, but it was also about senior management communicating their business visions and project concerns to those actively involved in NPD. Not only were individuals able to see and hear the many discussions and debates among senior management in the gate meetings, they could also learn what elements senior management were looking for and what strategic plans the firm was trying to pursue and accomplish through the IT. All ideas and opinions were logged in the IT.

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Individuals could therefore see the direction senior management were pursuing through the collection of ideas that have been approved and prioritised to progress as working projects. They could also see the direction senior management were ignoring based on the rejected and low-ranked ideas, and read the opinions and concerns senior management had. Senior management could purposely insert their comments in the IT to proclaim why they wanted certain ideas to be further investigated and developed. Nonetheless, individuals need to make use of the IT in order to receive the full benefits of which the IT is able to offer.

Middle management did, however, attempt to circumvent the IT to submit their new NPD ideas or customer requests for consideration. They criticised the NPD process was too lengthy in responding to customer needs and converting NPD ideas into reality. They tried to ask the NPD technologists to work on some alleged simple NPD ideas without entering the ideas into the IT. However, they were never successful in their attempts because NPD technologists insisted help would only be provided if the ideas were approved to be worked on. Middle management's criticisms were often shaped by the level of global transparency and the doubt they had of the MCS.

> "…I find that [the NPD] is quite a lengthy process. And sometimes customers don't understand that [… and demand] 'I want this product now', or […] 'just get me [the] pricing' … It can be difficult for salespeople to come to grips with, [when they] see a sales opportunity, [they] want to go and get it. … [They don't] get to see the background picture, everything that's going on about all the other projects … So it's difficult to explain for them clearly … about why some projects aren't going to go ahead". (Middle Manager #3)

Even though middle management tried unsuccessfully to convince NDP technologists to conduct tasks on new NPD ideas that were never recorded in the IT (and hence were never approved), they never circumvented completing NPD tasks they were assigned. They merely procrastinated inputting the task findings into the IT. The reason why middle management always entered their task findings might be because the IT spelt out the name of each individual who was assigned against each NPD task and they did not wish to be openly seen as neglecting their responsibilities.

Global transparency is about enabling individuals to understand the upstream and downstream implications of their work and to obtain a big picture of the situation at the firm. It operates best when internal transparency exists and is strong. IT enables transparency to be established throughout the NPD process. The enhanced communication also helps employees gain a more profound understanding of how their work affects other employees as well as how it contributes to the overall wellbeing of the firm. Panel D of Table 4 summarises the intention and outcomes for each of the three managerial levels in relation to the design principle global transparency.

4. Conclusion

Following a case study approach, this article explored how IT can be used for MC purposes to direct and influence individuals to act in the best interest of the firm. The focus was on understanding how three different levels of management interacted and made use, or avoided making use, of the IT-structured MCS. This involved examining the enforcers' intended use against the receivers' actual use of the IT, and analysing using Adler and Borys' (1996) theoretical lens. The study provides a good comparison between a paper-based Stage-Gate MCS (Jørgensen and Messner, 2009) and an IT-structured Stage-Gate MCS for managing NPD. It illustrates how IT can be leveraged to add substantial effects on and for MC in managing NPD by enhancing internal transparency and global transparency. The study also provides insights into how IT had actually worked and not worked for MC purposes in the post-implementation period. It depicts how individuals interacted and discovered ways to make use of IT including modifying settings, improvising procedures, and devising workarounds.

Case findings reveal there are two particular design principles, internal transparency and global transparency, that not only determine if MCS is enabling but also decide whether IT provides substantial effects on and for MC. These two design principles play leading roles in enabling IT to achieve favourable effects for MC. IT functioned as an electronic colleague who mediates and informs among the three different levels of management who are directly involved in NPD. The inclusion of IT enabled global transparency to be established and intensified throughout the NPD process. IT made several individuals feel obliged to share key information, which they previously kept to themselves, and to upload the requested data onto the IT. However, individuals were not able to realise the implications of their work and gain the full benefits from it unless they made use of IT to see how their work fits into the big picture within the firm. The case reveals global transparency is enhanced because internal transparency is strong. Simply put, the emergence and intensification of global transparency is dependent on internal transparency, without which global transparency cannot be enhanced. Furthermore, the enhancement of global transparency is constrained by human coordination efforts. The other two design principles which play subordinate roles, repair and flexibility, need not surface among all individuals at all times, so long as both elements surface for some individuals. In this case, both elements surface for lower management but not middle management. Repair and flexibility play subordinate roles since they can exist and be sound even without adopting IT. A leading role strongly facilities a MCS to be enabling, whereas a subordinate role does not hinder it from being enabling. This is because a leading role thrives on the strengths that IT provides. In contrast, a subordinate role takes little notice of those strengths, and thus explains why not all design principles need to surface for all individuals in the firm.

This article contributes to the MC literature in the following ways. It extends the existing literature by highlighting how two particular design principles, internal transparency and global transparency, play essential roles in producing an effective and enabling MCS. These two design principles determine how substantial an impact IT provides for MC. The study shows the

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intertwining relationship between these principles. Global transparency simply cannot be enhanced without a strong internal transparency. However, the benefits of global transparency that IT provides are only offered to those individuals who actively make good use of it. The key still lies in IT usage, which must be encouraged in order to secure IT success. The study also explains why some prior studies (Chapman and Kihn, 2009; Dowling and Leech, 2014) have found IT-structured MCS are considered enabling despite one of the four design principles is weak or missing because that design principle has played a subordinate role. In addition, the study illustrates the way MCS operates in its entirety by examining the original intention and resulting outcomes through the ongoing interactions between the enforcers and receivers of MCS. Finally, the study furthers our limited understanding on how different components of accounting and NPD operate in collaboration with each other.

This article also provides insights for practitioners on how to make use of IT for MC purposes. This can be achieved by engaging IT as an electronic colleague to facilitate and disseminate information, and as a personal coach for "knowledge sharing" to assist with resolving obstacles when using IT. The article offers suggestions to practitioners on how they could possibly train and prepare their employees to adopt and use IT for completing tasks in a manner that is consistent with their firms' intention and interests.

Adler and Borys' (1996) enabling control framework may be helpful for explaining the workings of an IT for MC purposes. However, one of the limitations of this article stems from the restriction of only being able to describe the case analysis and findings within the four design principles of the theoretical lens. Are there more findings and lessons that could be told beyond classifying the case data according to the four principles? Another limitation comes from having a single researcher who observed the gate meetings and conducted the interviews as part of the data collection as well as performed the analysis of the case data. Different researchers may have noticed different cues when observing the various gate meetings and led the interview dialogues down a different path. Different researchers may also have had dissimilar interpretations of the case data and may have produced findings that are different from those presented in this article. However, a single researcher has the advantages of forging closer relationships with the research participants as well as gaining a fuller and more holistic picture of the case firm and its people from all the spoken and unspoken cues in the observations and interviews. Another limitation of this article is that it was a study carried out at a single organisation. However, the in-depth study did provide the richness of data, particularly the multitude of interactions and dialogues from both the enforcers and receivers of the IT. One possibility for enhancing and extending the study in the future is to conduct similar in-depth case study investigations on other firms that use another IT solution to verify the findings from this study. The corroboration with other case sites is particularly important because we know different firms use and enforce MC differently for their NPD processes (Christiansen and Varnes, 2009; Jørgensen and Messner, 2009).

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Appendix 1. General descriptions of the three launched projects at *Big Fish*

Project X	The produced product of Project X is an uncooked fish fillet flavoured with seasonings and pin boned[a]. The fillet, which weighs between 850g and 950g, can be placed straight into the oven to bake and is prepared for consumers' convenience without needing to do much except for remove from pouch, bake and serve.
Project Y	The produced product of Project Y is a selection of smoked seafood products assembled on a 400g vacuum sealed platter. The four different hot and cold smoked items are beautifully presented, ideal as a party platter. The items require no further cooking, food plating or presentation, and can be eaten immediately from the platter upon opening.
Project Z	Project Z is about automated machine cutting whole fish fillets into exact fish portions and providing these fresh fish portions at extended refrigerated shelf life[b] especially for small retailers to sell to consumers. Project Z resulted in three variations of fresh fish products based on how they are cut: loin, escalope, and stir-fry. The loin and escalope fish pieces are machine cut from whole fish fillets. The loin consists of four pieces of fresh fish cut on a 90° angle with a specified weigh of ±62g per piece to a total of 250g per pack. The escalope consists of two pieces of fresh fish cut on a challenging 45° angle with a specified weigh of ±125g per piece to a total of 250g per pack. The stir-fry contains 275g of fish tails and belly trim surplus pieces from the loin and escalope products.

[a] Pin boned refers to the removal of needle-like fish bones.

[b] The extended refrigerated shelf life was at an unprecedented minimum of 10 days by packing the fresh fish products in a modified atmosphere packaging. Normal packaging usually only allows for 2–3 days refrigerated shelf life.

Appendix 2. Interviews undertaken at *Big Fish*

Managerial group	Job role and/or NPD role	Before launch	Near launch[a]	Soon after launch[b]	Far after launch[c]
Senior management	Senior manager #1 – Sales and marketing	110 min			
	Senior manager #2 – Processing	60 min	12 min		
	Senior Manager #3 – Aquaculture		100 min		
	Senior manager #4 – Finance		25 + 40 min		
	Senior manager #5 – Technical	60 + 60 min			10 min
Lower management	NPD technologist #1 – NPD administrator	45 min		85 min	
	NPD technologist #2 – Project team leader		75 min		15 min
	NPD technologist #3 – Project team leader		75 min		30 min

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(continued)

Managerial group	Job role and/or NPD role	Before launch	Near launch[a]	Soon after launch[b]	Far after launch[c]
Middle management	Middle manager #1 – Domestic sales		100 min		
	Middle manager #2 – Domestic marketing		55 min		
	Middle manager #3 – Export sales				135 min
	Middle manager #4 – Cost Accountant		75 min		
	Average length of interview (in minutes)	67 min	62 min	85 min	48 min

[a] Near launch was within 4 to 6 weeks before the historical market launch date when the 3 lines of new products were introduced.
[b] Soon after launch was 5 months after the historical market launch date when the 3 lines of new products had been introduced.
[c] Far after launch was 14 months after the historical market launch date.

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