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Author(s)	Curtis, Emer; Sweeney, Breda
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Managing different types of Innovation: Mutually Reinforcing Management Control Systems and the Generation of Dynamic Tension

Abstract

Using a single case study of a highly innovative medical device company engaged in two types of innovation (technological and customer-oriented), this paper examines the nature of the relationship between mutually reinforcing management control systems (MCSs) and the generation of dynamic tension between the different types of innovation. Findings show how mutually reinforcing MCSs create a push for consistency but fail to generate a dynamic tension between different types of innovation, thus crowding out one type of innovation. While the literature to date has been unclear on how mutual reinforcement and the generation of dynamic tension are related, this study makes a distinction between mutually reinforcing control systems that support each other in driving momentum around a particular strategic objective (consistent reinforcement), and control systems which are reinforcing in creating dynamic tension, thus reducing momentum in one particular direction (countervailing reinforcement). It also contributes to the literature by highlighting the protective role that MCSs can play in the management of innovation. Feedback and measurement systems reduce the vulnerability of resources to diversion to other areas by stimulating action on projects, driving accountability around the use of the resources, and commanding management attention.

Keywords: Innovation, Management control systems, Mutual reinforcement, Dynamic tension, Simons' levers of control

1. Introduction¹

The literature has pointed to the importance of combinations of management control systems (MCSs) that are mutually reinforcing and generate dynamic tension (Bedford 2015, Mundy 2010, Simons 1995). The levers of control framework (Simons 1995) views mutually reinforcing combinations of MCS as combinations which produce dynamic tension through the introduction of countervailing forces. However, Bedford (2015) points to mutual reinforcement and dynamic tension as different attributes of MCSs and argues that they have varying importance depending on the types of innovation pursued. For organisations pursuing one type of innovation (in his study exploration or exploitation), he hypothesises a need for mutually reinforcing combinations of MCSs, whereas for organisations pursuing multiple types of innovation (in his study ambidextrous organisations) he hypothesises a need for combinations of MCSs that generate dynamic tension. According to Henri (2006), dynamic tension is important for managing inherent organisational tensions. Engaging in different types of innovation can introduce additional inherent tensions such as the potential for a crowding out of one form of innovation due to a natural bias in organisations in favour of innovation activities with a greater likelihood of short-term success (O'Reilly and Tushman 2013). In addition to this lack of clarity on how mutual reinforcement and dynamic tension are related, Moll points to the limited understanding in the literature of 'how tensions appear or disappear when different controls are used together, and how particular combinations of practices might contribute to the success or failure of firms undertaking NPD [new product development]' (Moll 2015, p. 9).

The objective of this study is to examine the nature of the relationship between mutually reinforcing combinations of MCSs, and the generation of dynamic tension between different types of innovation. Dynamic tension is central to Simons' levers of control (LoC) framework (Simons 1995), which has frequently been used in the literature to examine problems associated with managing innovation (e.g. Bedford 2015, Bisbe and Malagueno 2009, Bisbe and Otley 2004). It provides a 'window into understanding' two aspects of the complexity of controls (how MCSs are used and how they act in combination) in relation to

¹ Abbreviations used: LoC = Levers of control; MCSs = Management Control Systems; ICSs = Interactive Control Systems; DCSs = Diagnostic Control Systems; R&D = Research and Development; NPD = New Product Development; EBITDA = Earnings Before Interest, Taxation, Depreciation, and Amortisation.

innovation (Chenhall and Moers 2015) and it addresses the interplay of controls in managing organisational tensions (Mundy 2010). The organisational tension addressed in our study (tension between two forms of innovation) differs from that addressed by Simons' (1995) framework, which focused on tension between innovation and predictable goal achievement. However, his framework has been used in quantitative research to investigate control systems appropriate for managing different and multiple forms of innovation (Bedford 2015). Furthermore, his framework provides useful control categorisations to classify control systems and analyse the nature of the relationship between mutually reinforcing MCSs and the generation of dynamic tension between different types of innovation.

To address our objective we conducted a case study of a highly innovative company (Caseco) in the medical devices industry. The study is set in the context of a strategic adjustment in the focus of R&D activity in Caseco. Prior to our study, Caseco's strategy was to be 'the best technology company' and much had been achieved by Caseco over a 10-year period through a strategy of technological innovation (which involved finding 'a problem' for new technologies developed by the company) and customer-oriented innovation (which focused on customers' immediate requirements). However, at the time our study commenced, management had decided to redirect the focus of R&D away from technology development and to concentrate on becoming more customer oriented. This involved partnering with key customers and engaging in fewer isolated technology development projects. The strategy intended to reduce technology innovation from approximately 40% to 20% of overall R&D activity; however, the outcome of the strategic adjustment was to virtually eliminate technology innovation.

Our study contributes to the literature in a number of ways. Firstly, the study contributes to theory by making a distinction between two forms of reinforcement in control systems: (1) mutually reinforcing control systems that create a push for consistency and increase momentum around a particular strategic objective (referred to as consistent reinforcement), and (2) control system containing countervailing forces that generate dynamic tension, thus reducing momentum in one particular direction (referred to as countervailing reinforcement). In relation to consistent reinforcement, findings demonstrate how MCSs that lack dynamic tension can create a push for consistency. Smith and Lewis (2011) identify the potential for an organisational push for consistency in the context of managing radical and incremental innovation; however, the role of MCSs in this regard was not considered. In relation to

countervailing reinforcement, Simons (1995) identifies interactive control systems (ICSs) and beliefs systems as ‘yang’ systems and diagnostic control systems (DCSs) and boundary systems as ‘yin’ systems. He suggests that yin and yang systems are mutually reinforcing, and that their combined use generates dynamic tension. We found evidence of the active use of MCSs in a consistent manner encompassing all four levers of control. While it could be expected that this consistent reinforcement would be positive, in fact appropriate dynamic tension between the two types of innovation was absent as the ICS and beliefs system reinforced the dominance of customer-oriented innovation. Rather than creating a tension with the ‘yin’ systems (DCSs and boundaries), they supported these systems leading to greater momentum than intended around customer-oriented innovation and resulting in the virtual elimination of technology innovation activity.

Further, our study contributes to the literature by providing evidence on the insufficiency of value systems to foster innovation, and points to the protective role of feedback and measurement systems in reducing the vulnerability of resources invested in particular projects to diversion (for example, to short-term crises or higher profile projects). The role of value systems as an MCS has been increasingly acknowledged in the literature (Marginson 2009) and recent research suggests that the beliefs system (in conjunction with the culture) acts as a corner stone of MCSs (Heinicke et al. 2016). Consistent with this, our findings point to the important role of the value systems in providing an infrastructure to support multiple types of innovation. However, our findings further suggest that unless interactive and diagnostic control systems are in place to command attention, stimulate action and drive accountability, resources invested in innovation are vulnerable to diversion. While this finding is consistent with previous research on the positive role for ICSs and DCSs in fostering innovation (e.g. Bedford 2015, Henri 2006), a protective role for innovation has not been explicitly attributed to feedback and measurement systems; this study provides in-depth findings on how feedback and measurement systems achieve this.

The remainder of the paper is set out as follows. The next section sets out our research objective and reviews prior literature on MCSs and innovation and the management of multiple types of innovation. Next the research methods are explained. The findings section describes the MCSs used to manage innovation in the company together with an analysis of the levels of mutual reinforcement/dynamic tension in these MCSs. This is followed by a discussion of evidence of consistent reinforcement and countervailing reinforcement. Section 6 concludes the paper and discusses areas for future research.

2. Research objective and prior literature

In the context of the management of two types of innovation (technological and customer oriented), our study examines the nature of the relationship between mutually reinforcing MCSs² and the generation of dynamic tension between the different types of innovation.

Managing multiple forms of innovation is challenging given the need to tailor MCSs to the innovation mix (Davila et al. 2006) and to counteract the momentum in organisations in favour of innovation with a greater likelihood of short-term success (O'Reilly and Tushman 2013). The first section of the literature provides a discussion of MCSs and innovation, specifically addressing the integration of multiple MCSs and evidence to date on the nature of the relationship between mutually reinforcing MCSs and the creation of dynamic tension. This is followed by an overview of the discussion in the innovation management literature on the challenges associated with managing a mix of types of innovation and the need for active management of organisational tensions between different types of innovation.

2.1 MCSs and Innovation

The role of MCSs and their impact on innovation outcomes has been the focus of research attention over a number of years. Arguments have been made that formal MCSs can stifle innovation (Amabile 1998, Ouchi 1979) and empirical studies have found that looser forms of control are more prevalent in high innovation settings (Abernethy and Brownell 1997, Abernethy and Lillis 1995). However, more recently, arguments point to the potential for formal controls to contribute to innovation by providing support and direction for the process (Davila et al. 2009) and empirical evidence highlights the positive role that control systems can play in managing innovation (Bedford 2015, Henri 2006).

Resulting from this debate, it is now generally accepted that MCSs can have a positive role in innovation management, and effective design and use of MCSs is regarded as crucial for fostering innovation (Davila et al. 2006). Traditional management accounting techniques have evolved into more complex MCSs to deal with the challenges of generating innovation (Chenhall and Moers 2015) and attention has been given in the literature to the relationships between multiple MCSs. One framework that points to the importance of examining multiple

² We define MCSs as 'formal, information-based routines and procedures' (Simons, 1995, p. 5).

controls collectively is Simons' (1995) levers of control (LoC) framework (Chenhall and Moers 2015). This framework has been frequently used in the literature to examine the challenges of managing innovation (e.g. Adler and Chen 2011, Bedford 2015, Bisbe and Malagueño 2009, Bisbe and Malagueño 2015, Bisbe and Otley 2004, Henri 2006) and provides a 'window into understanding' two aspects of the complexity of controls in relation to innovation (how MCSs are used and how they act in combination) (Chenhall and Moers 2015). While Simons' framework focuses on the tension between creative innovation and predictable goal achievement, it provides insights into the interplay of controls in managing dynamic tension (Mundy 2010) and has been used to examine the management of multiple types of innovation (Bedford 2015). Simons (1995) describes how MCSs operate as four levers of control (beliefs, boundary, diagnostic and interactive systems) in an integrated manner to manage four strategic variables (core values, risks to be avoided, critical success factors and strategic uncertainties).

Revellino and Mouritsen (2009) point to the connections between the various levers as being more important than their individual roles. To explain how the LoC are used by senior managers 'to achieve a dynamic tension that allows for the effective control of strategy' (p. 8), Simons (1995) draws on the Chinese philosophy of 'yin' and 'yang'. He categorises beliefs and interactive levers as the positive or 'yang' side and boundary and diagnostic levers as the negative or 'yin' side. Simons (1995) maintains that the yin and yang produce countervailing forces leading to dynamic tension and that the 'four systems, then, are mutually reinforcing' (p. 161). In other words, the positive and negative forces are used to 'create *dynamic tension* that contributes to manage inherent organizational tension' (Henri, 2006, p. 533).

Empirically, Henri's (2006) study provides evidence to support the benefits of dynamic tension, created through the use of a performance measurement system both in an interactive and diagnostic way, as a unique capability of an organisation. Further, Widener (2007) points to how the generation of dynamic tension can be understood by viewing control systems as complementary where doing more of one raises the return from doing more of the other (Milgrom and Roberts 1995) and her findings support a complementary relationship between the levers.

In the context of managing innovation momentum, Bisbe and Malagueno (2009) find a complementary relationship between control systems and point to the importance of generating dynamic tension. They examine the impact of a fit between choice of control system for interactive use and innovation management mode (IMM) on levels of innovation. Their study initially viewed the concept of 'fit' as a supplementary fit, such that control systems reinforce each other. However, they find that high innovation firms with a fit between IMM and MCSs are more likely to have higher levels of innovation and low innovation firms with a fit are more likely to have lower levels of innovation. Hence they revise their idea of fit to that of a complementary fit and suggest that a possible explanation for their findings is the need for control systems to introduce diversity rather than a reinforcement of existing patterns. They draw on relevant literature on momentum in organisations (Amburgey and Miner 1992, Jansen 2004, Kelly and Amburgey 1991, Miller and Friesen 1980), and argue 'that firms with a propensity to innovate will be inclined to become even more innovative, whereas those not inclined to innovate tend to further limit the circumstances under which they engage in innovative activities' (p. 381). They suggest that without mitigating influences, innovation momentum can lead to dysfunctional excesses of too much innovation in high innovation firms and too little innovation in low innovation firms. Thomas et al. (2005) also find evidence of control systems introducing diversity in the context of multinationals seeking a balance between global control and efficiency (termed exploitation) and local autonomy and innovation (termed exploration). They provide an example of the interactive use of budgets and profit planning systems being used to focus attention on exploration in a phase where the company was oriented towards exploitation. Their study supports Simons' (1991) point on how the choice of ICS can appear counterintuitive as it is driven by strategic uncertainties and the vision of the organisation, in contrast to DCSs which are driven by the implementation of current strategy. Thus, in the context of Thomas et al.'s (2005) study, the ICS lever is not needed to emphasise exploitation in a phase where there is a high level of exploitation activity but is needed to question the absence of a high level of exploration activity. In contrast, DCSs are needed to emphasise exploitation in order to implement the exploitation-oriented strategy. Research has also found support for this in the context of the overall level of innovation in an organisation and Bisbe and Otley (2004) find that while ICSs are held to be important for innovation, they are negatively associated with innovation in high innovation companies, and the opposite (though not entirely conclusive) in low innovation companies pointing to the need for ICSs to provide a countervailing force.

Overall these studies suggest that in managing innovation, the levers in combination need to work in opposite directions (in Simons' (1995) terms, to introduce dynamic tension) either to manage the overall innovation momentum in the organisation or the momentum of a particular type of innovation. However, other studies point to the importance of mutually reinforcing control systems that do not necessarily introduce dynamic tension. For example, Tuomela (2005) highlights how performance measurement systems can be used to reinforce beliefs and boundaries and that 'selected performance measures strengthen (weaken) the establishment of beliefs and strategic boundaries when the measures are set in line (contradiction) with the intended strategy' (p. 298). Tuomela (2005) does however acknowledge the role of ICSs in questioning and redefining beliefs and boundaries. Granlund and Taipaleenmaki (2005) show how systems can become more aligned over time. They illustrate how a clash between financial control systems and a culture of innovativeness, flexibility, empowerment and freedom, can be alleviated as an organisation grows and learns the meaning of financial fundamentals which become embedded in the culture. This suggests that these mutually reinforcing control systems lead to a reduction in dynamic tension over time.

Mundy's (2010) study provides insight into the potential consequences of low levels of dynamic tension in the context of an outsourcing decision. While her study focuses on dynamic tension in relation to how organisations balance different uses of MCSs (controlling and enabling), her findings illustrate the poor outcomes that can result when beliefs, boundary and diagnostic processes are all mutually reinforcing and ICSs are suppressed. She finds a number of factors to be important in determining the capacity of organisations to balance different uses of MCSs, including internal consistency, suppression, and logical progression. Her findings support Widener (2007) in emphasising the importance of consistency between the beliefs system and the other three levers. In relation to logical progression in the use of the levers, she refers in particular to the importance of this for organisations undergoing strategic change where ICSs need to be mobilised before boundary and diagnostic processes become 'hard-wired' into the organisation as there is a risk that ICSs mobilised afterwards will be used to support agreed plans and stifle discussion. In other words, while ICSs used after the mobilisation of DCSs and boundary levers may operate to reinforce these levers, they may fail to provide a countervailing force. Finally, in relation to suppression, she points out what while prior studies have focused on use of MCSs, her

findings illustrate how suppression of controls can play an equally important role in balancing different uses of MCSs.

Bedford (2015) adds to our understanding of particular contexts in which dynamic tension may be more important. Essentially, his argument is that MCSs need to operate jointly to produce dynamic tension in organisations pursuing competing strategic priorities (ambidextrous organisations) and MCSs need to operate in a mutually reinforcing manner in organisations pursuing a single type of innovation (exploration or exploitation). For organisations pursuing exploitation, he hypothesises a mutually reinforcing relationship between the yin systems (for exploration, a mutually reinforcing relationship is hypothesised between the yang systems). In relation to ambidextrous organisations, he maintains that as these firms are pursuing competing strategic priorities, they require the joint use of control systems that ‘represent countervailing and opposing forces’ (p. 18). For firms pursuing a single type of innovation, his findings show a relationship between ICSs and performance in exploration firms; in exploitation firms, his findings show that DCSs and boundary systems are independently related to performance. For ambidextrous firms he finds support for a complementary effect between DCSs and ICSs but not between beliefs and boundary systems.

Overall, the MCSs literature suggests that organisational tensions can be managed through mutually reinforcing control systems that generate dynamic tension (Henri 2006, Mundy 2010, Simons 1995). However, there are few empirical insights into the use of MCSs to generate dynamic tension between different forms of innovation (Bedford (2015) being an exception). In addition, with the exception of Mundy (2010), most of the other studies examining the generation of dynamic tension have been quantitative (e.g. Bedford 2015, Bisbe and Malagueno 2009, Bisbe and Otley 2004, Henri 2006, Widener 2007). In general, the literature has not provided in-depth insights into how tension is increased/decreased by particular combinations of control systems and the consequences for success or failure of NPD (Moll 2015). Also, the nature of the relationship between mutual reinforcement and dynamic tension is unclear given findings on how mutually reinforcing control systems can result in a reduction of dynamic tension over time (Granlund and Taipaleenmaki 2005) and findings on the relative importance of mutual reinforcement/dynamic tension in the context of managing different/multiple forms of innovation (Bedford 2015).

The innovation management literature presents us with some additional insights into the organisational tension associated with the management of different innovation types and this is discussed in the following section.

2.2 Innovation Management

The innovation management literature points to various different issues which arise in managing a mix of types of innovation, such as the significant challenge of balancing creativity, flexibility and technological innovation with market orientation and customer focus (Burgers et al. 2008). Customer (or market) orientation assumes that the customer is the source of all wisdom, whereas the technological or innovative orientation is based on the view that technological innovation will drive growth and while this view does not ignore the customer, it assumes that the customer may not be able to identify a need for a new technology (Berthon et al. 2004).

Customer focus has been associated with incremental innovation (Lukas and Ferrell 2000) and the organisational ambidexterity literature has identified challenges associated with managing a mix of radical and incremental innovation (Lin et al. 2013) due to the potential for a bias in organisations in favour of innovation activities with a shorter time lag to revenue and greater likelihood of short-term success (O'Reilly and Tushman 2013). The literature has pointed to the importance of both a high level of overall innovation activity and a high level of balance in the relative levels of different innovation types in order to build on current capabilities and develop new capabilities (Cao et al. 2009). Furthermore, the literature has pointed to the importance of making tensions salient in managing these different types of innovation (Smith 2014, Smith and Lewis 2011) and the need for management to consciously combine opposites in decision making (Fredberg 2014). Smith and Lewis (2011) point to the potential for organisational forces to create a push for consistency resulting in a focus on a single choice. They suggest a need for 'consistent inconsistency' (p. 392) to ensure that attention is simultaneously given to alternatives. The role of MCSs is not addressed in this stream of literature; however, the studies do provide insight into the importance of directing management attention to different types of innovation (namely, radical and incremental) and suggest that consistency is not necessarily desirable for an organisation. Findings in the MCSs literature identifying the need for control systems to introduce diversity (Bisbe and Malagueño 2009) support these points on the need for 'consistent inconsistency' (Smith and Lewis 2011), consciously combining opposites in decision making (Fredberg 2014) and increasing the salience of tensions between alternatives (Smith 2014).

Research has called for greater insight into how dynamic tension is reinforced and managed in daily activities and how control systems are balanced depending on strategic change (Henri 2006). More recently, Bedford (2015) called for an examination of how MCSs are implicated in shifting between different modes of innovation and pointed to the need for a deeper understanding of dynamic tension in the context of multiple competing strategic priorities. It is relevant that our study focuses on a strategic adjustment in the relative levels of the two types of innovation, which resulted in a change in the innovation momentum in favour of customer-oriented innovation. This enabled us to examine the nature of the relationship between mutually reinforcing MCSs and the generation of dynamic tension between the two types of innovation in the context of the innovation outcomes associated with the strategic adjustment.

3. Research methods

3.1 Research site selection

The lack of clarity around the nature of the relationship between mutually reinforcing MCSs and the generation of dynamic tension between different types of innovation was outlined in the previous section. In-depth methods of data collection are particularly suitable for examining complex issues where there is a lack of clarity in the literature and our study adopted a case study method based on a company in the medical devices industry (Caseco) employing approximately 860 people with 4 divisions across 3 continents. The medical device industry was selected as it was undergoing significant cost pressures due to changes in healthcare brought about by the Obama administration. Caseco in particular was selected as it was regarded as a highly innovative company and we sought to gain insights into MCSs in a company that was regarded as successful. Significant expansion took place in the year before and during our study and the company grew from two to four divisions. In advance of collecting field data, as much information as possible was collected from public sources (company website and press reports) to increase the researchers' understanding of the characteristics and products of the company.

3.2 Methods

As recommended by Yin (2003), we collected data from different sources and while the helpfulness of the term 'triangulation' has been debated, data from multiple sources does increase the plausibility of findings (Ahrens and Chapman 2006). A total of 28 interviews

were carried out over an 18-month period (January 2011 to June 2012) and appendix 1 contains a list of interviewees. Interviewees were selected to obtain data that included perspectives of employees and multiple levels of management (senior management, heads of functional units, and project leaders) across the functional areas of the organisation. The interviews took place in formal surroundings in the field and lasted between 50 and 90 minutes; both researchers were present for all but 2 of the interviews. In addition, we were given copies of company documentation such as strategy documents, company employee newsletters, organisational charts, employee performance evaluation templates, project evaluation forms, and PowerPoint presentations for monthly management meeting. These documents were used to corroborate findings from interviews and to generate questions for further interviews where we lacked clarity on the content or where there was inconsistency between the documents and views of the interviewees. For example, a copy of the PowerPoint slides at the monthly meeting helped our understanding of which slides generated most discussion and what ‘airtime’ was given to various issues, thus supporting interview findings on how management divided their attention between different types of innovation.

Furthermore, we were given a tour of the plant and were invited to have coffee in the canteen on a number of occasions. While these opportunities for observation did not result in any direct evidence reported in the findings section, they did contribute to deepening our understanding of the company.

All of the interviews were semi-structured and interview schedules were developed based on the literature reviewed to include the main forms of control systems involved in managing R&D. While interview schedules were tailored to individual interviewees’ areas, a summary of the main areas covered in the schedules is contained in Appendix 2. Interviews were digitally recorded and notes were taken during the interviews of important points and areas where contradictory findings arose. These areas of contradiction were followed up in subsequent interviews. For example, interviewees referred to the automation of product lines that seemed unrelated to the move to customer-oriented innovation. However, further interviews revealed that the move to automate the product lines was driven by the demand from customers for products at a lower cost and this is viewed as a customer-oriented project. In one particular case where subsequent interviewees were unable to provide clarification on an issue (the current use of the technology funnel), we carried out a second interview with the Head of R&D.

Recognising the importance of a disciplined approach to data analysis as documented in previous research (e.g. Miles and Huberman 1994), a structured analytical approach was adopted in the study. Both authors carried out the data analysis. The recordings were transcribed verbatim immediately after the interviews and both of the researchers listened to the recordings and checked the transcripts for accuracy. As recommended by Patton (1990), an initial set of codes was developed before the interviews commenced. This initial set of codes was mainly based around categories of innovation and categories of MCSs and the first few transcripts were coded based on the initial codes and inputted into NVIVO. As data collection progressed, the initial codes were refined based on a re-examination of the literature and the data. The data collection extended over a period of 18-months as data collection was interspersed with periods of data analysis.

Through ‘continuous back and forth questioning of interpretations and discussion of recorded field data’ (Ahrens and Chapman 2006, p. 833), data was re-examined to discern if it fitted emerging patterns and we searched for negative evidence (Miles and Huberman 1994) contradicting our emerging patterns. NVIVO facilitated the selection of quotations which expressed views well and these were used to present the ‘thick description’ (Denzin 1994) in the next section. Following selection of the quotations, transcripts were read again in full by one of the researchers to ensure these quotations were not taken out of context.

The findings are set out in the following section. The R&D innovation activities and the MCSs used to manage those activities are described along with an analysis of the operation of MCSs to mutually reinforce each other and generate dynamic tension between the two types of innovation.

4. Innovation at Caseco

Caseco grew from a small innovative family company in the engineering sector to a supplier of choice for some of the biggest med-tech companies in the world. The founders of the company were actively involved in the running of the company for approximately 12 years, and were members of the board of directors at the time of our study. Revenue in the company is generated from subcontracted manufacture of components of medical devices and subcontracted NPD. Caseco has a proven track record of NPD, evident from its sales growth rate of in excess of 40% in 2009 compared with growth rates of less than 10% for the

majority of top 10 worldwide medical device companies, calculated from medical product outsourcing magazine (Delporte et al. 2010).

Our case study is focused on the R&D activity in one of Caseco's divisions (the division also engaged in manufacturing and contract design activity). This division was the largest and was also where Head Office was located, thus facilitating access to senior management. The R&D activity comprised a mix of technological and customer-oriented projects. Technological projects involved the generation and application of new technologies that improve either products or the manufacturing process, resulting in better functionality for the components manufactured by Caseco. Customer-oriented projects involved feeding into their customers' NPD processes by developing new or improved components which form part of the customers' new products. The R&D centre incorporated both R&D and prototyping activity and was comprised of a Middle Manager, approximately 30-40 engineers and a small number of product builders.

The nature of the creativity (problem solving versus problem finding) in technology development differed from customer-oriented projects as technology development involved problem finding in addition to problem solving whereas customer-oriented projects involved only problem solving:

the creativity starts further back with this group [technology development] whereas [customer-oriented projects] comes with a problem, they're more problem solving. Now they can be creative about their problem solving but they're problem solving whereas these guys [technology group] are creating. (Senior manager)

Shortly before the commencement of our study, and partly in response to intelligence gathered on changes in the environment (a degree of maturing in the medical device market combined with budgetary constraints in the hospital sector worldwide, imposed cost pressure on medical device companies), the company changed its strategy to increase its focus on customer-oriented projects. The company's previous strategy was to grow by being a leader in developing the best technology. However, management began to question this strategy in changing market conditions and it was decided that a closer alignment was needed with customers and the growth strategy was changed to being the partner of choice for key customers by 'delivering cost and technologically effective solutions' (per Caseco's strategic plan). This resulted in a strategic adjustment of R&D away from technology development towards customer-oriented projects, where future revenue potential was clearer:

Our focus has changed in the last year or so... the [R&D] Centre developed ideas, processes, materials, whatever, just people had ideas and I said this could be a good idea, ... then we'd go out there and we'd sell it, see if we could sell it to people, ... but it left our [R&D] Centre I suppose slightly isolated and in a sort of an academic environment and not really linked that closely to customers. So our focus has changed, it's changing at the moment, in that we're more product focused so now, we'll develop technologies that we know that a particular customer will want or will buy. ... So therefore you've more of a link then to your sales and marketing team.
(Middle manager)

Thus, the executive team took a decision to change the relative levels of customer-oriented and technology projects with an increase in customer-oriented R&D from approximately 60% to 80% of total R&D activity and a corresponding reduction in technology R&D from 40% to 20% (refer to figure 1 which shows a timeline of the change). We obtained and analysed both the strategy discussion document dated June 2010 and the strategic plan dated December 2010 and this corroborated interview evidence on the logic and intent of the strategic adjustment.

[INSERT FIGURE 1 HERE]

Pursuing multiple types of innovation creates an inherent tension in the competition for resources and the importance of control systems introducing diversity and preventing momentum in a single direction has been pointed to in the literature (Bisbe and Malagueno 2009). Our findings examine mutual reinforcement and the generation of dynamic tension by key control systems mobilised in the management of R&D activity and are presented in the following subsections (4.1 Value systems and annual performance evaluation, 4.2 Financial Performance Measures, 4.3 Sales funnel and sales performance measures, 4.4 Intelligence gathering system, and 4.5 Technology funnel). Table 1 summarises these key control systems and their role in managing technological and customer-oriented projects.

[Insert Table 1 here]

4.1 Value systems and annual performance evaluation

The beliefs and boundary systems, termed value systems (Marginson 2002), were used as mechanisms to communicate the importance of innovation and the changed strategic direction. As Simons (1995) points out, 'beliefs systems and boundary systems transform unbounded opportunity space into a focused domain that organisational participants can be encouraged to exploit' (p. 41).

The beliefs system, which communicated the core values of the company, strongly emphasised innovation and did not discriminate between technology and customer-oriented innovation, thus supporting both. ‘Innovative’ was articulated as one of the formal core values of the company on a plaque on the wall in reception and the importance of innovation in the company was attributed to the original founder of the company:

It’s kind of how he [founder] would think himself, and then [he] would have recruited people who think like that and would have recruited [the CEO], she’d be very entrepreneurial, very innovative, but very practical at the same time. She would have kind of hired the team of similar mind-set and then suddenly you’ve got a whole group who approach the world who want to be innovative. (Senior Manager)

While this quote was from a senior manager, it was striking the extent to which these values permeated the thoughts and words of the interviewees at all levels:

I’d say one of the strengths with [Caseco] is the flexibility we have in all we do. (Sales team member)

It’s a very open structure as well, anybody can come in with an idea and a complaint or a grumble, or whatever it may be, so the communication is always there which is helpful. (Senior engineer)

In addition to a core value of ‘innovative’, the statement of core values articulated three other core values: flexible, open and honest. These core values were manifest in a relatively flat organisation structure, the willingness to embrace change, the open and flexible channels of communication, and the acceptance of failure, all of which supported innovation:

There is that flexibility and willingness to change, looking at what’s happening with the customer, what’s happening in the market space overall, competitors and all of that and then adapting and changing. (Account manager)

The open and flexible communication fostered between R&D engineers, sales staff, account managers and customers was commented on by a number of interviewees and led to the generation of ideas for both technology development and customer-oriented projects:

the engineers are very, very free to talk with our customers, we don’t have that ‘well no you’re an engineer, it’s a sales guy deals in the front end’ and what that allows the engineer do is to really understand what the customers needed. And it’s a direct translation so they’re not hearing it from a customer to a sales guy, sales guy to an engineer. It’s customer to engineer and that to me fosters a much more free thinking innovative type of environment. (Middle manager)

[ideas for technology development] come from a group of us internally, mostly technically minded people who would be engaged in a lot in dialogue with the customers, who would be observing the types of problems the customers are trying to

solve and then trying to anticipate or analyse what solutions. If a different set of solutions are available for these customers maybe we could improve the offering that we are giving to them. If we had an improved [material type] that had better [functionality] that might be something the customers might want. (Middle manager)

The attitude of the company to failure further supported innovation and interviewees consistently emphasised the importance of an environment where failure is accepted and not punished. There was evidence that the value systems and the annual employee performance evaluation were mutually reinforcing in emphasising the importance of innovation and the acceptance of failure. All employees were rated on innovation as part of their performance evaluation and employees were required to provide examples of how they were innovative in their job. However, there was evidence of an historical acceptance that some failures were an inevitable consequence of innovation:

To this day people are encouraged to have a go ... of course they will think 'well what happens if it doesn't work, what does that do to me?' So I used to call it "the gamble" and that implies that it's okay if it doesn't work. (Senior manager)

The views of middle managers were consistent with that espoused by senior management and they maintained that attention and energy was not devoted to assigning blame but to organisational learning:

When things don't go well, we do it very constructively. We critically analyse ourselves, and look, why didn't that go well? And then we decide, well, actually, how will we change our tack with the customer going forward because of that? And in some cases, it's not our fault. It's the customer has promised us everything and hasn't delivered, and then CEO looks here and goes, guys why did we mess this up? And we said 'well we took a risk, we took a chance, we invested capital and it hasn't worked out for us'. What that means is me as a sales guy, needs to go out and approach the customer differently now and say, look, our world has changed now. (Middle manager)

In addition to the values espoused by the formal control systems of the company, in coding our interview data we found another recurring theme which permeated interviewees in R&D: the potential for generating revenue and profit:

we've managed to keep a very strong commercial focus, and as engineers sometimes that's hard, because you like the technology for the technology but it was always like, how are we going to make money out of it. (Senior manager)

Our data illustrated a pervasive commercial focus throughout the division. When asked what was of most concern to management, the reply 'whether we've hit our revenue targets' (Middle manager) was the typical response. While the strong commercial focus was not a

stated core value of the company, it was evident that it was as powerful in guiding actions as any of the stated values:

We will know exactly what we need to get out of it [project] in terms of profitable revenue, so that is a key, key requirement. (Middle manager)

While Jorgensen and Messner (2010) find evidence of a general understanding of the importance of profitability among NPD staff in their case study, our findings present stronger evidence on the ingrained awareness of this in Caseco. Findings suggest that this was actively and intentionally managed through the communication processes that constitute a number of control systems, which were infused with a strong commercial rhetoric, as is evidenced by the following quotation from senior management:

Now, what I was focused on was the margins, ... that was the focus, focus, focus on profitability above all else ... Yes, so it was profitability and to this day it's profitability is what matters most and to me it's the margins that matter most rather than anything else. (Senior manager)

The degree of mutual reinforcement between innovation and profitability was such that the message communicated by the other core values could not be divorced from the understood need for commercial focus. Innovation was understood and accepted as referring to profitable innovation. As one senior manager described the typical discussions about innovation:

How are we actually going to make money, who are we going to sell this to, and what's it going to do. So I'd say that very strong commercial focus in what we did and I suppose that led us to throw things out quicker ... I think we are very open and I think we look at a lot of stuff and scan a lot of stuff. (Senior manager)

The ingrained nature of the commercial awareness is critical to understanding how control systems that could potentially have created countervailing forces, ultimately became mutually reinforcing around customer-oriented innovation.

4.1.1 Strategic and business planning systems

Boundary systems in the form of the strategic planning system and associated business plan set out the areas where R&D opportunities were to be exploited and were central to communicating the strategic adjustment. Caseco had a written strategic plan developed by senior management, which was reviewed annually and revised every few years. Regular communication of the strategic plan took place through quarterly company meetings with all

staff. As explained earlier, this strategic plan clearly articulated the intended strategic adjustment. The strategy was operationalised in a business plan developed by senior management:

The strategy document itself would be more verbiage and intent and then out of that, the businesses would roll out what we believe we can achieve to get there. The business plan comes out of that ... and then it rolls back to exactly what are the innovation guys doing that will get us that business. (Senior manager)

Operational management developed the business plan rather than the accounting staff as it set out planned sales volumes and sales mix of products. It was used to focus attention and allocate resources in R&D:

You have a business plan at the start of the year which says we need to grow about 4 million this year, existing [X] business, it's the biggest amount of our business but really we think it is going to be relatively flat in the future, it might only grow by one million and here is this other segment where we have no sales in it right now and we want to grow by six million. So if those are our business plan objectives we have to make sure from an R&D perspective that we are working on projects that stack up with all those. (Middle manager)

The espoused beliefs provided the infrastructure for innovation activity in both technology projects and customer-oriented projects; however the proximity of customer-oriented innovation activity to revenue generation in the short term coupled with the deeply embedded value of commercial awareness, resulted in these systems mutually reinforcing the increased importance of customer-oriented innovation rather than generating dynamic tension between the two types of innovation.

Simons (1995) points out that on their own, beliefs and boundary systems are likely to be insufficient to ensure that desired activity is translated into organisational action. Consistent with this, we found evidence of other MCSs operating in a manner that mutually reinforced the new strategic direction and these are discussed in the next sections. However, we also found that these systems failed to generate dynamic tension to protect technological innovation.

4.2 Financial performance measures

Financial measures of performance played a key role in translating desired activity into organisational action through creating accountability for meeting targets and embedding the importance of commercial awareness. While the involvement of accountants in the R&D

centre was historically limited and the only cost information provided to the centre by the finance department was a summary of expenditure each month, this belied the extent of management attention captured by accounting figures of revenue, earnings before interest, taxation, depreciation and amortization (EBITDA), and free cash flow, illustrated by the following quote:

if we make the device for €10, we have to be making x amount in terms of profit or contribution on that. That's a key, key, key measure that's measured all the way up to [CEO] and CFO. That's a very, very important measure for the business, its profitability. And we have defined profitable targets in terms of EBITDA and then in terms of free cash flow. That's a very, very important measure. How do we get that? It's by getting good revenue growth, but revenue growth that is profitable. (Senior manager)

These financial measures played a significant role in reinforcing a strong commercial orientation and the need for new ideas to be useful in terms of generating profit. R&D was evaluated on the basis of revenue earned on new products as a percentage of total revenue further emphasising the importance of financial results:

There's one kind of key metric which comes out every month which is the value of what we're selling today that has been introduced in the last 2 years. So we aim for it to be 25-30 per cent, so everything that we made today we shouldn't have been making it 2 years ago because products come and go and lifecycles change so that's our measure that we're bringing in new business really. (Senior manager)

It was acknowledged by interviewees that revenue is a lagging indicator of performance and limits the accountability of the R&D centre to previous work; however, the difficulty of finding meaningful leading indicators of current R&D activity resulted in the abandonment of measures such as number of product launches for technology projects. While this system was not intended to favour one type of innovation, the shorter time lag between R&D work and revenue for customer-oriented projects resulted in a bias in favour of projects with shorter time outcomes (O'Reilly and Tushman 2013) in striving to meet financial measures of performance.

4.3 Sales funnel and sales performance measures

Further increasing the momentum towards customer-oriented projects were additional control systems in the form of the sales funnel and sales staff performance measures that related solely to customer-oriented projects and excluded any activity related to technology projects. The sales funnel was an existing MCS and the sales staff performance measures were introduced following the redirection in innovation strategy.

4.3.1 Sales funnel

The sales funnel was a project management system that tracked all active and proposed R&D customer-oriented projects along with ideas generated. It played a pivotal role in filtering ideas to be pursued as projects. The sales funnel contained up to 100 potential projects for generating sales over a 6-18 month period, although typically only 20-30 of these projects would be active at a given time. A cross-functional management team composed of the R&D manager, the prototyping centre manager, the commercial manager and the global sales manager – together known as the ‘commercial team’, managed the sales funnel. The filtering of ideas, prioritisation of projects, allocation of resources and monitoring of project progress took place at weekly meetings each Friday morning. Project teams that were due for review presented their progress at this meeting and priorities were reviewed taking account of customer needs, available resources and progress on projects. Any new ideas or proposals for projects were considered and filtered at these meetings to avoid any further time being devoted to ideas that had limited potential for revenue generation:

we essentially look at those [ideas] and try and weed out what we know is just pie in the sky. We do that based on, I suppose all of us have been in the industry for a long time, we know the customers, we have a lot of sales people out there on the ground, we have a lot of commercial people that are talking to their buyers and planners all of the time, we know what projects are coming, we know what projects are less likely to ever get commercialised and we try and be a little bit more honest with them in telling them that we don't see a future with that. (Middle manager)

In terms of resources, the R&D centre received an annual budget to cover staff costs and associated R&D costs. Although specific cases could be made to top management for additional resources for strategically important projects, typically there were more viable projects than there were resources to complete them and thus there was a need to prioritise the allocation of resources between projects. Prioritisation was not based on a rigid set of criteria and the commercial team had significant latitude to subjectively evaluate the trade-offs. They explained that the key factors considered included commercial criteria such as the size of the project in terms of potential for revenue and profit generation, the extent of the resources required and the importance of the particular customer relationship. The typical discussions on potential new R&D projects were described as follows:

How are we actually going to make money, who are we going to sell this to, and what's it going to do. So I'd say that very strong commercial focus in what we did and I suppose that led us to throw things out quicker ... I think we are very open and I think we look at a lot of stuff and scan a lot of stuff. (Senior manager)

An overall value was calculated for the sales funnel by assigning a potential sales value to all of the open projects in the sales funnel and multiplying that by the estimated probability of success. Reviewing the composition (mix of projects) and the value of the sales funnel allowed top management to monitor the increased activity around customer-oriented projects.

4.3.2 *Sales team metrics*

In order to support the planned increase in the level of customer-oriented projects, the global sales manager introduced a set of critical success factors in early 2011 for the sales team, designed to encourage customer-oriented idea generation. Measures focusing on the level of sales staff/customer communication included the number of meetings held with customers, and the number of ideas generated and logged by sales staff from their customer base. These measures were used to drive idea generation around customer-oriented projects by making sales staff accountable for focused customer interactions:

So a certain proportion of the performance measurement is based on rock turning. So how many openings or opportunities or calls or face-to-face meetings have you [sales person] had with each of those customer segments? So we have a defined quota of those ... that's really a measure of productivity. (Middle manager)

While the focus of this measure was on increasing the number of ideas, to ensure that excessive time was not wasted considering ideas without potential, additional performance measures were introduced to create dynamic tension between quality and quantity of ideas by limiting the number of ideas suggested where no clear potential for a reasonable return on investment existed:

I've done a study myself in terms of what hits our prototyping centre and the conversion rate to production and it's quite low, I think it was 26% the last time I looked at it, so you're saying well there's 74% of R&D goes nowhere. If you had much tighter marketing controls on what that was, and how it got in there, and how it got qualified in the first place to get into the initial stage gate process, then maybe that percentage could be driven up at the other end. (Senior manager)

Hence, sales staff were also assessed based on the ratio of ideas converted to projects. These sales performance measures commanded management attention and stimulated action among sales staff, thus reinforcing the values of the company (in particular innovation, openness, commercial awareness) and the strategic adjustment.

The emphasis on customer-oriented projects and the introduction of the sales team performance measures described above were perceived to have paid dividends in terms of the success of projects:

All that funnel stuff I think has improved dramatically, the success rate of stuff coming through the funnel and getting out the far side into a prototype and into some sort of a product is dramatically better than what it used to be. (Middle manager)

Hence, management viewed the strategy of increasing customer-oriented innovation as successful.

The sales performance measures drove idea generation among the sales team around customer-oriented projects and created accountability. The weekly meeting of the cross-functional commercial team as part of the innovation management process implemented and aligned the strategic focus for R&D across the organisation through the weekly filtering, defining and allocation of resources. The project management element of the sales funnel created pressure for action on individuals and teams who were called to account to the commercial team at various stages throughout project lives. These systems working in concert created a consistent pressure for action in relation to customer-oriented projects, the consequence of which was protection of the underlying R&D activity as resources were allocated and accountability was demanded.

4.4 Intelligence gathering system

An intelligence gathering system was employed to inform the company on trends in the industry and changes in direction of customers. We found evidence that this operated in a manner that mutually reinforced commercial awareness and the strategic adjustment, and diverted attention away from technology innovation. Senior management characterised the primary purpose of this intelligence gathering system as questioning and assessing the future strategic direction of the company consistent with Simons' description of an ICS. However, the communication processes that were encompassed in this system served to both reinforce the importance of innovation, openness and commercial awareness and also focus senior management attention on customer-oriented projects, in line with the strategic adjustment. Thus, the system commanded management attention and further increased momentum towards customer-oriented innovation.

Top management personally devoted substantial amounts of attention to intelligence gathering and customer relationship management and talked about constantly filtering information about customers, the direction of the industry and the competitive landscape:

I would spend a lot of time getting and picking those signals, ... mostly with the commercial people but I'd spend a lot of time myself with customers as well and just talking and what are you seeing, hardly ever trying to sell anything I have to say, but more - I'd like to meet you for a while, what are your challenges, ... what do you see coming. (Senior manager)

While the marketing function was responsible for analysing information about industry, customer and competitor trends, top management also encouraged other levels and functions in the organisation to discuss, debate and share information about customers:

we are constantly analysing the customers, ... if we see that [Customer X] is going to be coming out with a new product that's going to take a whole market share of [Customer Y] and that's going to impact on a product we make, that has implications for us so we monitor the customer landscape. (Middle manager)

At the core of this system was the monthly management meeting, a cross functional meeting where senior and middle managers responsible for R&D, manufacturing, sales and marketing, commercial, and human resources present 2-3 slides each, including key metrics, opportunities for improvement, and expected outcomes for their area. These key metrics encompassed financial and non-financial metrics across the activities of the company including sales, manufacturing, and R&D activity and while metrics featured prominently on the slides, senior management emphasised the importance of the discussion that the metrics generated rather than the actual metrics:

Each of the managers do a monthly report, so they report on their metrics and talk to their metrics. That's what I depend on hugely is getting those together, so instead of getting the number, it's a discussion. (Senior manager)

The meeting provided the focus for inward sharing of the intelligence gathered through face-to-face debate and discussion between different levels of management.

The function of the weekly sales funnel meeting by the commercial team (R&D, prototype centre, commercial and sales managers) was the implementation of strategy for R&D through prioritising and allocating resources to projects. However, issues raised at this weekly meeting also informed the intelligence gathering, as middle managers were mindful of questioning the current strategy and not completely closing the door on high revenue opportunities that might not fit with the strategy:

Sometimes the sales guys wouldn't really be technically all that up to speed and they see something they go 'oh that's something we can make' and to be honest 'no it's not something that we can make', it's just not an area that we operate in. I wouldn't say we always close the door on those because sometimes you go 'oh Jesus look at the amount of zeros on that'. (Middle manager)

While no separate resourcing of these opportunities was possible, they were discussed with top management at monthly meetings. Other interlocking opportunities for debate and discussion included the quarterly sales conference between senior management, middle management and the sales team:

We hold a quarterly sales conference so we'll gather all the front end sales team, the back end account managers, a lot of the executive management team within [Caseco] into a room for really a two to three day war session. So here's what we proposed we were doing in terms of managing a territory, here's what we are seeing, is there anything we need to change tactically in terms of the plan? ... We'll say, look, we're not getting traction in this area, we identified it as something that we should be doing but we're not and here is the reason why and that really feeds that back then through our company. (Middle manager)

Senior management used these meetings to create a strong and pervasive commercial focus that cascaded throughout the organisation. While the literature refers to market knowledge residing in the marketing department as opposed to the R&D department which is associated with technological knowledge (Burgers et al. 2008), in Caseco the intensity of this intelligence gathering activity, and its sponsorship by top management led to the embedding of customer knowledge throughout the organisation.

To the extent that the information feeding this system came from a wider perspective than interactions with current customers, and included both the marketing department's work on directions of future markets and information from the commercial team on potentially lucrative opportunities which had been avoided, this system should have alerted the company when the strategy of partnering with customers may have been invalidated and resulted in timely signals to redirect strategy. However, to the extent that the information feeding this system came from interaction with customers by sales staff, R&D engineers and management, the system reinforced Caseco's new strategic direction of shifting greater resources to customer-oriented projects. Some of the comments made by senior management emphasised a degree of customer focus and bias in favour of focusing on short-term revenue generation to the extent that it raises questions as to whether the debate of strategic

uncertainties which took place in the context of this intelligence gathering system represented an unbiased view of the potential focus of R&D activity, illustrated by the following quote:

we've started saying it's about a two year view. So what's going to be revenue in two years? And if it's not going to be revenue in two [years], this might be the next greatest thing somebody is doing and it's five years out, we are saying it's not actually revenue. While we want to keep it there, we want to make the prototypes and be involved but it shouldn't be showing up on our revenue funnel. So you have to separate what's going to happen in the kind of short or medium term versus having the good stuff, and putting more of the resources onto those ones that are going to be revenue this year, next year and the year after. (Senior manager)

While this quote from senior management is consistent with the commitment to longer term innovation set out in the strategic plan, the elimination of longer term projects from the sales funnel and the pressure to deliver the short term projects resulted in an absence of any longer term R&D activity as explained in the next section on technological innovation.

4.5 Technology funnel

The control of technology projects provides a significant contrast to the control of customer-oriented projects through the sales funnel explained in section 4.3. Internally generated ideas for technology development projects typically emerged from engineering staff and there was no formal process for capturing those ideas. The R&D manager filtered them informally:

I would be having a lot of conversations with different people about what we could do and making initial judgements on my own as to what it is that is feasible and what is completely not feasible. ... I suppose more technically I would act as the initial filter.

If a decision was taken by the R&D manager to invest engineering time and resources in a technology development idea, then a lead engineer was appointed to work on the project and a detailed design brief was written and agreed. This process was managed through ad hoc meetings between the R&D manager and the engineer. The R&D manager explained that a stage-gate system had previously been put in place to manage technology projects, but that over time its use was abandoned as it was felt that the additional bureaucracy was not warranted. Although progress was currently assessed at regular intervals, strictly imposed time deadlines were not applied to technology development projects. As projects were not related to specific customers, account managers did not act as advocates for the projects. No sales staff performance measures existed over the generation of ideas in the technology development space due to the relatively limited involvement of sales staff in this area. In contrast to projects related to customers, no figure for potential revenue was assigned to these

projects as it was considered that any such figure would tend to be completely arbitrary. Justifying the lesser importance of financial criteria, it was pointed out that many of Caseco's successful technology projects may not have been pursued if rigorous financial criteria had been applied at the outset:

Some of them [technology projects] brought vast amounts of business to us and have been key to the development of the company and would never have withstood the sort of analysis that projects – a lot of projects get [in other companies] quite frankly.
(Senior manager)

Prior to the strategic adjustment in 2010, a 'technology funnel' describing details of current technology projects in process, their timelines for completion and potential applications for the new technologies, had formed part of the monthly reporting pack to senior management and was the basis for discussion between senior and middle management around changes in the technological playing field. However, following the strategic adjustment in the focus of R&D activity, this technology funnel was abandoned. There was evidence that members of the senior management team had not reflected on the significance of the absence of the technology funnel until we questioned them about it in interviews:

I When you said that it's no longer presented to the Board ...?

R No ... I'm not sure what he's replaced it with, it was a nice graphic, it was a very nice graphic. I must ask him actually and see what ... (laughs) ... I'm curious. (Senior manager)

This finding is consistent with evidence of a lack of senior management awareness on the absence of technology innovation obtained during a feedback session to management post data collection. At this meeting, they expressed surprise about the extent of diversion of R&D resources away from technology projects.

While the technology funnel did not have the formality of a stage gate process with a requirement for a decision at each stage, it did set out the stage and progress of each of the projects and management attention was devoted to it at meetings, which created accountability.

Considering the operation of MCSs in relation to technology development provides a significant contrast to the situation for customer-oriented projects. The company strategy operationalised in the business plan shifted focus away from technology development. The

increased attention now devoted to customer-oriented projects was evident from the PowerPoint slides for the management meeting and the airtime given to the global sales manager and to the R&D manager to discuss the sales funnel. The intelligence gathering system directed management attention towards markets and customer needs and management reporting of activity in the technology funnel ceased. Hence, the MCSs offered no opportunities to create accountability, command management attention, or reinforce the strategy that specified 20% activity in this area. Unsurprisingly the resources in this area were almost wholly diverted to customer-oriented projects where both strategy and management attention was clearly focused.

In technology projects, the typical time lag between innovative activity and revenue generation was significantly greater than for customer-oriented projects. As such this type of innovation was much more vulnerable to invasion. Historically, there had been an on-going tendency for engineers working on technology projects to be pulled off to help solve short-term crises in manufacturing. The relevant Middle manager estimated that 30-40% of engineers' time had been lost in the past to sorting out production problems. This vulnerability of technology project resources was recognised by management, though there was no evidence it was given any on-going attention by senior management as it was seen as a middle management issue:

We want those guys [R&D Engineers] ideally developing the next [Technology X] or the next [Technology Y] or whatever is coming next. But somebody comes in with a customer complaint ... They'll tend to snatch from that group. ... Well everybody needs to understand the cost of this so there's a constant balancing and trade off going on there all the time and that's just a managed process at a line management level. So it's up to [Middle manager] to create the space to get stuff done that he's committed to getting done. (Senior manager)

This view of the senior manager again supports a commitment by the company to longer-term technological innovation and while the strategic adjustment communicated the intent to reduce this activity, there was no evidence that senior management intended to eliminate all activity. However, the outcome of the strategic adjustment was a dramatic reduction in activity on technology projects to virtually nothing:

Very few now [technology projects] because there's been such intense pressure on delivering the sales funnel and delivering the sales targets that we just have not been able to afford to – well, we haven't got the ideas in the first place. I suppose maybe the ideas is because we haven't been given the time to work at it, but we kind of feel that there's enough opportunity out there with what we have anyway so all the attention needs to be on delivering and executing on that, so there's very little activity going on outside of the

sales funnel ... Our challenge is trying to justify why we have 40 engineers working on projects and showing the efficiency of those engineers ... we don't need to be doing R&D on new technologies because when there's so much sales opportunity out there. (Middle manager)

The previous senior manager quote suggests that a tension between different types of innovation activity would be experienced at middle manager level in allocating resources between technological and customer-oriented projects; however, this middle manager quote suggests that middle managers did not experience such tension as they were focused on delivering the sales funnel which contained only customer-oriented projects. As a result, resources that had been invested in technology projects were diverted to customer-focused process improvements with a view to improving operating efficiency:

because I know this year he [R&D manager] focused a lot more of it back on the business ... he focused an awful lot of his resources back on – I won't say manufacturing just new ways of solving very old problems ... because [Senior manager] wanted that, [Senior manager] wanted the Operations side sorted. (Senior manager)

While these projects may appear to be internal efficiency based, they are customer focused and an example was given where a customer had indicated to Caseco that unless it was able to sell a component at half the cost, the customer would no longer be able to purchase the component. This example resulted in a significant R&D project to automate the process used to manufacture that component and corroborates findings on the cost pressure faced by the medical device industry.

The analysis of the operation of MCSs over technology projects highlights how the absence of MCSs as a channel for management attention, accountability and reinforcement of strategy can result in an unprotected space where innovation is suppressed or even repressed. The strong core values around innovation coupled with clear strategic direction to maintain 20% of R&D effort on technology projects, were insufficient to protect this space when feedback and measurement systems focused management attention elsewhere. In contrast, the combination of the direct customer interest, accountability of sales staff, account manager advocacy and the formal project management element of the sales funnel created strong boundaries around resources devoted to customer-oriented projects which protected them from pressures to deal with crises in other parts of the organisation.

Table 2 summarises the outcome of the interaction between different control practices for customer oriented innovation (below and left of the diagonal) and technology innovation (above and right of the diagonal). It is evident from the table that multiple control practices

interacted to mutually reinforce customer-oriented innovation, whereas the absence of mutually reinforcing practices in relation to technology innovation resulted in a lack of dynamic tension between the two different types of innovation.

[INSERT TABLE 2 HERE]

A simple conclusion would indicate that the company ought to introduce some form of feedback and measurement system around technology innovation. However, we argue that the problems experienced by Caseco are symptomatic of, and provide insights into, the challenges of simultaneously managing different types for innovation, where blind spots can develop with the result that management fail to even acknowledge the need for additional or altered control systems to achieve intended outcomes for innovation. This is discussed in the next section in relation to the generation of dynamic tension.

5. Discussion

The findings described the range of MCSs, which were used to manage customer-oriented and technology projects, and analyses the operation of the control systems to mutually reinforce each other and to generate dynamic tension between the different types of innovation. Consistent with Marginson (2002), we found evidence of the use of value systems as mechanisms for strategic change. They provided the infrastructure for different types of innovation to flourish and could be viewed as a corner stone of MCSs (Heinicke et al. 2016). However, we also found that the other control systems served to mutually reinforce the increased emphasis on customer-oriented innovation detailed in the strategic and business plans and did not generate any dynamic tension between the two types of innovation. The absence of dynamic tension resulted in a failure to curb the unabridged momentum towards customer-oriented innovation. The next section discusses how the interplay of four levers of control resulted in the absence of dynamic tension. Following this, the need to distinguish between two forms of reinforcement is discussed.

5.1 Interplay of control systems and dynamic tension

Innovation tension could be expected to be inherent in any organisation that seeks to engage in multiple types of innovation due to the need for prioritisation and trade-offs. The

innovation management literature has pointed to the importance of making inherent tensions salient in managing different types of innovation (Smith 2014, Smith and Lewis 2011) and evidence points to the ability of MCSs to create dynamic tension (Henri 2006). While the LoC framework (Simons 1995) focuses on the tension between innovation and predictable goal achievement, it has been used in previous research in the context of managing different types of innovation (Bedford 2015) and provides useful categorisations of control systems for qualitative research to examine dynamic tension between different forms of innovation. Beliefs systems and ICSs create ‘positive and inspirational forces’ while boundary systems and DCSs create ‘constraints and ensure compliance with orders’ (Simons 1995).

In Caseco, boundary systems and DCSs were strongly aligned in focusing organisational attention on customer-oriented innovation. It would be expected that beliefs and ICSs would provide countervailing forces to these ‘yin’ systems. Tension ought to have been created by the strongly embedded and espoused core values of innovation, flexibility and openness, when pitched against the new (and narrower) strategy for R&D focused on the customer. However, both the beliefs system and the ICS served to reduce potential resistance to altering the balance of R&D activity in favour of activity with clearer short-term outcomes for revenue generation. This was successful in increasing the level of customer-oriented innovation but had unexpected consequences for levels of activity in technology projects. While the strategic adjustment envisaged a reduction in innovative activity in this area, the lack of feedback and measurement systems left resources in this area wholly unprotected. Despite a clear strategy of maintaining technological innovation at 20% of activity, the outcome was a virtual elimination of the activity.

The purpose of an ICS is to focus on strategic uncertainties to counteract risks of unanticipated shifts in the competitive landscape; nevertheless, Simons (1995) notes the potential risk that ICSs can focus organisational search ‘on the wrong strategic uncertainties’ (p. 114). Mundy (2010) notes the crucial role of ICSs ‘in creating and maintaining a balance between the remaining levers’ (p. 515). Analysis of the ICS in Caseco suggests that this system resulted in further senior management emphasis on customer-oriented projects. Thus in spite of the fact that the intelligence gathering system focused on the strategic uncertainties associated with changing customer needs, there is little evidence of it creating forces to counter the momentum in favour of customer-oriented projects. Our findings suggest that the strong mutual reinforcement of the levers increases the potential for blind-spots in the selection of strategic uncertainties for managing through an ICS. As Simons (1995) points

out, 'by focusing attention on subsets of potential opportunity within that space, other opportunities are eliminated from consideration' (p. 114). To enable the full range of necessary adaptations to be made to systems, Milgrom and Roberts (1995) point to the importance of recognising all the dimensions across which complementarities operate. Selecting an appropriate set of strategic uncertainties for ICS management is likely to be more challenging in companies like Caseco where the strategic intent embraces potentially competing objectives (the pursuit of different types of innovation).

The absence of any activity on technology projects by the R&D group was not a source of concern as customer-oriented projects were regarded as successful in meeting short-term financial targets (consistent with the commercial focus in the company). Hence, diagnostic controls (in the form of financial measures of revenue, EBIDTA and free cash flow) did not draw management attention to the substantially decreased activity in technology innovation. Consequently, the response of management to our feedback suggested that management were unconscious of the drift from the intended strategy.

Similar to Mundy's (2010) findings on the suppression of ICSs reducing conflict between different strategic priorities, we found that the suppression of DCSs over technology innovation reduced conflict between different strategic priorities as management attention was fully focused on achieving increased customer-oriented innovation and was not directed towards the absence of technology innovation. Hence, the ability of MCSs to generate dynamic tension was reduced by suppression of this lever. While the suppression of the technology funnel did not appear to be intentional at senior management level, it was consistent with middle management's perception of the new priorities of senior management.

Previous research points to the ability of managers to favour one type of innovation by placing greater emphasis on either yin or yang control levers (Bedford 2015). In Caseco, ICSs and beliefs systems (yang) were in prominent use; however, the forces operating through these levers (which could be expected to oppose the yin levers) had been reduced through the momentum gained by the yin levers in defining and implementing the increase in customer-oriented innovation. In addition, the yin lever in the form of DCSs was absent for technology innovation. It is evident from our analysis that the MCSs used in Caseco were mutually reinforcing around customer-oriented innovation and the absence of the creation of dynamic tension between the two forms of innovation led to the apparently successful implementation of a strategy of increased customer-oriented innovation in a relatively short

space of time. However, this obscured the repression of technology innovation. The need to understand how reinforcing control systems can operate with or without the creation of dynamic tension is discussed in the next section.

5.2 *Different forms of reinforcement*

While Simons (1995) points to the co-existence of mutual reinforcement and the generation of dynamic tension within control systems, our study presents evidence of strong mutual reinforcement between control systems and the absence of dynamic tension. Our analysis leads us to describe two types of reinforcement in the integration of multiple control systems. Firstly, control systems may be mutually reinforcing because they create a push for consistency in a single direction (what we term consistent reinforcement). For example, the sales staff performance measures and sales funnel mutually reinforce the importance of customer-oriented innovation. Secondly, control systems may contain countervailing forces and reinforce the generation of dynamic tension (termed countervailing reinforcement). For example, if the financial performance measures and the technology funnel had reinforced management attention on value creation both in the short term (through financial measures of performance) and in the long term (through technology projects which may not meet strict financial criteria), these MCSs could have generated dynamic tension between the two types of innovation.

In Caseco, the various diagnostic controls operated in a manner that consistently reinforced the increased importance of customer-oriented projects. Similar to Mundy's (2010) finding on how productive tensions can be minimised through the use of the levers of control, our analysis demonstrates how mutually reinforcing control systems resulted in a momentum that supported and protected customer-oriented innovation but conversely left technological innovation vulnerable and unprotected. Previous research suggests that MCSs can provide a mitigating force to innovation momentum whether in the context of high/low levels of innovation (Bisbe and Otley 2004), different innovation management modes (Bisbe and Malagueno 2009) or different types of innovation activities (Bedford 2015). However, as explained in the literature review, this mitigation is dependent on the existence of dynamic tension. Findings in this study advance our understanding of the challenges created when a range of control systems are structured in a mutually reinforcing way, resulting in a dearth of dynamic tension and an absence of countervailing forces.

6. Conclusion and future research

In the context of the management of two types of innovation activity (technological and customer-oriented innovation), this study examined the nature of the relationship between mutually reinforcing MCSs and the generation of dynamic tension between the different types of innovation. We have provided evidence on how innovative activities can flourish or languish depending on the combination of MCSs mobilised and on the degree to which the control systems create dynamic tension. We contribute to the literature by distinguishing between consistent reinforcement where MCSs create a push for consistency around a particular strategic objective and countervailing reinforcement MCSs that create dynamic tension, thus reducing excessive momentum towards one particular strategic objective. Previous research in the context of organisational ambidexterity has pointed to the potential for this push for consistency to result in a focus on a single choice (Smith and Lewis 2011), though the role of MCSs in this regard was not examined. While our study focuses on different types of innovation than examined in the ambidexterity literature, it demonstrates how MCSs can create a push for consistency and result in shorter-term innovation projects crowding out longer-term value creation.

In addition, the study contributes to the literature by detailing the protective role that feedback and measurement systems can play. Value systems are increasingly recognised as an important MCSs (Heinicke et al. 2016, Marginson 2009) and our findings point to their important role in providing an infrastructure for multiple types of innovation to flourish. Yet, findings also show their insufficiency without feedback and measurement systems as resources invested in technology projects were vulnerable to diversion to other areas. A positive role for ICSs and DCSs in managing innovation has already been detailed in the literature (Bedford 2015, Henri 2006) and this study contributes to evolving our understanding of this positive role by providing evidence on how feedback and measurement systems can protect innovation by commanding management attention, stimulating action on particular projects and driving accountability around the use of resources invested in innovation projects.

The contributions need to be interpreted in light of the limitations. The study focused on one division of Caseco only, and evidence was not gathered in relation to other divisions nor was the mix of innovation types or use of control systems in other divisions considered. Nonetheless, the division selected was where senior management were located and was the

largest division in the company. A further limitation is that we do not have any evidence of whether the elimination of technological activity was ultimately deemed a success or failure by the company. However, the focus in this paper is on understanding how the dynamic tension generated by the MCSs was insufficient to implement the stated strategy, rather than the success or otherwise of the elimination of technological innovation. Lastly, the study was carried out immediately following the strategic adjustment and a need for stability in the company in this period may have impacted on how the MCSs operated, particularly the operation of ICSs which have potential to destabilise the organisation (Mundy 2010).

Findings point to a number of areas for future research. Firstly, the study finds a need for control systems to introduce diversity and generate dynamic tension. Simons (1995) expresses this as the interplay between the 'yin' and the 'yang'. While we found that the combination of controls mobilised to manage innovation comprised both 'yin' and 'yang' control systems, dynamic tension between two forms of innovation was largely absent. Hence, while previous research focuses on the extent to which levers are mobilised in examining the interplay of systems (Bedford 2015, Kruis et al. 2015), there is a need for studies to not only examine the extent to which particular levers are used but in addition the substance of the underlying control systems which operate as levers. For example, while we found that the ICS was used and relied on extensively, it was found to operate in a manner which reinforced the innovation momentum towards customer-oriented projects rather than in a counterintuitive fashion as suggested by Simons (1995). This may relate to the order in which the levers were mobilised and Mundy (2010) points to the importance of mobilisation of ICSs before DCSs and boundary systems become 'hardwired' into the organisation.

Secondly in relation to ICSs, while the nature and operation of ICSs have been considered ambiguous (Ferreira and Otley 2009, Hall 2010), our in-depth findings on the use of an intelligence gathering system as an ICS provides an interesting contrast to examples in existing literature which are primarily comprised of performance measurement, budgets and similar accounting-based profit planning systems (e.g. Kruis et al. 2015, Tuomela 2005, Widener 2007). Although Simons (1995) envisaged this type of interactive system in the development of his framework, there is little or no empirical research providing examples of its operation and there is scope for future research to provide insights into other forms of ICSs. Also, as pointed out in the limitations, it is possible that the focus of the ICS on customer-oriented innovation may reflect the newness of the strategic adjustment and the potential for ICSs to destabilise an organisation (Mundy 2010). Management may have been

reluctant to encourage a questioning of the strategy of increased customer-oriented innovation at such an early stage phase of its implementation. Future research using a longitudinal study would be particularly useful in examining how dynamic tension generated by MCSs may change over a longer period following a strategic adjustment.

Thirdly, our study highlights the role of feedback and measurement systems in protecting R&D activity. Findings highlight how the absence of DCSs over technological innovation was significant in removing attention and accountability from this type of innovation. Hence, resources invested in these projects were vulnerable to diversion to other areas. While ‘protection’ is not typically a role associated with control systems, studying the absence or suppression of controls (Mundy 2010) is likely to be fruitful for future research in identifying the implications of the operation of different combinations of levers of control.

Lastly, further research is needed on differences between espoused and enacted core values. Commercial awareness has been found in previous research to be an important aspect of the climate of the organisation (Marginson and Bui 2009) and inseparable from the operating agenda due to its diffusion throughout the organisation (Granlund and Taipaleenmaki 2005). The commercial awareness in Caseco could be viewed as an outcome of the use of the other control systems (such as the diagnostic financial measures), though this would not explain how deeply embedded it was in the company, nor how the core value of innovation could only be understood in the context of a commercial awareness. In our view, it represents an unstated core value. This points to the need for researchers to establish enacted values by reference to words and actions of organisational actors rather than based on the espoused values of the organisation. Presentation of our findings at an industry workshop attended by CEOs, R&D managers and other middle management across functional areas provoked comments about the existence of sub-cultures within R&D departments that have the potential to exacerbate tension between innovation and control. Sub-cultures are created when the enacted core values in a group differ from the core values in the organisation and implications of subcultures for the operation of MCSs may be a fruitful area for future research.

Appendix 1 List of interviewees

Responsibility area	Title of interviewee	Referred to in paper as:
Management team	Founder and member of executive board	Senior Manager
	Managing Director	Senior Manager
	Operations Director responsible for R&D, manufacturing and contract design	Senior Manager
	Head of Marketing/Business Development	Senior Manager
	Head of specific new business development area	Senior Manager
	Chief Financial Officer	Senior Manager
Finance	Finance Manager	Member of Finance Team
	Financial Controller	Member of Finance Team
	Management Accountant	Member of Finance Team
R&D	Head of R&D (2 interviews)	Middle Manager
	Manager of Prototype centre	Middle Manager
	Senior Engineer	Senior Engineer
	Senior Engineer	Senior Engineer
	Senior Engineer	Senior Engineer
	Head of Account Managers	Middle Manager
	Account Manager	Account Manager
	Head of Global sales	Middle Manager
	Sales Employee	Member of Sales Team
Contract design	Head of Contract	Middle Manager
	Project Manager	Project Manager
	Project Manager	Project Manager
	Project Leader	Project Leader
	Project Leader	Project Leader
Manufacturing	Head of Lean Operations	Middle Manager
	Manager of value stream	Middle Manager
	Manager of value stream	Middle Manager
Marketing	Marketing Manager	Middle Manager

Appendix 2 Summary of areas included in interview schedule

Background

Role and responsibilities of employee
Length of time in company and current role
Structure of company and business model
Key sites of innovation and creativity
Number of projects ongoing at present

Strategy and business planning

Existence of formal planning process
Knowledge of/involvement in process
Strategic uncertainties
Change in strategy
Communication of strategy

Role of finance division

Degree of interaction with rest of company
Key responsibilities

Process

Key stages involved in NPD from idea generation to manufacturing
Prioritisation of ideas
Allocation of projects to teams

Key control systems for innovation and creativity

Allocation of resources to NPD
Controls over each of NPD stages
Fostering of creativity/Protection of creative space

Performance measurement

Key metrics monitored on daily/weekly/monthly basis
Perception of metrics
Changes in use of metrics

Individual performance evaluation

System of performance evaluation
Reward and recognition for creativity

Communication

Key upward/downward meetings
Degree of formality

Culture

Description of culture
Impact of growth of company

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Figure 1:

Timeline of strategic adjustment in relative levels of customer-oriented and technological projects

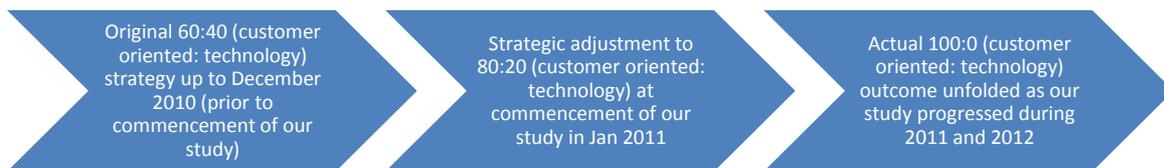


Table 1:

MCSs and their role in managing customer-oriented and technology innovation projects

Control system/practice	Description of system	Role in relation to customer-oriented and technology innovation projects
Vision, mission and statement of core values	Static documents describing the core values (innovative, flexible, open and honest), the purpose of the company in specialising in minimally invasive medical devices and how the company believes it delivers value to customers through outstanding quality and exceptional service and core values.	Espoused core values of 'innovative' and 'open' focused attention at all employee levels on innovative ideas (both technological and customer-oriented). Core value of 'flexible' created an environment with limited bureaucracy, a willingness to embrace change and an acceptance of the inevitability of some failures which supported both types of projects.
Annual employee performance evaluation	Yearly objectives set for employees and annual meeting held to discuss performance. All employees required to provide examples of innovativeness.	Promoted importance of innovation and created accountability for innovative action throughout the company.
Strategy discussion document	Set out logic behind old strategy (" <i>we will grow by delivering better product and service solutions to our customers, and we will use the best technology to maintain high margins.</i> ") and proposed changes (" <i>we will grow by getting access to bigger partnering opportunities with our customers, and we will be the partner of choice because we can deliver cost and technologically effective solutions</i> ") as basis for review of strategy	Set out the rationale for a strategic adjustment in favour of customer-oriented projects and away from technology projects
Strategic plan	1 page document setting out new strategy (" <i>be the most trusted partner to medical and life science companies in providing solutions along their product life cycle</i> ") and logic behind strategy. Made a living system through company meetings with all staff on a quarterly basis	Set out the rationale for a strategic adjustment in favour of customer-oriented projects and away from technology projects
Business plan	Translated new strategic direction into areas for growth which informed prioritisation of creative ideas in R&D. Set out key targets for sales volume and sales mix of products and specified the areas of the business that were seen as strategically important for the growth of the company	Business plan used to prioritise projects in the sales funnel for customer-oriented projects. Identification of areas for future growth indicated potential areas for technology development. Guided the allocation of resources in R&D. Created accountability for sales volume and sales mix targets.

Financial performance measures	Performance metrics focused on revenue, EBITDA, cash flow, return on new products introduced in last two years	Supported the prioritisation of projects likely to lead to profitable revenue generation within a 2 year horizon. Focused top and middle management attention on revenue, EBITDA and free cash flow which defined the success of the strategic adjustment. No close link between financial metrics and technology projects
Sales staff performance measures	Performance metrics focused on the number of meetings held with customers, number of ideas generated and logged by sales staff, and ratio of ideas converted to products	Created accountability and directed sales team and management attention to the importance of generating useful customer-focused ideas. No role in managing technology projects
Intelligence gathering system	This system comprised of set of practices encompassing multiple departments, including (1) extensive direct customer engagement by top management (2) formal monitoring and reporting of customer needs, product and industry trends by marketing department (3) extensive direct customer engagement by R&D engineers and account managers on specific customer needs (4) creation of a 'Customer first' programme to review all customer service processes (5) discussion and debate of information through monthly management meeting and quarterly sales conference.	Focused attention across a range of functions and at all levels in the organisation around customer-oriented strategy and moved management attention away from technology innovation.
Sales funnel	Innovation project management system focused solely with customer-oriented projects which drove filtering of projects and allocation of resources. It contained details of up to 100 projects for future sales over a period of 6-18 months. Discussed at weekly cross-functional meeting consisting of the R&D manager, the commercial manager, the global sales manager and the prototyping centre manager.	Sales funnel commanded significant middle management in prioritising customer-oriented projects and resource allocation. Created accountability for customer-oriented projects and focused top and middle management attention on i) the 'value' of the sales funnel and ii) the mix of projects in the sales funnel
Technology funnel	Detailed technology projects with stage and progress made on each project.	No role in managing customer-oriented projects. Created accountability for technology projects but abandoned following strategic adjustment.

Table 2

The role of combinations of control systems in relation to Customer oriented and Technology Innovation

Technology Innovation Customer Oriented Innovation	Espoused and enacted core values (including commercial awareness)	Strategic and business plan	Overarching financial performance measures	Sales Funnel (project mgt system)	Sales performance measures	Intelligence gathering system	Technology funnel (project management)
Espoused and enacted core values (including commercial awareness)		Diverted management attention away	Diverted management attention away	Not applicable	Not applicable	Diverted management attention away	Suppressed
Strategic and business plan	Reinforced the strategic adjustment		Diverted management attention away	Not applicable	Not applicable	Diverted management attention away	Suppressed
Overarching financial performance measures	Reinforced commercial awareness	Reinforced the strategic adjustment		Not applicable	Not applicable	Diverted management attention away	Suppressed
Sales Funnel (project mgt system)	Reinforced commercial awareness	Reinforced the strategic adjustment	Reinforced commercial awareness		Not applicable	Diverted management attention away	Suppressed
Sales performance measures	Reinforced innovation, openness and commercial awareness	Reinforced the strategic adjustment	Reinforced commercial awareness	Reinforced strategic adjustment and commercial awareness		Diverted management attention away	Suppressed
Intelligence gathering system	Reinforced innovation, openness and commercial awareness	Reinforced the strategic adjustment	Reinforced commercial awareness	Reinforced the strategic adjustment	Reinforced the strategic adjustment		Suppressed
Technology funnel (project management)	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	

Note: The table summarises the outcome of the interaction between different control practices for customer oriented innovation (below and left of the diagonal) and technology innovation (above and right of the diagonal).