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MANAGEMENT CONTROL SYSTEMS AND INNOVATION PROCESS EFFICIENCY. A CONCEPTUAL MODEL

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Abstract

Research background: There seem to be a research gap concerning the relation between management control and innovation. Previous research in the field has generated inconclusive findings.
Purpose: The purpose of the present study was to create a conceptual model representing the relation between management control and innovation.
Research methodology: The study relied on a systematic literature review. The initial search yielded 269 papers, which were later analysed and reduced to select those with a substantial contribution to the purpose of the study. Next, the meta-synthesis method was employed to create a thematic map and extract information from the papers.
Results: The formulated conceptual model indirectly links management control systems to innovation process efficiency through decision-making quality. Furthermore, it connects management control systems indirectly to decision-making quality, through the transactive memory system (specialisation, building credibility and coordination) and shared interpretation schemes. The link between decision-making quality and innovation process efficiency is introduced and based on the concept of an innovation process.
Novelty: The paper fills in the missing link between management control and innovation by introducing decision-making quality into this context.

Keywords: Innovation, management control, decision-making

JEL classifications: G32, O31, O32

Introduction

A management control system (MCS) represents the type of planning that synchronises operational (day-to-day routine) and strategic (long-term) control (Strauß, Zecher, 2013). Its successful implementation depends on the ability to join tight formal output controls with the flexible diagnostics of these controls (Simons 1994). Innovation is understood here as "a process of implementing positive and new ideas into business practice" (Szutowski, 2016, p. 25). It is of crucial importance for companies operating on highly competitive markets. Previous research produced inconclusive findings on the relation between MCS and innovation. While several studies emphasised the benefits of using financial control to steer innovation projects (Rabino 2001; Davila, Wouters, 2004; Suomala, 2004), others pointed to a negative effect (Bonner, Ruekert, Walker, 2002; Sethi, Iqbal, 2008) or no clear effect whatsoever (Calantone, Harmancioglu, Dröge, 2010; Pattikawa, Verwaal, Commandeur, 2006). The reasons for the introduction of management control systems in innovation management are diverse. Firstly, MCS may be used to select and schematise the appropriate accounting objects and to provide current information on their status, which in turn supports rational decision-making. Secondly, MCS may deliver data on market demand and technologies available on the market, which in turn allows one to build realistic scenarios for future development (Suomala, 2004). On the other hand, the negative effects of MCS introduction include an imposed rigidity which confines creativity – a crucial feature within the new product development process (Sethi, Iqbal, 2008).

There remains a research gap concerning the relation between management control and innovation, as research generates mixed results. In order to fill the gap, consecutive studies introduce mediators and moderators to the studied relation, e.g. control types, control methods, different contexts and different approaches to innovation. Despite the considerable advancements in the field, according to the author's best knowledge, no model achieved satisfactory explanatory power. The research problem is expressed in the following question: what is the relationship between management control systems and innovation management? Thus, the purpose of the present study was to create a conceptual model representing the relation between management control and innovation. The study was primarily based on a systematic review of literature, encompassing at first 269 scientific papers published within the 10-year period of 2009–2019. The research relied on the meta-synthesis method, which allowed for the creation of both: a thematic map integrating all the themes identified within the set of papers and a model explaining the dependencies between variables and placing them within the existing theory. The model integrates the concept of the process approach to innovation with control theory and transactive memory theory, and innovatively introduces decision-making quality as the missing link between management control and innovation.

The following sections are structured as follows. First, the research methods are presented, with a particular focus on a systematic literature review. Second, the research findings are provided. The thematic map is presented first, and then, the dependencies that make up the model are described, and the graphic form of the model is provided. The paper ends with conclusions.

1. Research methods

The paper builds on the systematic approach to a literature review, which allowed for the creation of a thematic map and, ultimately, a conceptual model of the relation between management control and innovation. The review strategy comprised (1) the search for relevant studies, (2) meta-synthesis, and (3) information extraction.

The studies were found in three separate searches in three electronic databases: Web of Science, Scopus, and Scholar. All searches were limited to papers published in the 10-year period between 2009 and 2019 (inclusive). Search terms were constant and linked two fields: innovation (innovation, new product development, NPD) and management control (management control, performance measurement). The search terms were researched in keywords, titles and abstracts. The procedure yielded 269 papers.

Next, the papers were sifted. The sifting procedure was divided into a technical and a substantial part. In the technical sifting procedure, the exclusion criteria included: inaccessibility of the complete paper, language other than English, and duplication. In total, 59 papers were eliminated. Substantial sifting was performed to identify those papers in which management control and innovation constituted the principal axis of research. The papers with no actual contribution to the subject of analysis were excluded. In the initial substantial check, the titles and abstracts of all the remaining 210 papers were carefully verified, which allowed for eliminating 174 of them. Next, the full texts of the remaining 36 papers were analysed. It allowed for selecting 11 papers with a substantial contribution to the subject of analysis.

The electronic searches were augmented by performing a reference check of the papers and networking with specialists in the field. It ultimately allowed for identifying 1 additional paper containing useful insights in the light of the set out objectives of the present investigation. Thus, a total of 12 scientific papers were analysed. The papers are presented in Table 1.

Table 1. Papers analysed in the systematic literature review

No.	Paper	Keywords	Paper type	Contribution to thematic map	Code
1	2	3	4	5	6
1	A. Arundel, R. Kemp, 2009	eco-innovation, measurement, indicators, data needs	Literature review	The process of (eco-) innovation measurement	Eco, M, I, MC
2	J. Guan, K. Chen, 2010	Innovation production process (IPP), Efficiency measurement, China's high-tech innovations, Network data envelopment analysis	Research paper	Overall, R&D and commercial efficiency. Decomposition of innovation process	I, M, MC, Proc
3	W. Hammedi, A.C.R. Van Riel, Z. Sasovova, 2013	–	Research paper	Transactive memory systems. Decision-making efficiency. Decision-making effectiveness	DM, I, TMS
4	I. Kihlander, S. Ritzén, 2012	Concept decisions Product development Decision-making Case study	Research paper	Linking compatibility between systems with new product development	DM, C, I
5	E. Lövstål, A.M. Jontoft, 2017	Management control, Innovation, Tension, Literature review	Literature review	Tensions: inherent innovation-control, inherent management control, created management control, decision-making	DM, I, MC
6	O. Pesämaa, 2017	Management control, Organizational control, Personnel control, Action control, Gazelle, Growth	Research paper	Feedback – the link between innovativeness and personal and action control	I, MC
7	C. Schultz, S. Salomo, U. De Brentani, E.J. Kleinschmidt, 2013	–	Research paper	The link between organisational control theory, decision-making clarity and NPD performance	DM, I, MC, PM, Proc, SGS
8	R. Spano, F. Sarto, A. Caldarelli, R. Vigano, 2016	Performance measurement, innovation, research-intensive network, balanced scorecard	Case study	Management control tool – innovation-oriented balanced scorecard	I, M, MC
9	E. Tervala, T. Laine, T. Korhonen, P. Suomala, 2017	Financial control, NPD, Project manager, Accounting, Project model	Research paper	The link between financial control and new product development	I, MC
10	M. Ylinen, B. Gullkvist, 2014	Management control systems, Exploitation Exploration Innovation project Performance Tension	Research paper	The link between organic and mechanistic control and project performance through innovativeness	I, M, MC, O/T

1	2	3	4	5	6
11	O. Zizlavsky, 2015	Innovation Process, Management Control, Performance Measurement, Czech Manufacturing Industry	Research paper	Reasons for innovation MCS implementation Management control tools used	I, M, MC, Proc
12	O. Zizlavsky, 2016	Innovation, Performance Measurement System, Management Control, Innovation Scorecard	Conceptual paper	Management control tool – innovation scorecard Decomposition of the innovation process	DM, I, MC, Proc

Source: own development.

In the next stage, the full texts of the 12 papers were integrated, coded and interpreted with the use of the meta-synthesis method. Meta-synthesis is a non-statistical technique used to integrate multiple studies by identifying their common core elements and themes (Cronin, Ryan, Coughlan, 2008). The core elements and complementary themes were identified by attributing codes. The procedure was performed independently by three scholars. The initial set of common core codes (I – innovation, MC – management control) was later expanded with complementary codes during the screening of the full texts (C – concept decision-making, DM – decision-making, Eco – eco-innovation, M – measurement, O/T – organisational/technical control, PM – project management, Proc – process approach, TMS – transactive memory system). Based on the attributed codes, a thematic map was produced, containing all the areas of interest.

Next, further relevant information was extracted from the texts in accordance with the thematic map. In line with the literature, the meta-synthesis involved analysing and synthesizing the key elements of each study with the aim of transforming individual findings into new conceptualizations and interpretations (Polit, Beck, 2006). Thus, the core elements and themes presented in the map were compared with one another, translated through one another, and joined to complement one another, so as to produce a model representing the relation between management control and the innovation process. While the thematic map integrates all the themes identified within the set of papers, the model reduces the number of themes in order to focus on the key elements, and substantially deepens the reasoning by developing explanations of the dependencies between variables and placing them within the existing theory.

2. Results

The analysed studies represented significantly different approaches to the link between management control and innovation. The common elements and the complementary themes identified within the whole set of papers were systematised and are presented in a graphical

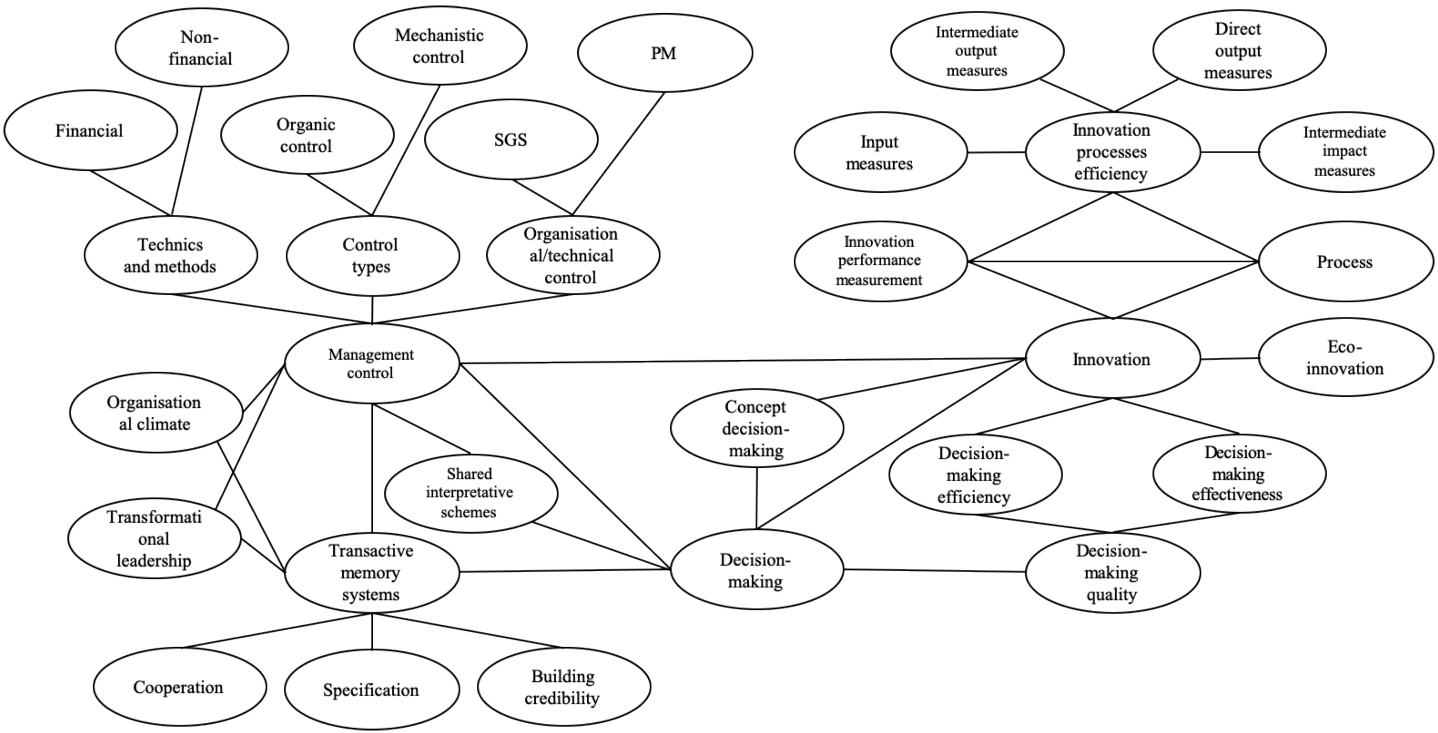

Figure 1. Thematic map presenting the links between the key aspects of management control and innovation.

Source: own development.

form below. Figure 1 presents all the themes raised within the studies and the connections between them.

The thematic map constitutes a graphical summary of the research in the field. It presents management control and innovation in their wide environments. Despite helping to identify the general themes, it may suggest potential connections between themes and unstudied areas, driving ultimately to further research. The number of themes that were discussed indicated the complexity of the issue. In the case of complex phenomena, developing a theoretical explanation of the dependencies found is of crucial importance, as it allows one to schematise the relationships. Thus, the themes presented in the map were confronted with existing concepts and theories, and reduced to produce a comprehensive model. The model is composed of a graphical representation and a three-part descriptive component.

2.1. Management control and decision-making quality

The link between management control systems and decision-making was established and theoretically explained based on the control theory, and constitutes the first component of the model. The primary purpose of management control systems is to minimise the uneven distribution of data and information across the actors within an organisation (Jaworski, Macinnis, 1989). High knowledge accessibility supports both the effective coordination of activities undertaken in different departments, and staff motivation (Hoegl, Parboteeah, 2006; Turner, Makhija, 2006). The introduction of management control strengthens internal communication and provides personnel with greater clarity about company goals, actions and results, as well as a sense of structure and sequence (Tatikonda, Montoya-Weiss, 2001). Besides, the link between management control systems and decision-making clarity is present irrespective of the innovativeness level. While projects at the low end of the innovativeness spectrum benefit most from a project-management-type system due to its wider acceptance, simplicity, greater ease of implementation and lower cost; highly innovative projects take advantage of stage-gate-stage formal control (Schultz et al., 2013). Moreover, different control types are suitable for different project innovativeness levels (Ylinen, Gullkvist, 2014), and innovativeness produces feedback to management control (Pesämaa, 2017). Among these different aspects of management control, control types emerged as a principal issue in the innovation context. First, it has been indicated that balancing organic and mechanistic forms of control helps in fostering creativity, which is in turn a necessary component of innovation development (Dougherty, 1992). Second, opposing these control types fosters innovativeness, which is fundamental for the innovation process (Henri, 2006). At the same time, it is widely accepted in the literature on the subject that what improves innovation performance is not the mere fact of making a decision, but the quality of the decisions made, especially since they represent an on-going compromise between the competing goals of actors and departments (Lövstål, Jontoft, 2017). Thus, the concept of decision-making transmits smoothly to that of decision quality. In consequence, one may not conclude that the role of management control systems simply boils down to supporting making any decision; instead, it should be stated that their role is to support high quality ones.

2.2. Decision-making quality and innovation process efficiency

Innovation, in order to be successful, should be carried out in a systematic way, from idea to launch. The go/no-go decisions at consecutive stages of innovation projects are characterised by relatively limited information and high levels of uncertainty, which hinders the allocation of the company's scarce resources (Hammedi et al., 2013). The process approach to innovation prevail in the literature on the subject, as innovation is rarely treated as a simple occurrence, but rather as the effect of a series of actions (Guan, Chen, 2010; Zizlavsky, 2015). Adopting a process perspective on innovation is significant for the developed model. The concept of the process approach to innovation relies on its gradual development through a series of consecutive stages, separated by decision points (Cooper, 2008). At each decision point, a decision is made to either proceed with the innovation project or to stop, hold or recycle it. The innovation process is presented in Figure 2. It comprises seven main stages (grey boxes) and five complementary ones (white boxes). All the stages are mutually linked, allowing for the continuation of the process from earlier to later stages and for the feedback loops drawing the process back from later stages to prior ones (two-sided arrows). The numbers 1–6 in white boxes (solid line) represent consecutive key decision points, which separate the main stages. The numbers 1S–8S in white boxes (dotted line) present supplementary decision points.

The relevant information is gathered to minimise project uncertainty and risk and to verify if the criteria for the continuation of the process are met (Zizlavsky, 2016). Thus, at its very essence, the concept of the innovation process is inseparably linked to decision-making. The innovation process is the sum of functional innovation events which is characterised by multiple divisional and relational sub-processes (Bernstein, Singh, 2006; Roper et al., 2008). The multi-stage character of the process entails the need for measuring the transformation quality of individual sub-processes (Hansen, Birkinshaw, 2007). As the transformational quality of each sub-process depends on the decisions made at a particular stage, the overall efficiency of the innovation process results from the sum of the quality of all decisions made throughout the process, with special regard to conceptual decision-making at its early stages (Kihlander,

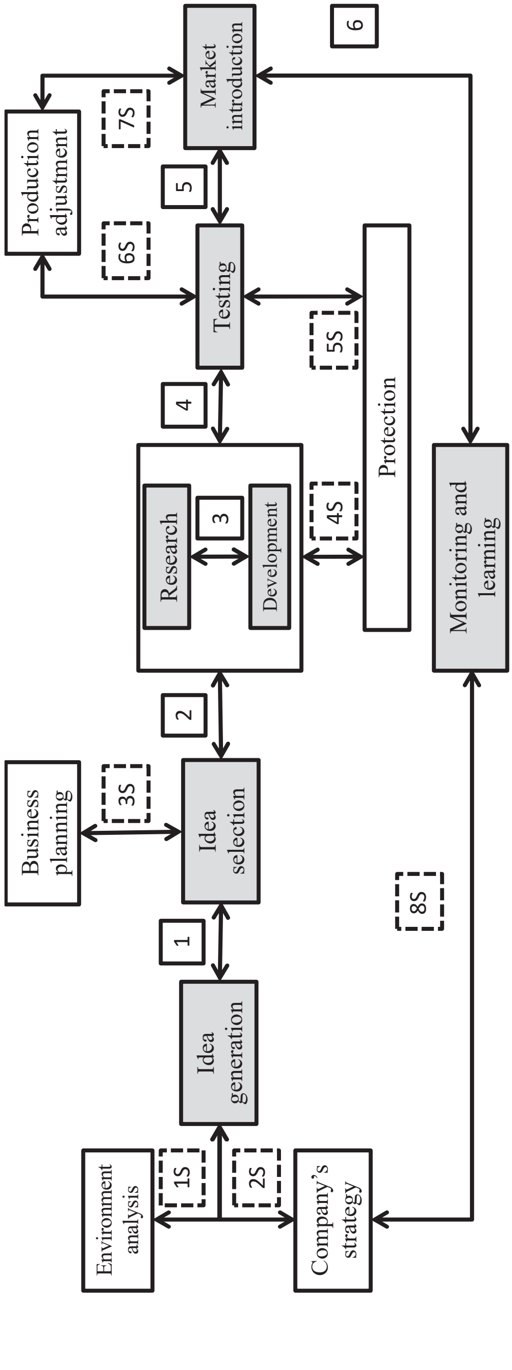

Figure 2. Model of the innovation development process

Source: Szutowski (2019).

Ritzén, 2012). At the same time, in highly competitive markets, making effective decisions is insufficient, as the decisions also need to be made on time, or otherwise the benefits of innovation may be lost or significantly reduced (Szutowski, 2018). Thus, decision-making effectiveness defined as "meeting expectations established by top management regarding outcome quality in terms of the optimization of resource allocation and the strategic fit of the innovation project" (Hammedi et al., 2013, p. 319) and decision-making efficiency defined as the "ratio between input and output of a process", while "process input could be conceptualized in terms of time and effort needed to reach a consensus and to make a screening decision" (Hammedi et al., 2013, p. 319), seem clearly separable from each other and both are equally important in increasing the efficiency of the innovation process.

Numerous innovation objectives may be set, and performance measurement methods may build on the data provided by management control systems (see Spano et al., 2016; Tervala et al., 2017). However, it is the concept of innovation efficiency understood as "more innovation outputs with respect to the inputs" (Roth, 2015 p. 281) that seems to allow the comprehensive evaluation of innovation success (Arundel, Kemp, 2009). At the same time, it corresponds to the information provision capabilities of management control systems, as it relies on input measures, direct output measures, intermediate output measures and intermediate impact measures.

2.3. Management control and decision-making quality – moderators

Furthermore, model development relied on the transactive memory theory (Lewis, 2003), according to which transactive memory systems emerge within an organisation to the extent that three processes occur jointly: specialization, building credibility, and coordination. Specialisation may be defined as the extent to which actors within an organisation know who possesses which information. Credibility refers to actors' beliefs about the others' ability to complete a task in a reliable way. Coordination focuses on the ability to divide tasks into sub-tasks and maintain relationships between the staff in charge of the sub-tasks.

In literature, TMS builds on organisational climate and transformational leadership, both of which are manageable through management control systems. Yet transformational leadership consists in providing constructive feedback to staff, motivating them to make extra effort, and coordinating their knowledge in a decision-making process (Zhang, Cao, Tjosvold 2011; Hammedi et al., 2013). Organisational climate, on the other hand, reflects the common perception of what is important and which behaviours are expected and rewarded, and determines individual propensity for information sharing (Bock, Zmud, Kim, Lee, 2005). Thus, as the two concepts being part of management control impact and the transactive memory system, it is assumed that different aspects of management control will share the same relation and also impact on TMS.

At the heart of TMS lies the limitation of individual information processing capability, cognition and expertise (Peltokorpi, 2008). On the one hand, management control systems correspond to all those limitations. On the other hand, efficient and effective decision-making builds on information processing, cognition and expertise. In relation to decision-making quality, TMS theory indicates that actors within organisations specialise in different areas (Brandon, Hollingshead, 2004) and rely on each other to provide expertise, so that collectively they possess the knowledge required to complete a task. As the cognitive division of labour is divided into internal memory (an individual actor's knowledge) and external memory (knowledge about the information possessed by other actors), a system allowing for the exchange of information, such as MCS, is required. Thus, it appears that decision-making quality may be improved as specialization, credibility, and coordination emerges, which in turn are all supported by management control systems.

Furthermore, shared interpretation seems to link management control and decision-making similarly to TMS. On the one hand, management control systems force a unified interpretation of events presented in numerical form. On the other hand, shared interpretation improves the consistency of decision-making throughout the innovation process.

2.4. Model – graphical representation

Based on the above theoretical explanation of the relation between management control systems and innovation process efficiency through decision-making quality, the graphical form of the model was developed; see below (Figure 3).

The model links management control systems directly to decision-making quality based on the control theory. It assumes that on the conceptual level, the link exists irrespective of the specific tools and control types implemented within an organisation. Furthermore, the model indirectly links management control systems to decision-making quality through the transactive memory system (specialisation, building credibility and coordination) and shared interpretation schemes, based on transactive memory theory. Lastly, it links decision-making quality (broken down into efficiency and effectiveness) to innovation process efficiency based on the concept of the innovation process. At this point, it assumes that the overall efficiency of the innovation process results from the sum of the quality of all decisions made throughout the process.

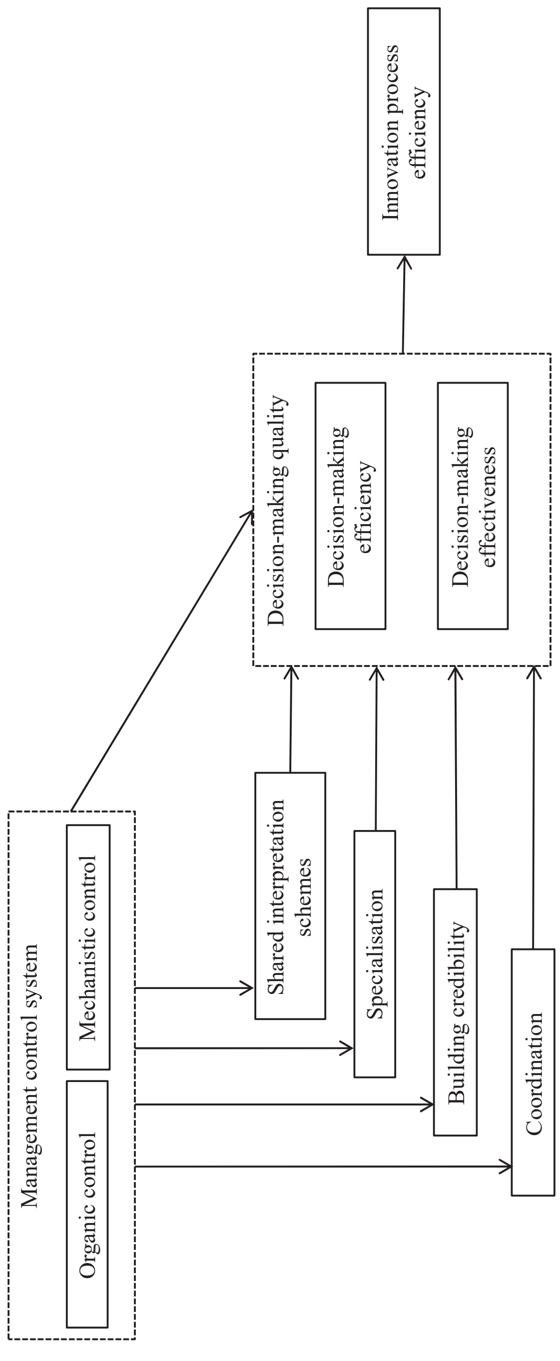

Figure 3. Model representation of the relation between management control systems and innovation process efficiency

Source: own development.

Conclusions

The purpose of the study was to create a conceptual model representing the relation between management control and innovation. The model was successfully developed. It is theoretically and conceptually based in the concept of the process approach to innovation, control theory, and transactive memory theory. It innovatively introduces decision-making quality as the missing link between management control and innovation. It is theorised that MCS impacts directly and indirectly on decision-making quality through the transactive memory system and shared interpretation schemes, which in turn affects innovation process efficiency. Therefore, the study contributes to control theory, decision theory and to the field of innovation management.

The methods of systematic literature review, including the meta-synthesis and the creation of a thematic map, allowed for achieving the purpose of the present study. However, it was burdened with certain limitations. First of all, only papers published in English were accounted for. Second of all, the study omitted several papers due to the inaccessibility of complete texts.

The empirical verification of the model in a large-scale quantitative study would be a necessary element of further research. Moreover, an in-depth qualitative study on the moderators of the relation between decision-making quality and innovation process efficiency should be performed. Lastly, as the model adopts the process approach to innovation, it would be of value to conform it to the consecutive stages of the process, as the relative importance of variables may change. After the empirical confirmation of the relationships included in the model and the in-depth study on the actual tools and methods applied within MCS, the research will contribute not only to theory development, but also to business practice.

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