

SPINNING BETWEEN PERSPECTIVES: IN SEARCH FOR THE “CONTINUOUS INNOVATION EXCELLENCE FIT” OF THE CTO AND THE COO

Patricia Wolf, Dieter Hottiger, Leila Gisin, Julien Nussbaum and Stephanie Kaudela-Baum

Lucerne University of Applied Sciences and Arts, Department of Management

{[patricia.wolf](mailto:patricia.wolf@hslu.ch); [dieter.hottiger](mailto:dieter.hottiger@hslu.ch); [leila.gisin](mailto:leila.gisin@hslu.ch); [julien.nussbaum](mailto:julien.nussbaum@hslu.ch); [stephanie.kaudela](mailto:stephanie.kaudela@hslu.ch)}@hslu.ch

ABSTRACT

Within companies, executive managers with different roles and responsibilities take over the challenging task to deal with strategic paradoxes that result from the tensions that arise from multiple demands conflicting with one another due to the differences in the logics of exploitation and exploration. Extant literature also assumes a fit of perspectives on individual level between the CTO and the COO.

This research aims at contributing to extant literature by empirically studying the assumption of the assumed fit in perspectives between CTOs and COOs based upon a sample of data from the current “Continuous Innovation Survey” reflecting the perspectives of CTO’s and COO’s of 190 manufacturing companies. We used these data to exploratively testing the convergence of the perspectives of the CTO and the COO of the same company and identifying topics where these perspectives diverge.

Keywords: *Continuous innovation management, perspectives fit, CTO, COO, ambidexterity*

1. INTRODUCTION

In today’s increasingly competitive markets, innovation capability can be seen as one of the core competencies for manufacturing organizations. According to Mintzberg (1979), a fit between internal capabilities and external requirements is a necessity for a successful innovation business. To secure future earnings, firms need to find a fitting mix between the ability to change and innovate, while simultaneously keeping up the efficiency. The so-called “reconciliation” (Slack and Lewis, 2002) should lead to “dynamic capabilities” (Eisenhardt and Martin, 2000), and therefore to the ability to react in time to the various challenges posed from the external environment as well as from within the company. This field of tension between exploitation (development and adoption in small steps) and exploration (big innovation leaps) is considered as rather problematic, especially when taking place within the same system and at the same time (He and Wong, 2004; Smith and Tushman, 2005; Smith and Lewis, 2011; Martini et. al., 2013; Turner, Swart and Maylor, 2013).

Hyland and Boer (2006) regard “continuous innovation excellence” as a product of coordinated operational excellence, innovation excellence and strategic excellence. To adjust these three critical factors for “continuous innovation excellence”, they should be interconnected by integration, alignment and coordination, in order to have a maximum impact on sustained business performance (see figure 1).

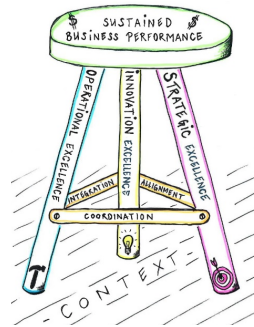


Figure 1. The continuous innovation stool (drafted according to Hyland and Boer, 2006)

2. ASSUMPTION OF FIT IN PERSPECTIVES OF CTO AND COO IN CONTINUOUS INNOVATION PROCESSES

Within companies, executive managers with different roles and responsibilities take over the challenging task to deal with strategic paradoxes that result from the tensions that arise from multiple demands conflicting with one another due to the differences in the logics of exploitation and exploration (He and Wong, 2004; Smith and Lewis, 2011; Smith, Levis and Tushman, 2016). These partly contradicting logics manifest particularly in the Chief Technology Officer's (CTO) and the Chief Operating Officer's (COO) roles: Whereas the CTO is responsible for exploration in terms of new technology monitoring and technological innovation (Smith, 2003; Cetindamar and Pala, 2011), the COO follows the logic of exploitation when leading the day-to-day operations of the firm with the aim to make it efficient (Bennet and Miles, 2006; Marcel, 2009).

If a company wishes to succeed in continuous innovation, these two players with differing priorities will however have to create a fit in terms of a common strategic perspective that would allow them “managing dualities” (Boer, Kuhn and Gertsen, 2006; 5), i.e. coordinating, aligning and integrating management activities that contribute to continuous innovation throughout the company in a consistent manner. This fit of the perspectives on individual level between the CTO and the CEO as managers was so implicitly assumed (for a summary, see Hyland and Boer, 2006 and Martini et al., 2013) but – to our knowledge – never studied. In general, both the CTO and the COO roles represent largely neglected research topics by organizational scholars (Bennett and Miles, 2006; Cetindamar and Pala, 2011). Regarding the tensions between exploration (primarily associated with the role of the COO) and exploitation (primarily associated with the role of the CTO), one could also hypothesize that the perspectives of the two players could in fact vary tremendously.

Extant literature on organizational ambidexterity (i.e. the ability to pursue exploration as well as exploitation within an organization) has extensively investigated and proposed supportive organizational structures, strategies, processes, and contexts (e.g. Tushman and O'Reilly 1996; Gibson and Birkinshaw, 2004; Smith and Tushman, 2005; O'Reilly and Tushman, 2008; Smith, Levis and Tushman, 2016). Furthermore, managerial approaches to ambidexterity advocate either differentiation or integration tactics (Andriopoulos and Lewis, 2009). Executives are generally understood as important for managing such innovation paradoxes across levels because they “set the context, providing strategic leadership and allocating resources that determine their firm's portfolio of projects” (ibid; 708) and use “both integration and differentiation approaches to managing paradoxes of innovation” (ibid; 708).

Smith and Tushman (2005; 534) find that “while there is a growing literature on the importance of exploration and exploitation, ambidextrous designs, and dynamic

managerial capabilities, there is limited literature on the characteristics of the senior team that can manage these complex strategies as associated complex organizational forms.” They call for future empirical research studying managerial cognitions (ibid; 533). However, at individual level of CTOs and COOs perspectives, the fit-assumption of perspectives on continuous innovation was so far not investigated. Little is so far known about the themes where convergence or / and divergence in these perspectives on continuous innovation processes occur.

This paper aims at contributing to extant literature by empirically studying the assumption of a fit in perspectives of COOs and CTOs based upon a sample of survey data reflecting the perspectives of CTO’s and COO’s of 190 manufacturing companies. The data were collected in the frame of the current “Continuous Innovation Survey” launched by a consortium of researchers of the continuous innovation network (CINet). We used the data to exploratively

1. test to how far the perspectives of the CTO and the COO of the same company on continuous innovation excellence are the same, and/or
2. (if applicable) identify and discuss topics where these perspectives diverge.

3. RESEARCH DESIGN

The purpose of this current “continuous innovation survey” launched by a consortium of researchers of the continuous innovation network (CINet) is to investigate to what extent high performance is related to alignment, coordination and integration of exploitative and explorative activities within manufacturing companies (CINet, 2016a). The survey assumes that for competitive advantage and long-term proficiency, production companies need to find and operate a balance between the ability to change and innovate on the one hand and to be efficient on the other – this is what determines their continuous innovation capability (Boer, 2001; Boer et al., 2006). The aim of the Continuous Innovation Survey was to test the following three core hypotheses developed by Hyland and Boer (2006) concerning the continuous innovation stool:

1. “The better a firm bundles relevant capabilities in each of the three critical competence areas (the legs), the stronger the three competences and the better the firm’s operational, innovation and strategic performance and, through that, business performance.
2. The better a firm organizes the interplay between the three critical competence areas, the better the firm’s business performance.
3. The appropriateness of alignment, coordination and integration mechanisms is related to unit of analysis – job, group, organization, and network.” (CINet, 2016b; 3)

3.1 DATA COLLECTION

To achieve this purpose, two questionnaires have been developed which allow capturing the perspectives of COOs and CTOs within the same firm, on a multitude of constructs and units of analysis. The questionnaire consisted of the following eleven sections overall, using existing scales as much as possible (see also for further information CINet, 2016a):

I. Company information

- Name, country of origin, and main product of the business unit the department belongs to
- Industry
- Business unit size

II. Business strategy, orientation and integration

- Business strategy
- Business orientation
- Competitor orientation
- Business strategy integration

III. Competitive priorities

- Evaluation of areas where the company wins customers by performing better than competitors

IV. Business Strategy Practices and Flexibility

- Business strategy capabilities and practices
- Strategic flexibility

V. Business Performance

- Business strategy capabilities and practices
- Strategic flexibility

VI. Processes, Strategy and Investments

VI a) Production (COO)	VI b) Innovation (CTO)
• Production strategy	• Innovation strategy
• Strategic integration	• Strategic integration
• Production investments	• Innovation investments

VII. Personnel, tools and techniques

VII a) Production (COO)	VII b) Innovation (CTO)
• Production personnel	• Innovation personnel
• Production tools and techniques	• Innovation tools and techniques

VIII. Coordination and improvement

VIII a) Production (COO)	VIII b) Innovation (CTO)
• Supply chain coordination practices	
• Production innovation/improvement	• Innovation/improvement practices
• Inter-departmental coordination mechanisms	• Inter-departmental coordination mechanisms

IX. Performance

IX a) Operation (COO)	IX b) Innovation (CTO)
• Innovation introduction rate	
• Operation performance	• Innovation performance (overall, incremental, radical)

X. Organizational structure and culture

- Centralization
- Formalization
- Connectedness

- Culture

XI. Market, competitive and technological context

- Technological context
- Market
- Competition

As described above, the questions in the sections V-VIII that concerned the specific business unit (operation or innovation) and function (production and New Product development) differed according to their headlines for the CTO and the COO. However, the questions asked were the same. The COO had additional questions to answer concerning supply chain coordination practices (section VII) and innovation introduction rate (section VIII).

Overall, 11 countries participated in this global survey. Namely Austria, Brazil, Canada, Denmark, Hungary, Italy, Netherlands, Pakistan, Spain, Sweden and Switzerland. Apart from Netherland, all listed countries were able to collect at least one data set, meaning that data could be collected from COO and CTO of the same companies. As the aim of this “continuous innovation survey” is to examine to which extend the statements of each party correspond, and how high correspondence affects the companies’ outcomes, only complete data sets are considered in the final sample. In order to meet the set goal, the data sets of Brazil, Canada, Denmark, Hungary, Italy, Pakistan, Spain, Sweden and Switzerland (N = 190) will be included in the analysis. The final sample of N = 190 companies is described in the hereinafter presented tables 1 and 2.

Country	Number of Data Sets	In % of Sample
Austria	1	0.5
Brazil	9	4.7
Canada	7	3.7
Denmark	7	3.7
Hungary	40	21.1
Italy	32	16.8
Pakistan	41	21.6
Spain	37	19.5
Sweden	7	3.7
Switzerland	9	4.7
TOTAL	N = 190	100%

Table 1. Final Sample; classified in (n) companies per country

Characteristics	Specification	Quantity	In % of Sample
Industry (N = 190 companies)	(1) Manufacture of food products	21	11.1
	(2) Manufacture of beverages	1	0.5
	(3) Manufacture of textiles and shoes	24	12.6
	(4) Manufacture of leather and related products	4	2.1
	(5) Manufacture of wood and of products of wood & cork	0	0.0
	(6) Manufacture of paper and paper products	9	4.7
	(7) Manufacture of chemicals & chemical products	13	6.8
	(8) Manufacture of basic pharmaceutical products	6	3.2
	(9) Manufacture of rubber and plastics products	14	7.4
	(10) Manufacture of other non-metallic mineral products	3	1.6
	(11) Manufacture of fabricated metal products	14	7.4
	(12) Manufacture of computer, electr. & optical products	8	4.2
	(13) Manufacture of electronic equipment	13	6.8
	(14) Manufacture of machinery & equipment	18	9.5
	(15) Manufacture of motor vehicles and (semi)trailers	7	3.7
	(16) Manufacture of other transport equipment	4	2.1
	(17) Manufacture of furniture	0	0.0
	(18) Other manufacturing	22	11.6
	(19) Construction of buildings	2	1.1
	(20) Civil engineering	3	1.6
		<i>missing</i>	4
	TOTAL	N = 190	100%
Business Unite Size (N = 190 companies)	Small (< 50 employees)	6	3.2
	Medium (< 250 employees)	108	56.8
	Large (≥ 250 employees)	76	40.0
	TOTAL	N = 190	100%

Table 2. Final Sample; classified in industry sector and business unit size

3.2 DATA ANALYSIS

As stated in section 3.1, the two CINet questionnaires were filled in independently by the CEO and the CTO of each firm of the sample. While some of the questions were specifically addressed either to the CTO or the COO, 92 core questions with the same wording were addressed to both the CTO and the COO. Receiving these answers by the two respondents in separated questionnaires allows us clearly distinguishing their opinions and perspectives.

All items were measured using five-point Likert scales where respondents positioned their answers between "strongly agree" and "strongly disagree". To answer our research questions, we used the Wilcoxon matched-pairs signed-ranks test to identify potential differences in the assessment of items between the CTO and the COO perspectives and to test their significance.

4. FINDINGS

Overall, the statistical analysis shows a very high fit between the perspectives of CTO and COO. We identified no significant differences in sections

- II Business strategy, orientation and integration
- IV Business strategy, practices and flexibility
- V Business Performance
- VI Processes, strategy and investments
- VIII Coordination and improvement
- IX Performance
- XI Market, competitive and technological context

Nevertheless, nine significant differences were identified in the sections

- III Competitive priorities
- VII Production/Innovation personnel, tools and techniques and
- X Organizational structure and culture

Table 3 below lists these significant differences.

Item No.	Item	<i>P</i>
Competitive Priorities		
3.1.3 (<i>n</i> = 187)	We try to win orders from our customers by performing better than our competitors in terms of reputation as a good employer and contributor to societal development and welfare	.003
3.1.12 (<i>n</i> = 188)	We try to win orders from our customers by performing better than our competitors in terms of delivery reliability	.045
Production/Innovation Personnel, Tools and Techniques		
7.1.3 (<i>n</i> = 171)	Indicate the degree of adoption of the following practices in your department: Teams that operate together with suppliers and customers	.002
7.1.5 (<i>n</i> = 173)	Indicate the degree of adoption of the following practices in your department: Objective-based employee remuneration	.038
7.1.7 (<i>n</i> = 173)	Indicate the degree of adoption of the following practices in your department: Employee rotation amongst different activities, tasks, positions or departments	.033
Organizational Structure and Culture		
10.3.1 (<i>n</i> = 187)	In our company there is ample opportunity in our organization for informal “hall talk” among employees from different departments	.000
10.3.2 (<i>n</i> = 188)	In our company employees from different departments feel comfortable calling each other when the need arises	.005
10.3.4 (<i>n</i> = 188)	In our company people around here are accessible to those in other departments	.001
10.3.5 (<i>n</i> = 188)	In this organization, it is easy to talk with anyone you need to, regardless of rank or position	.018
<i>Note.</i> N = 190; level of significance $p \leq .05$		

Table 3. Significant differences in the perspectives of COO and CTO

In section III “Competitive priorities”, COOs agree significantly stronger than CTOs to the statements “We try to win orders from our customers by performing better than our competitors in terms of

- reputation as a good employer and contributor to societal development and welfare (question 3.1.3, $p = .003$), and
- delivery reliability” (question 3.1.12 $p = .045$)

Figures 2 and 3 display the distribution of CTO and COO answers:

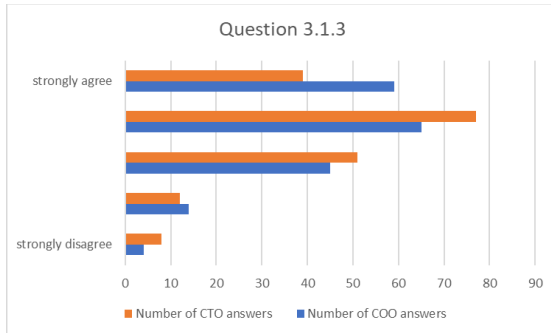


Figure 2. Distribution of COO and CTO answers on question 3.1.3

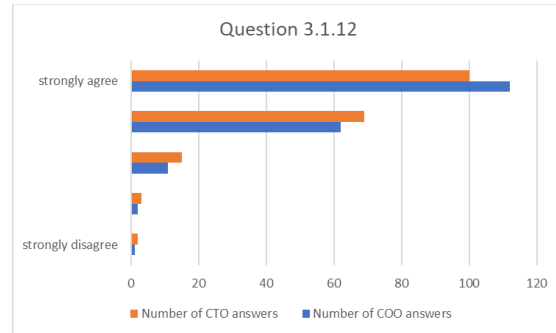


Figure 3. Distribution of COO and CTO answers on question 3.1.12

In section IIV “(Production/ Innovation) Personnel, tools and techniques”, the answers of CTO and COO show significant differences regarding the questions concerning personnel but not regarding tools and techniques applied. When asked about the degree of the adoption of personnel related practices in the production respective new product development processes,

- CTOs indicate a significantly higher degree of the adoption of teamwork involving employees with different know-how and skills than COOs (question 7.1.3, $p = .002$).
- COOs indicate a significantly higher degree of the adoption of objective based employee remuneration (question 7.1.5, $p = .038$) and employee rotation amongst different activities, tasks, positions or departments (question 7.1.7, $p = .033$) than their CTO colleagues.

Figures 4-6 below display the distribution of CTO and COO answers:

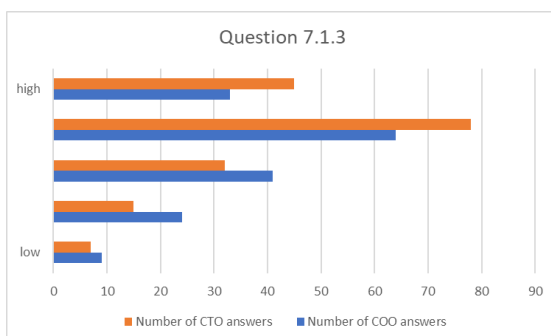


Figure 4. Distribution of COO and CTO answers on question 7.1.3

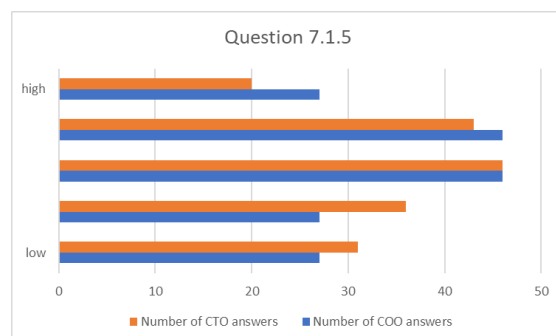


Figure 5. Distribution of COO and CTO answers on question 7.1.5

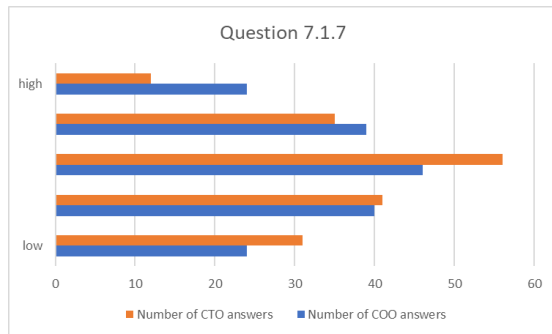


Figure 6. Distribution of COO and CTO answers on question 7.1.7

These differences do not reflect differences in perspectives but in personnel related practices in the production department and new product development processes respectively.

In the answers to section X “Organizational structure and culture”, COOs and CTOs share common perspectives on the questions regarding centralization, formalization and culture. Significant differences exist in the perspectives of COOs and CTOs concerning the perceived level of connectedness: CTOs agree significantly stronger than COOs to the statements that in their company,

- there is an ample opportunity for informal hall talk among employees from different departments (question 10.3.1, $p = .000$)
- employees from different departments feel comfortable calling each other when the need arises (question 10.3.2, $p = .005$)
- people are quite accessible to those in other departments (question 10.3.4, $p = .001$)
- it is easy to talk with anyone, regardless of rank or position (question 10.3.5, $p = .018$)

Figures 7-10 below display the distribution of CTO and COO answers:

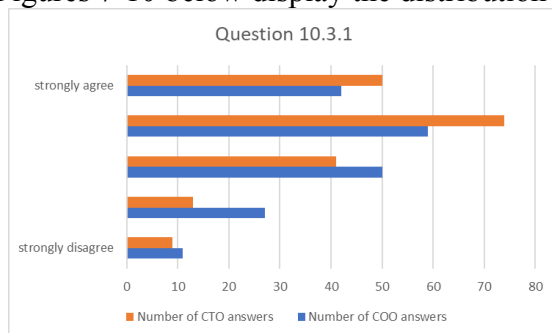


Figure 7. Distribution of COO and CTO answers on question 10.3.1

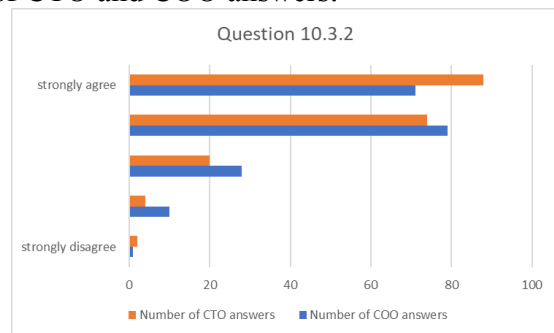


Figure 8. Distribution of COO and CTO answers on question 10.3.2

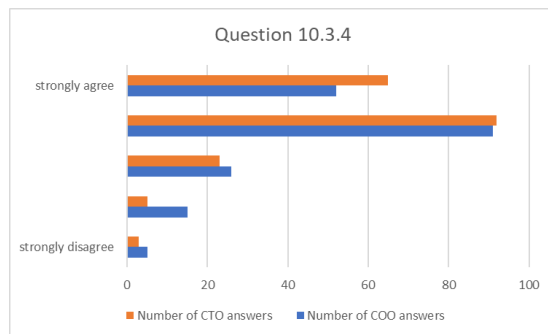


Figure 9. Distribution of COO and CTO answers on question 10.3.4

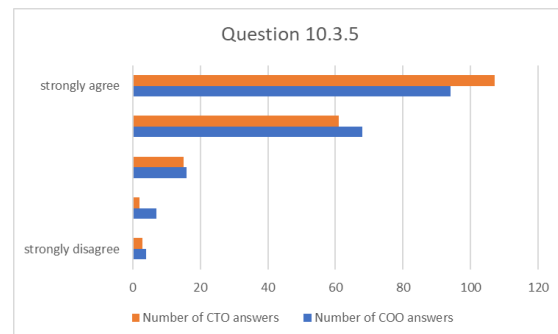


Figure 10. Distribution of COO and CTO answers on question 10.3.5

5. DISCUSSION & CONCLUSIONS

This research aimed at contributing to extant literature by empirically studying the assumption of a fit in perspectives of COOs and CTOs in continuous innovation (for a summary, see Hyland and Boer, 2006 and Martini et al., 2013) based upon a sample of data from the current “Continuous Innovation Survey” reflecting the perspectives of CTO’s and COO’s of 190 manufacturing companies. We used these data to exploratively testing the convergence of the perspectives of the CTO and the COO of the same company and identifying topics where these perspectives diverge.

In general, the data provide a strong support for the fit-assumption to a large degree. There are not many sections where we were able to identify significant differences in perspectives. We identified a difference in section III “Competitive priorities” where COOs agree significantly stronger than CTOs that the company try to win orders from customers by performing better than our competitors in terms of reputation as a good employer and contributor to societal development and welfare and delivery reliability. Delivery reliability is a performance measure that concerns the operational tasks of the COO who is in the day-to day business also much more in contact with employees and customers (Bennet and Miles, 2006; Marcel, 2009) than the CTO who is dealing mainly with new technology monitoring and technological innovation (Smith, 2003; Cetindamar and Pala, 2011). This might explain the perceived differences which represent, although being significant, rather slight deviations than contractionary opinions if we look at the data.

As said above, the differences identified regarding personnel practices do not reflect differences in perspectives but in personnel related practices in the production department and new product development processes respectively. It is not surprising that CTOs indicate a significantly higher degree of the adoption of teamwork involving employees with different know-how and skills than COOs: New product development processes are often organized in the form of cross-functional project teams to ensure knowledge sharing and collaboration amongst the experts with domain specific knowledge (e.g. Dougherty, 1992; Carlile, 2002; 2004; Carlile and Rebentisch, 2003; Holzer, Wolf and Kocher, 2011). Also, the higher degree of objective based remuneration in the production department (COO perspective) is probably related to the type of work performed by blue color workers in the production department where easily measurable objectives can be set – a well-known approach of manufacturing control (Mckay, 2010). This is much more difficult in New Product Development (NPD) teams where team members are self-motivated, enjoy diversity and idea development and outcomes of the development process cannot be predicted (for a summary, see Baumann, Wolf and Papenberg, 2014).

The significant higher degree of employee rotation assumingly also represents the reality in the production department (e.g. Azizi, Zolfaghari, and Liang, 2010), whereas the contributors to new product development initiatives rotate less between departments or tasks but rather get involved into projects while keeping their initial position.

We also identified significant differences in perspectives in section X “Organizational structure and culture”. Interestingly, these concern only the perceived level of connectedness and not centralization, formalization or culture. Significant differences exist in the perspectives of COOs and CTOs concerning the perceived level of connectedness: CTOs agree significantly stronger than COOs to the statements that affirm that employees from different departments, ranks and positions have the opportunity and feel comfortable with talking to each other. Again, we assume that this is related to the job profiles: Whereas the CTO is responsible for exploration in terms of new technology monitoring and technological innovation (Smith, 2003; Cetindamar and Pala, 2011) and therefore has to network and bring together people from different departments, the COO must ensure efficiency in the day-to-day operations of the organization (Bennet and Miles, 2006; Marcel, 2009).

All identified differences are good examples for how CTO and COO are “managing dualities” (Boer, Kuhn and Gertsen, 2006; 5) in their departments while at the same time exposing common perspectives that allow them coordinating, aligning and integrating management activities that contribute to continuous innovation throughout the company in a consistent manner. The contribution of this paper is that it empirically provided support to the fit-assumption of continuous innovation research (Hyland and Boer, 2006 and Martini et al., 2013) while at the same time identifying areas where CTO and COO set slightly different priorities and apply different practices for being able to cope with the different logics of their departments and at the same time ensure a fit.

As this paper was just explorative and focused on differences and similarities in CTO and COO perspectives of manufacturing firms in the frame of continuous innovation processes, we have not studied the impact of the identified differences on innovation excellence. We invite follow up studies that dig deeper into this issue for investigating whether organizations with higher or lower convergence in COO and CTO perspectives or concerning certain areas indicate better performance indicators regarding continuous innovation.

Some further limitations apply to this research: First, a potential bias might result from the cultural differences of the countries involved. As we know from studies on cultural differences (Hofstede, 2010) and the country-specific conditions (Schwab, 2017), management approaches vary largely across cultural clusters and country-specific economic situations. With the available data set, we were second not able to compare data sets from different cultural clusters. Additionally, we cannot differentiate between industries and sectors or company size.

REFERENCES

- Andriopoulos, C. and Lewis, M. W. (2009). Exploitation-Exploration Tensions and Organizational Ambidexterity: Managing Paradoxes of Innovation. *Organization Science*, 20(4), pp. 696-717.
- Azizi, N., Zolfaghari, S., and Liang, M. (2010). Modelling job rotation in manufacturing systems: The study of employee’s boredom and skill variations. *International Journal of Production Economics*, 123, pp. 69–85.
- Baumann, S., Wolf, P., and Papenberg, S. (2014). Challenges for managing creativity and innovation in interdisciplinary Teams in organizations: A literature review. *Proceedings of the 15th International CINet Conference*. (pp. 182-193). Overdinkel: CINet.

- Bennett, N. and Miles, S. (2006). Second in Command: The Misunderstood Role of the Chief Operating Officer. *Harvard Business Review*, 84(5), pp. 70-78.
- Boer, H. (2001). And [Jethro] said ... Learning: the link between strategy, innovation and production, Inaugural Lecture, Center for Industrial Production, Aalborg University, 4 May.
- Boer, H., Kuhn, J. and Gertsen, F. (2006). Continuous innovation - Managing dualities through co-ordination. *CINet Working Paper WP2006-01*.
- Brown, S. and Eisenhardt, K. (1995). Product development: Past research, present findings, and future directions. *Acad. Management Review*, 20(2), pp. 343-378.
- Carlile, P. R. (2002). A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organisation Science*, 13(4), pp. 442-455.
- Carlile, P. R. (2004). Transferring, translating, and transforming: an integrative framework for managing knowledge across boundaries. *Organisation Science*, 15(5), pp. 555-568.
- Carlile, P. R. and Rebentisch, E. (2003). Into the black box: the knowledge transformation cycle. *Management Science*, 49(9), pp. 1180-1195.
- Cetindamar, D. and Pala, O. (2011). Chief technology officer roles and performance. *Technology Analysis & Strategic Management*, 23, pp. 1031-1046.
- CINet (2016a). Continuous Innovation Survey 2016: Workbook. Continuous Innovation Network.
- CINet (2016b). Continuous Innovation Survey 2016. Background, hypotheses, constructs and operationalization. Continuous Innovation Network.
- Dougherty, D. (1992). Interpretative barriers to successful product innovation in large firms. *Organisation Science*, 3(2), pp. 179-202.
- Eisenhardt, K.M. and Martin, A. J. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, 21, pp. 1105-1121.
- Galbraith, J. (1973). *Designing Complex Organisations*. Reading, MA, Addison-Wesley.
- Gibson, C. B. and Birkinshaw, J. (2004). The antecedents, consequences, and mediating role of organizational ambidexterity. *Academy of Management Journal*, 47, pp. 209-226.
- He, Z.-L. and Wong, P.-K. (2004). Exploration vs. Exploitation: An Empirical Test of the Ambidexterity Hypothesis. *Organization Science*, 15(4), pp. 481-494.
- Hinds, P. (1999). The curse of expertise: the effects of expertise and de-biasing methods on predictions of novice performance. *Journal of Experimental Psychology*, 5, pp. 205-221.
- Hofstede, G. (2010), "Cultures and Organizations", McGraw-Hill, Professional Publishing, New York.
- Holzer, J., Wolf, P. and Kocher, P.-Y. (2011). The usage of boundary objects for the construction of organizational innovation processes. *International Journal of Innovation and Sustainable Development*, 5(2/3), pp. 119-141.
- Hyland, P. and Boer, H. (2006). A continuous innovation framework. Some thoughts for consideration. Proceedings of the 7th International CINet conference 2006, CI and sustainability – Designing the road ahead, Lucca, Italy, 8-12 September.
- Iansiti, M. (2000). *Technology Integration: Making Critical Choices in a Dynamic World*. Cambridge, C.A., Harvard Business School Press.
- Kogut, B. and Zander, U. (1996). What firms do? Coordination, identity, and learning. *Organisation Science*, 7, pp. 502-518.
- Lawrence, P. R. and Lorsch, J. W. (1967). *Organisations and Environment: Managing Differentiation and Integration*. Cambridge, MA, Harvard Business School Press.
- Leonard-Barton, D. (1995). *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation*. Boston, MA, Harvard Business School Press.
- Luo, L., Kannan, P. K., Besharati, B. and Azarm, S. (2005). Design of robust new products under variability: marketing meets design. *Journal of Product Innovation Management*, 22, pp. 177-192.

- Marcel, J. J. (2009). Why top management team characteristics matter when employing a chief operating officer: a strategic contingency perspective. *Strategic Management Journal*, 30(6), pp. 647-658.
- Martini, A., Laugen, B. T., Gastaldi, L. and Corso, M. (2013). Continuous innovation: towards a paradoxical, ambidextrous combination of exploration and exploitation. *International Journal of Technology Management*, 61(1), pp. 1-22.
- Mckay, K. N. (2010) Historical survey of manufacturing control practices from a production research perspective, *International Journal of Production Research*, 41(3), pp. 411-426.
- Mintzberg, H. (1997). *The structuring of organizations. A synthesis of the research.* Prentice-Hall, Englewood Cliffs.
- Nonaka, I. and Takeuchi, H. (1995). *The Knowledge-Creating Company.* Oxford, University Press.
- Nonaka, I., Toyama, R. and Byosièrè, P. (2003). A theory of organisational knowledge creation: understanding the dynamic process of creating knowledge. In M. Dierkes, A. Berthoin, A. Antal, J. Child, I. Nonaka (eds), *Handbook of Organisational Learning and Knowledge* (pp. 491-517). Oxford, Oxford University Press.
- O'Reilly, C. A. and Tushman, M. L. (2008). Ambidexterity as a dynamic capability: Resolving the innovator's dilemma. *Research in Organizational Behavior*, 28, pp. 185-206.
- Schwab, K. (Ed., 2017) *Global Competitive Report 2017-2018.* World Economic Forum. Online available at <http://www3.weforum.org/docs/GCR2017-2018/05FullReport/TheGlobalCompetitivenessReport2017%E2%80%932018.pdf>.
- Tatikonda, M. V. and Montoya-Weiss, M. M. (2001). Integrating Operations and Marketing Perspectives of Product Innovation: The Influence of Organizational Process Factors and Capabilities on Development Performance. *Management Science*, 47(1), pp. 151-172.
- Turner, N., Swart, J. and Maylor, H. (2013). Mechanisms for Managing Ambidexterity: A Review and Research Agenda. *International Journal of Management Reviews*, 15, pp. 317-332.
- Tushman, M. L., & O'Reilly, C. A. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California Management Review*, 38(4), pp. 8-30.
- Schilling, M. A. and Hill, C. W. L. (1998). Managing the new product development process: Strategic imperatives. *Academy of Management Executive*, 12(3), pp. 67-81.
- Slack, N. and Lewis, M. (2002). *Operations strategy.* Prentice-Hall, Harlow.
- Smith, R. (2003). The Chief Technology Officer: Strategic Responsibilities and Relationship. *Research Technology Management*, 46(4), pp. 28-36.
- Smith, W. K. and Lewis, M. W. (2011). Toward a theory of paradox: A dynamic equilibrium model of organizing. *Academy of Management Review*, 36(2), pp. 381-403.
- Smith, W. K. and Tushman, M. L. (2005). Managing Strategic Contradictions: A Top Management Model for Managing Innovation Streams. *Organization Science*, 16(5), pp. 522-536.
- Smith, W. K., Lewis, M. W. and Tushman, M. L. (2016). "Both/And" Leadership. Don't worry so much about being consistent. *Harvard Business Review*, 94(5), pp. 62-70.
- Ulrich, K. T. and Eppinger, S. D. (2000). *Product Design and Development.* Irwin McGraw-Hill, New York.
- von Hippel, E. (1988). *The Sources of Innovation.* London, Oxford Press.
- von Krogh, G. (2003). Knowledge sharing and the communal resource. In M. Easterby-Smith, M. A. Lyles (Eds.), *Handbook of Organisational Learning and Knowledge Management* (pp. 372-392). Malden, Blackwell.