SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2023
ORGANIZATION AND MANAGEMENT SERIES NO. 185

PARADOXES IN THE ENGINEERING CHANGE MANAGEMENT PROCESS

Jakub TRYCZAK[1*], Anna LIS[2], Paweł ZIEMIAŃSKI[3]

[1] Merito WSB University in Gdańsk; jtryczak@wsb.gda.pl, ORCID: 0009-0000-8737-0060
[2] Gdańsk University of Technology, Faculty of Management and Economics; anna.lis@zie.pg.gda.pl, ORCID: 0000-0002-1527-7796
[3] Gdańsk University of Technology, Faculty of Management and Economics; pawel.ziemianski@pg.edu.pl, ORCID: 0000-0002-4391-9282
* Correspondence author

Purpose: The main purpose of this paper is to conceptualize and operationalize paradoxes that are significant in the engineering change management (ECM) process. The following research question was stated: What are the paradoxes that influence the ECM process, and how can they be measured?
Design/methodology/approach: The study is divided into two parts: conceptualization and operationalization. Conceptualization involved a literature review, which allowed for identifying initial categories of paradoxes that were later verified during in-depth personal interviews with the study participants. The subsequent operationalization involved developing a measurement tool which is a semantic differential scale that allows for assessing the perceived current and desired approach to solving paradoxes affecting ECM. The tool was revised based on in-depth personal interviews with participants of the ECM process. For the study, a manufacturing company which implemented a change management process was selected.
Findings: Four general groups of paradoxes previously identified in the paradox theory literature (i.e. learning, belonging, performing, and organizing) were used to develop a list of paradoxes specific to the ECM process. In-depth interviews allowed to obtain data from experienced participants of the process, which was used to verify the preliminary list. The result of this verification was the list of 12 paradoxes that was included in the final measurement tool.
Research limitations: Even though the study involved well-informed participants who are experienced in the ECM process, they represented a single company. Additionally, the proposed research tool may require further verification in subsequent studies.
Practical implications: The knowledge regarding paradoxes specific to the ECM process and the created tool can be helpful for change administrators, project managers, and other stakeholders. They allow to define the areas of most significant tensions in the ECM process that require attention and effort.
Originality/value: This paper's main value pertains to two different domains- cognitive and methodic. The undertaken attempt to include paradoxes and their significance in the analysis of the ECM process broadens the current understanding of process determinants. The proposed research tool, which is based on a well-grounded theoretical approach to paradoxes and adapted to fit the ECM process, can be used in further research.

Keywords: Paradox Theory, Paradox Management, Tension, Engineering Change Management, Engineering Change.

Category of the paper: Research paper, Case study.

1. Introduction

The engineering change management (ECM) process is a process of information distribution that deserves in-depth studies because of its newness and importance for production companies. ECM is among the most important processes in companies with an Engineering-to-Order production environment. ECM involves the implementation of changes, modification of structures and alterations of functionality elements that are already utilized in the production process (Reddi, Moon, 2013; Hamraz et al., 2013). The ECM process can be considered in two ways: as a planned engineering change implementation (Tavčar, Duhovnik, 2005; Jarratt et al., 2011) and as an emergent engineering change implementation (Sjögren et al., 2019; Eckert et al., 2017). In both these approaches the importance of tensions that are present in the ECM process, should be considered and validated.

The contingency theory offers only one answer to the organizational tensions pertaining to management (Lawrence, Lorsch, 1967). Paradox theory adopts an alternative approach to organizational tensions, exploring how organizations can treat different tensions simultaneously (Smith, Lewis, 2011). The effect of selecting a one-sided answer when addressing competing tensions can be quick, but function only in a short-term. According to the paradox theory, it is possible to achieve a more long-term, sustainable solutions (Lewis, 2000). Paradoxes that are present in literature focus mainly the organizational aspects of management. According to the decision-making process perspective in management, paradoxes are present in every aspect of management.

There is a gap in the literature that the present paper intends to fill. In our paper, we aim to conceptualize and operationalize paradoxes that are relevant to the engineering change management (ECM) process. The end result of our efforts is a measurement tool that can help identify and analyze the ECM process.

The paper is divided into five parts. The first part includes the literature review which includes paradox theory and the ECM process. The second part concerns methodology employed in the conducted study which is followed by results shown in the third part. In part four, the authors describe the subsequent steps of conceptualizing and operationalizing paradoxes in ECM and propose a tool for measuring and analyzing paradoxes. Finally, fifth part includes theoretical and practical implications, research limitations and proposed further directions of research and inquiries.

MOST WIEDZY Downloaded from mostwiedzy.pl

2. Literature review

In organizations managers continuously have to decide between conflicting tensions; flexibility and stability, exploration and exploitation, global and local values etc. (Clegg et al., 2002; Smith, Lewis, 2011). Contrary to contingency theory, paradox theory proposes to change the question from 'Under what conditions should managers emphasize either A or B?' to the question 'How we can engage in both A and B simultaneously?' (Tabesh, Vera, 2020). It is stressed in the literature that it is essential for managers to accept 'paradoxical thinking' not only accept the contradictory tensions but to embrace them in order to obtain the long-term sustainable effects (Ingram et al., 2014). This type of thinking promotes 'acceptance and engagement' over paradox elimination and changing the perspective on tensions from 'either/or' to 'both/and' (Smith, Lewis, 2011).

In the literature few definitions of paradoxes (tensions) can be found. It is considered 'a persistent contradiction between interdependent elements' (Schad et al., 2016). Paradox is contradictory and includes interrelated elements, which seem logical when they are isolated but their simultaneous occurrence seems to be irrational (Lewis, 2000). According to another definition, paradox 'consists of two contrary or even contradictory propositions to which we are led by apparently sound arguments' (Poole, Van de Ven, 1989). A contradiction which exists in a paradox is compared to the tug-of-war experience (Schad et al., 2016). Interdependence in Schad et al. (2016) definition refers to the inextricable connection between opposing elements. According to scholars, it is possible to separate those elements, but their simultaneous existence creates a paradoxical wholeness (Poole, Van de Ven, 1989). In the literature the most popular example of such a connection is yin-yang (Schad et al., 2016; Lewis, 2000; Smith, Lewis, 2011). In the literature there are several different categorizations of paradoxes. The two most popular approaches include three groups of paradoxes proposed by Lewis (2000): learning, organizing and belonging and the later extension including four groups proposed by Smith and Lewis (2011): learning, organizing, belonging and performing (Table 1).

Table 1.
Groups of the organizational paradoxes

No.	Type of paradox	Meaning for organization
1	Organizing	Organizing paradoxes are the tensions which describe differences between behaviors in organization.
2	Learning	Differences between types of learning.
3	Belonging	This paradox describes differences in the approach to identity.
4	Performing	Differences between interests and strategies.

Source: Own elaboration based on Jarząbkowski, 2013; Smith, Lewis, 2011.

Four groups of paradoxes describe different approaches to managing different situation in organizations. These different approaches foster collaboration and competition or control and flexibility behaviors (organizing tensions). Learning paradoxes pertain to tensions between

MOST WIEDZY Downloaded from mostwiedzy.pl

building new reality and disassociating from the past in order to build up new types technologies, behaviors, etc. The third group – belonging tensions – foster tensions between individual and collective or between competing values, roles and memberships. The last group includes performing tensions which focus on different goals represented by different groups of stakeholders in organizations (Smith, Lewis, 2011).

Multiple examples of organizational tensions which are subject of research can be found in literature. In Table 2 we present examples of frequently studied organizational paradoxes (Smith, Lewis, 2011; Clegg et al., 2002; Schad et al., 2016; Lawrence, Lorsch, 1967). Presented examples of the organizational paradoxes include each of the four groups (Table 1). Because tensions can also exist between group of paradoxes, according to Smith and Lewis (2011) some of the paradoxes can be divided even more precisely.

Table 2.
Management paradoxes in the literature

No.	Type of paradox	Example of tension	Author
1	Organizing	Cooperation vs competition	Runge et al. (2022), Munten et al. (2022), Best et al. (2021), van Duijn et al. (2021), Rey-Garcia et al. (2021), Dooley, Gubbins (2019), Tóth et al. (2018), Chou, Zolkiewski (2018), Pressey, Vanharanta (2016), Stadtler, Van Wassenhove (2016), Fernandez, Chiambaretto (2016)
2	Learning vs Organizing	Rigidity vs flexibility	Schmidt (2019), Tóth et al. (2018), Chou, Zolkiewski (2018), Vangen (2017), Pressey, Vanharanta (2016), Pajunen, Fang (2013)
3	Learning	Exploration vs exploitation	Rey-Garcia et al. (2021), Lannon, Walsh (2020), Remneland, Wikhamn (2020), Dooley, Gubbins (2019), Brown, Head (2019)
4	Organizing	Short-term vs long-term orientation	Tóth et al. (2018), Chou, Zolkiewski (2018), Pressey, Vanharanta (2016), Pajunen, Fang (2013)
5	Organizing	Unity vs diversity	Rey-Garcia et al. (2021), DeFillippi, Sydow (2016)
6	Performing	Autonomy vs accountability	Rey-Garcia et al. (2021), Dooley, Gubbins (2019), Vangen (2017)
7	Learning vs Belonging	Knowledge sharing vs knowledge protection	Huang, Chiu (2020), Rouyre, Fernandez (2019), Stadtler, Van Wassenhove (2016)
8	Performing vs Belonging	Value creation vs value appropriation	Best et al. (2021), Stefan et al. (2021), Remneland Wikhamn (2020), Niesten, Stefan (2019), Gillett et al. (2019), DeFillippi, Sydow (2016)
9	Performing vs organizing	Economic vs social logic	Best et al. (2021), Ahmadsimab, Chowdhury (2021), Gillett et al. (2019)
10	Organizing	Trust vs distrust	Pressey, Vanharanta (2016), Pajunen, Fang (2013)
11	Belonging	Centralization vs decentralization	van Duijn et al. (2021), Schmidt (2019)
12	Belonging vs Organizing	Goal congruence vs goal diversity	Rey-Garcia et al. (2021), Vangen (2017)
13	Performing	Information sharing vs information protection	Fernandez, Chiambaretto (2016)
14	Learning vs Performing	Temporary vs permanent	DeFillippi, Sydow (2016), Stjerne, Svejenova (2016)
15	Learning vs Organizing	Standard vs standard flexibility	DeFillippi, Sydow (2016)

MOST WIEDZY Downloaded from mostwiedzy.pl

16	Performing vs Belonging	Proximity vs distance	Zaheer, Hernandez (2011)
17	Organizing	Power vs trust	Horak, Long (2018)
18	Performing vs Organizing	Individualistic vs collective social structure	Dooley, Gubbins (2019)
19	Learning vs Belonging	External R&D vs internal R&D	Wang et al. (2017)
20	Learning vs Organizing	Complexity vs simplification	Vangen (2017)

Source: Own elaboration based on: Fortes et al., 2023; Smith, Lewis, 2011.

Presented groups and paradoxes describe tensions that managers have to deal with in their daily work. Paradox theory as opposed to the contingency theory doesn't propose one good solution for the tensions (Lawrence, Lorsch, 1967) but tries to organize work and treat tensions simultaneously (Smith, Lewis, 2011). The most frequently appearing paradoxes in the literature are the cooperation vs competition (Runge et al., 2022; Munten et al., 2022; Best et al., 2021; van Duijn et al., 2021; Rey-Garcia et al., 2021; Dooley, Gubbins, 2019; Tóth et al., 2018; Chou, Zolkiewski, 2018; Pressey, Vanharanta, 2016; Stadtler, Van Wassenhove, 2016; Fernandez, Chiambaretto, 2016), exploration vs exploitation (Rey-Garcia et al., 2021; Lannon, Walsh, 2020; Remneland, Wikhamn, 2020; Dooley, Gubbins, 2019; Brown, Head, 2019) and rigidity vs flexibility (Schmidt, 2019; Tóth et al., 2018; Chou, Zolkiewski, 2018; Vangen, 2017; Pressey, Vanharanta, 2016; Pajunen, Fang, 2013). Those three paradoxes are the most frequently typed paradoxes in organizational management literature. This 'popularity' can stem from the difficulties which they pose to managers.

In organizations in general and production organizations particularly, changes are caused by multiple factors, e.g. the change of the shareholders' vision, the fact that the material did not arrive or a customer changed the order. In this type of organizations the ECM process involves many departments, such as design, engineering and production. The purpose of this process is the implementation of changes that were provided in technical documentation and making it available to other departments. It is important to make the information available not only after the implementation of changes, but also during the process (Iakymenko et al., 2020). Each process has its owner (Dumas et al., 2013) and in the case of ECM, the role of the process owner is assigned to the project manager who in the case of the ECM process is called an engineering changes coordinator (Iakymenko et al., 2020). The engineering changes coordinator as a process owner is responsible for the shape of the process, its inputs and outputs. Engineering changes coordinators, just as all leaders in a company involved in the ECM process, are required to take decisions pertaining to the process for which they are responsible.

Groups of paradoxes defined in organizational management are also present in the ECM process. Table 3 includes paradoxes grouped into the four previously described categories that are specific to the ECM process.

MOST WIEDZY Downloaded from mostwiedzy.pl

Table 3.
Groups of the ECM paradoxes meaning

No.	Type of paradox	Meaning for ECM
1	Organizing	This type of tensions describes difference in change order approach and in the analysis of change order.
2	Learning	Change performance and searching for the answer about the origin of the change order.
3	Belonging	ECM deals with the different departments in the organization.
4	Performing	Performing tensions concerns different effects of the implemented changes

Source: Own elaboration.

As per the ECM process, the organizing type of paradox does not concern behaviors in an organization, but requires the analysis of approaching different types of engineering change orders. Learning paradoxes would pertain to analyzing the origins of each change order. As the ECM process involves multiple departments, belonging paradoxes are an essential issue. Those paradoxes pertain to tensions that exist between departments and tensions between a department and processes. The last described group are the performing paradoxes. This type pertains to different final effects of change implementation. It is about the speed of change implementation or about range of the informed group of stakeholders. Organizational tensions shown in Table 2 are also present in case of the ECM process. The difference between organizational paradoxes and ECM paradoxes will concern the main actors of the process. For example temporary vs permanent tension describes that temporary arising company emerges separately and then coordinates its action within a permanent organization (Braun, Lampel, 2020). In the case of the ECM process this paradox will involve the durability of a technical solution which is related with the speed of change implementation.

3. Material and methods

In our paper, we describe an exploratory study aimed at addressing the following research question: How can we identify, define, operationalize, and measure paradoxes in engineering change management (ECM)? Our objective is to compile a list of the most common tensions that arise in a manufacturing company and develop a tool for analyzing paradoxes within the ECM process.

To answer this research question, we conducted an exploratory qualitative study rooted in the interpretative-symbolic paradigm (Sułkowski, 2012) and employing an abductive approach (Peirce, 1931; 1958). We employed purposive sampling, selecting a Polish manufacturing company for our study. This company specializes in low-volume, high-mix production and has been a prominent player in the automotive market for over 30 years. With over 800 employees, approximately 95% of whom are either directly involved in production or closely linked to it, the company was an ideal candidate for our research. Furthermore, the company was actively

MOST WIEDZY Downloaded from mostwiedzy.pl

implementing the ECM process at the time of the study, making it a suitable choice for our investigation.

The research unfolded in three stages. The initial stage involved an exhaustive literature review aimed at conceptualizing paradoxes within the ECM process. We scoured Polish and English-language publications indexed in global databases, including the Web of Science, Scopus, and ProQuest. Based on this review, we compiled an initial list of paradoxes relevant to the ECM process.

The second stage sought to validate and expand upon the initial set of paradoxes through empirical research. To accomplish this, we conducted a pilot study that relied on in-depth, semi-structured personal interviews. The interviews explored four key themes: 1) Knowledge about ECM, 2) Previous experience with ECM, 3) Impact on the process implementation, and 4) Organizational and personal challenges encountered during ECM implementation at the analyzed company. During this phase, we chose not to directly address the paradoxes but rather to derive them abductively from the statements made by the respondents. The study encompassed a total of 31 employees from the selected company, representing various positions, including 2 specialists, 19 heads of divisions, 8 heads of departments, and 2 project managers. These respondents were all directly or indirectly involved in ECM. Interviews, lasting an average of 105 minutes each, guaranteed the confidentiality and anonymity of the participants. Conventional qualitative content analysis (Hsieh, Shannon, 2005) was the primary technique used for data analysis and interpretation.

The culmination of the first two stages resulted in the operationalization of paradoxes within the ECM process and the development of a measurement tool—an empirical differential scale. This scale was designed to assess perceived current and desired approaches to resolving paradoxes affecting ECM. Validation of this tool took place during the third stage of our research, involving in-depth personal interviews that directly addressed the developed set of paradoxes. Respondents were asked to share their experiences related to each presented paradox and provide their opinions on the occurrence of these paradoxes within the ECM process. In total, 15 employees from the selected company participated in this stage, representing various positions, including 2 specialists, 8 heads of divisions, 4 heads of departments, and 1 project manager.

The stages of research are summarized in Table 4.

MOST WIEDZY Downloaded from mostwiedzy.pl

Table 4.
Research stages.

Stage no.	Method	Purpose	Effect
Stage 1	Literature review	Identifying paradoxes that can be important in the ECM process.	A list of paradoxes that can be important in the ECM process.
Stage 2	In-depth, semi-structured personal interviews with 31 participants directly and indirectly involved in the ECM process (a pilot study)	Verifying and supplementing the identified set of paradoxes with additional paradoxes reported by the participants.	An enhanced and specific list of paradoxes which were the basis of creating a tool for measuring paradoxes in ECM.
Stage 3	In-depth, structured interviews involving 15 participants directly involved in the ECM process	Validating the measurement tool.	Information about the paradoxes that are the most prevalent in the ECM process.

Source: own elaboration.

4. Results

This section of the article includes the description of results obtained in the consecutive research stages presented before in the article. In Stage 1 (the literature review), the list of paradoxes and their types described in the management literature and summarized earlier in the article (Table 2) served as a basis for identifying paradoxes that can be important in the ECM process. The paradoxes identified by the authors during this process are included in Table 5. Tensions belonging to each of the four types of paradoxes (i.e. organizing, performing, learning, and belonging) were included. They were still general at this stage, but their identification facilitated the interpretation of the data obtained in the second stage.

Table 5.
Types of paradoxes in Engineering Changes Management

No.	Type of paradox	Example of tension in ECM process
1	Organizing	Formal information flow vs informal information flow
2		Efficiency of process vs flexibility of process
3	Organizing	Standard solution vs flexible solution
4		Planned change implementation vs emergent change implementation
5		Piecemeal view of change vs holistic view of change
6		Macro scale of change vs micro scale of change
7	Performing	Temporary solution vs permanent solution
8		Short-term solution vs long-term solution
9		Wide group of informed vs narrow group of informed
10	Learning	External searching of solution vs internal searching of solution
11		Problem solving vs cause searching
12	Belonging	Cooperation with all departments in company vs cooperation inside department
13		Personal good vs common good

Source: Own elaboration.

MOST WIEDZY Downloaded from mostwiedzy.pl

In the second stage of the research the further verification of the paradoxes took place. As has already been mentioned, at this stage, which was still exploratory, respondents were asked about their experiences related to the ECM process, but they were not directly asked about the previously identified paradoxes. This procedure was purposeful and was intended to enable exploring potential other paradoxes as they are perceived by those who participate in ECM processes on daily basis without limiting or biasing their answers. Rather, they were abductively derived from the obtained information. This allowed for the creation of a more specific list of paradoxes that is presented in Table 6. It includes the list of paradoxes considered by the authors as the most relevant in the ECM process. The letter "I" is used to mark those paradoxes that were identified during the interviews whereas the letter "L" refers to those that were identified in the literature analysis.

Table 6.
Final questions in the study

No.	Type of paradox	Example of paradox	Source: Literature (L), Interviews (I)	Given question
1	Learning	Exploration vs exploitation	L / I	Focusing on the existing products development vs Focusing on the searching new, convertible solutions.
2	Organizing	Macro vs micro	I	Changes implementation comprehensively, after coexisting elements analysis vs Changes implementation only in the chosen part after its identification.
3	Organizing	Trust vs distrust	L / I	Autonomy and self-solving the problem by employees vs Searching way to solve the problem with supervisor of department.
4	Learning and Organizing	Rigidity vs flexibility	L	Focusing on the flexible form of information transfer vs Focusing on the procedures of information transfer.
5	Organizing	Emergent vs planned	L / I	Changes implementation one by one vs Batching changes and implementation a few changes at the same time.
6	Learning and Organizing	Standard vs standard flexibility	L / I	Changes implementation whenever the engineering change request is register vs Consideration and analysis of each change request.
	Organizing	Emergent vs planned		
7	Performing	Autonomy vs accountability	L	Additional tasks avoidance and focusing on the basic responsibilities vs Additional tasks acceptance keeping in mind the common good.
8	Learning and Belonging	Knowledge sharing vs knowledge protection	L / I	Widely discussing results of changes vs Informing about results of changes only the most interested people.
9	Belonging	Centralization vs decentralization	L	Emphasis putting (in case of serial product) on the solution searching inside the company vs Emphasis putting (in case of serial product) on the solution searching outside the company.
10	Organizing	Short-term vs long-term orientation	L / I	Problems identifying with problem cause identification vs Problems identifying without problem cause identification.

MOST WIEDZY Downloaded from mostwiedzy.pl

Cont. table 6.

11	Performing and Belonging	Value creation vs value appropriation	L	New specialist hiring vs Looking for the specialist in existing staff.
12	Performing and Organizing	Individualistic vs collective social structure	L	Investing in the trainings to build the human potential vs Investing in new technologies to build market advantage.
13	Learning and Belonging	Knowledge sharing vs knowledge protection	L	Cooperation, due to product creation, with similar product portfolio companies vs New product creation independently.
	Performing	Autonomy vs accountability	L	

Source: Own elaboration.

The paradoxes presented in Table 5 were used to develop the measurement tool, which we consider an important outcome of the described process and our study. It was inspired by the semantic differential method (Osgood, 1957), which originated in psychology and is considered reliable and valid in social sciences. Typically, when this method is applied, respondents need to provide an answer on a scale anchored with bipolar adjectives (e.g. good – bad; strong–weak) indicating their attitude or the way they perceive a designated object. Since the introduction of the method, it has been widely used in the context of, for example, intercultural studies (e.g. Skrandies, Chiu, 2003), investigating the content of stereotypes (Kervyn et al., 2013), marketing research (e.g. Kriyantono, 2017) or possible future scenarios using horizon scanning (Hideg et al., 2021).

The original semantic differential technique involves bipolar adjectives belonging to three dimensions identified through factor analysis in Osgood's intercultural research (i.e. evaluation, potency, and activity). More recent studies used measures belonging to different underlying categories that were adjusted to specific study objectives. For example, Kim and Jung (2023) found a complex (six-factor) structure of people's attitudes towards Artificial Intelligence agents in their study that used the semantic differential. Following this general logic, we created our own tool to fit the needs of the current study.

In the process of developing the tool, we utilized the idea of presenting to respondents stimulus based on two bipolar options, which in this case were contradictory approaches to resolving problems that emerge when dealing with ECM (i.e. paradoxical tensions). They are included in the last column of Table 5. Each option presented as a scale's pole represents a rational and plausible action that cannot be followed simultaneously with its opposite. Such conflicting and rational approaches are at the heart of the emergence of organizational paradoxes (Jarzabkowski et al., 2013). Respondents were asked to indicate the perceived current state in the organization (how the tension is presently resolved) and the perceived desired state (how the tension should, in their opinion, be resolved). An example of the used questions is provided below and pertains to the paradox number 5 as listed in Table 5. Other paradoxes listed in this table have been included in the measurement tool in the same manner.

MOST WIEDZY Downloaded from mostwiedzy.pl

It is better to implement single changes one by one vs. It is better to batch changes and implement several at once.

What is the current state?

Single changes Batching changes

-5 0 5

What is the desired state?

Single changes Batching changes

-5 0 5

What should be done to obtain the desired state?

……
……
……

We decided to further verify the measurement tool with people with first-hand experience with the ECM process. During semi-structured interviews that had a broader focus and content, the participants were asked to indicate whether they encountered each of the identified paradoxes in their general professional activities and in the ECM process. Table 6 includes the percentages of participants who indicated that each of the 13 paradoxes was present in their professional activities.

The research has shown that 6 out of 13 defined paradoxes were indicated by at least half of the participants as experienced by them in the ECM process. They include paradoxes number 1, 2, 3, 5, 6, and 8 presented previously in Table 5. These paradoxes can be considered particularly important in ECM and thus should be given the most attention by people who manage or guide that process. Additional three paradoxes were identified by at least half of participants belonging to one of the study groups (but were not indicated by 50% of the total number of participant) – number 4, 10, and 12. Four other paradoxes were indicated as occurring in the ECM process less often. Even though each of the previously identified paradoxes was considered to be present in the process by at least one of the participants, some of them can be considered less prevalent. As the number of participants involved in the validation that took place in the last stage of the research was limited, the obtained results should be approached cautiously. Nevertheless, they can be considered valuable guidelines for verifying and further developing the designed measurement tool.

MOST WIEDZY Downloaded from mostwiedzy.pl

Table 7.
Questions in the study accuracy

Number of paradox	Overall score		Senior management		Specialists	
	General	ECM	General	ECM	General	ECM
1	53%	**73%**	63%	**75%**	43%	**71%**
2	67%	**80%**	75%	**75%**	57%	**86%**
3	80%	**53%**	75%	38%	86%	**71%**
4	60%	47%	63%	38%	57%	**57%**
5	53%	**67%**	63%	**63%**	43%	**71%**
6	60%	**80%**	63%	**75%**	57%	**86%**
7	33%	20%	38%	13%	29%	29%
8	53%	**60%**	75%	**63%**	29%	**57%**
9	47%	13%	75%	13%	14%	14%
10	53%	33%	75%	**50%**	29%	14%
11	60%	20%	63%	13%	57%	29%
12	60%	47%	75%	38%	43%	**57%**
13	33%	20%	50%	25%	14%	14%

Source: own elaboration.

5. Conclusions

Our paper contributes to the existing state of knowledge about ECM by conceptualizing and operationalizing paradoxes in this process. Although the theory of paradoxes is quite well described in the literature, it is used mostly in the context of organizational change management. Its potential in the context of ECM seems to be not sufficiently utilized. In fact, we are not aware of publications that directly linked the issues of paradoxes to the management and development of the ECM process.

Our study also provides practical implications, since – based on the conceptualization and operationalization performed – we have proposed a useful tool for measuring paradoxes in the ECM process. This is particularly useful for manufacturing companies, which can recognize areas for improvement on its basis. The proposed measurement tool can be particularly useful for human resources (HR) managers and chief operating officers (COOs), especially when describing the role of the change coordinator. Using the tool within a company can indicate areas in which need development or need special attention of the management team. It can also provide a useful basis for further discussions and informed decisions within a company because results have a potential to show different approaches to the same case represented by a management team, specialists and other co-workers.

There are also a few limitations to the study. The first was the small research sample. Actual shape of the tool was proposed based on the experience of a single company. This narrows the research perspective. The second, related limitation pertains to the particular organizational culture and structure of the selected company. These aspects may influence the

MOST WIEDZY Downloaded from mostwiedzy.pl

shape of the ECM process – number of stakeholders, involved departments, etc. It can also affect the nature of the paradoxes itself. Therefore, the created measurement tool containing a set of identified paradoxes should be treated as a starting point for further in-depth research, taking into account the participation of additional companies. It will be of value to verify the tool in companies with different models of production: mass, single-piece, or low-volume.

References

1. Ahmadsimab, A., Chowdhury, I. (2021). Managing Tensions and Divergent Institutional Logics in Firm–NPO Partnerships. *Journal of Business Ethics*, *168(3)*, 651-670. https://doi.org/10.1007/s10551-019-04265-x.
2. Best, B., Miller, K., McAdam, R., Moffett, S. (2021). Mission or margin? Using dynamic capabilities to manage tensions in social purpose organisations' business model innovation. *Journal of Business Research*, *125*, 643-657. https://doi.org/10.1016/j.jbusres.2020.01.068.
3. Braun, T., Lampel, J. (2020). Introduction: Tensions and Paradoxes in Temporary Organising: Mapping the Field. *Research in the Sociology of Organizations*, *67*, 1-13. https://doi.org/10.1108/s0733-558X20200000067.
4. Brown, P.R., Head, B.W. (2019). Navigating tensions in co-production: A missing link in leadership for public value. *Public Administration*, *97(2)*, 250-263. https://doi.org/10.1111/padm.12394.
5. Chou, H.-H., Zolkiewski, J. (2018). Coopetition and value creation and appropriation: The role of interdependencies, tensions and harmony. *Industrial Marketing Management*, *70*, 25-33. https://doi.org/10.1016/j.indmarman.2017.08.014.
6. Clegg, S.R., da Cunha, J.V., e Cunha, M.P. (2002). Management paradoxes: a relational view. *Human Relations*, *55(5)*, 483-503. https://doi.org/10.1177/0018726702555001.
7. DeFillippi, R., Sydow, J. (2016). Project Networks: Governance Choices and Paradoxical Tensions. *Project Management Journal*, *47(5)*, 6-17. https://doi.org/10.1177/875697281604700502.
8. Dumas, M., La Rosa, M., Mendling, J., Reijers, H.A. (2013). *Fundamentals of Business Process Management*. Berlin: Springer.
9. Eckert, C.M., Wynn, D.C., Maier, J.F., Albers, A., Bursac, N., Chen, H.L.X., Shapiro, D. (2017). On the integration of product and process models in engineering design. *Design Science*, *3(3)*, 1-41. https://doi.org/10.1017/dsj.2017.2.
10. Fernandez, A.-S., Chiambaretto, P. (2016). Managing tensions related to information in coopetition. *Industrial Marketing, Management*, *53(1)*, 66-76. https://doi.org/10.1016/j.indmarman.2015.11.010.

MOST WIEDZY Downloaded from mostwiedzy.pl

11. Fortes, M.V.B., Agostini, L., Wegner, D., Nosella, A. (2023). Paradoxes and Tensions in Interorganizational Relationships: A Systematic Literature Review. *Journal of Risk Financial Management*, *16(1),* 35. https://doi.org/10.3390/jrfm16010035.
12. Fortes, M.V.B., Agostini, L., Wegner, D., Nosella. A. (2023). Paradoxes and Tensions in Interorganizational Relationships: A Systematic Literature Review. *Journal of Risk and Financial Management*, *16(35)*, https://doi.org/10.3390/jrfm16010035.
13. Gillett, A., Loader, K., Doherty, B., Scott, J.M. (2019). An Examination of Tensions in a Hybrid Collaboration: A Longitudinal Study of an Empty Homes Project. *Journal of Business Ethics*, *157(4)*, 949-967. https://doi.org/10.1007/s10551-018-3962-7.
14. Hamraz, B., Caldwell, N.H.M., Clarkson, P.J. (2013). A Holistic Categorization Framework for Literature on Engineering Change Management. *Systems Engineering*, *16(4)*, 473-505. https://doi.org/10.1002/sys.21244.
15. Heiberg, J.J. (2018). The Paradox Types: Tensions in Organizing, Performance, Belonging, and Learning. *Paradox Management*, 93-127. https://doi.org/10.1007/978-3-319-94815-7_5.
16. Hideg, É., Mihók, B., Gáspár, J., Schmidt, P., Márton, A., Báldi, A. (2021). Assessment in horizon scanning by various stakeholder groups using Osgood's semantic differential scale–a methodological development. *Futures*, *126(2)*, 102677. https://doi.org/10.1016/j.futures.2020.102677.
17. Horak, S., Long, C.P. (2018). Dissolving the paradox: Toward a Yin–Yang perspective on the power and trust antagonism in collaborative business relationships. *Supply Chain Management*, *23(6)*, 573-590. https://doi.org/10.1108/SCM-01-2018-0013.
18. Hsieh, H.-F., Shannon, S.E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, *15(9)*, 1277-1288. https://doi.org/10.1177/10497323052766.
19. Huang, M.-C., Chiu, Y.-P. (2020). A knowledge tension perspective on management control and performance in international joint ventures. *Journal of International Management*, *26(4)*, 1-16. https://doi.org/10.1016/j.intman.2020.100797.
20. Iakymenko, N., Romsdal, A., Alfnes, E., Semini, M., Strandhagen, J.O. (2020). Status of engineering change management in the engineer-to-order production environment: insights from a multiple case study. *International Journal of Production Research*, 1-23. https://doi.org/10.1080/00207543.2020.1759836.
21. Ingram, A.E., Lewis, M.W., Barton, S., Gartner, W.B. (2014). Paradoxes and Innovation in Family Firms: The Role of Paradoxical Thinking. *Entrepreneurship Theory and Practice*, *40(1)*, 161-176. https://doi.org/10.1111/etap.12113.
22. Jarratt, T.A.W., Eckert, C.M., Caldwell, N.H.M., Clarkson, P.J. (2010). Engineering change: an overview and perspective on the literature. *Research in Engineering Design*, *22(2)*, 103-124. https://doi.org/10.1007/s00163-010-0097-y.

MOST WIEDZY Downloaded from mostwiedzy.pl

23. Jarzabkowski, P., Lê, J.K., Van de Ven, A.H. (2013). Responding to competing strategic demands: How organizing, belonging, and performing paradoxes coevolve. *Strategic Organization*, *11(3)*, 245-280. https://doi.org/10.1177/1476127013481016.
24. Kervyn, N., Fiske, S.T., Yzerbyt, V.Y. (2013). Integrating the stereotype content model (warmth and competence) and the Osgood semantic differential (evaluation, potency, and activity). *European Journal of Social Psychology*, *43(7)*, 673-681. https://doi.org/10.1002/ejsp.1978.
25. Kim, S., Jung, Y. (2023). Development of Semantic Differential Scales for Artificial Intelligence Agents. *International Journal of Social Robotics*, *15*, 1155-1167. https://doi.org/10.1007/s12369-023-01010-3.
26. Kriyantono, R. (2017). Consumers' Internal Meaning on Complementary Co-Branding Product by Using Osgood's Theory of Semantic Differential. *Journal of Management and Marketing Review*, *2(2)*, 57-63. https://doi.org/10.35609/jmmr.2017.2.2(9).
27. Lannon, J., Walsh, J.N. (2020). Paradoxes and partnerships: A study of knowledge exploration and exploitation in international development programmes. *Journal of Knowledge Management*, *24(1)*, 8-31. https://doi.org/10.1108/JKM-09-2018-0605.
28. Lawrence, D., Gubbins, C. (2019). Inter-organisational knowledge networks: Synthesising dialectic tensions of university-industry knowledge discovery. *Journal of Knowledge Management*, *23(1)*, 2113-2134. https://doi.org/10.1108/JKM-06-2018-0343.
29. Lawrence, P., Lorsch, J. (1967). *Organizations and environment: Managing differentiation and integration*. Irwin, Homewood: Harvard Business Review Press.
30. Lewis, M.W. (2000). Exploring Paradox: Toward a More Comprehensive Guide. *The Academy of Management Review*, *25(4)*, 760-776. https://doi.org/10.2307/259204.
31. Munten, P., Vanhamme, J., Maon, F., Swaen, V., Lindgreen, A. (2021). Addressing tensions in coopetition for sustainable innovation: Insights from the automotive industry. *Journal of Business Research*, *136(3)*, 10-20. https://doi.org/10.1016/j.jbusres.2021.07.020.
32. Niesten, E., Stefan, J. (2019). Embracing the Paradox of Interorganizational Value Co-creation–Value Capture: A Literature Review towards Paradox Resolution. *International Journal of Management Reviews*, *21(2)*, 231-255. https://doi.org/10.1111/ijmr.12196.
33. Osgood, C.E., Suci G.C., Tannenbaum, P.H. (1957). *The Measurement of meaning*. Urbana: University of Illinois Press.
34. Pajunen, K., Fang, L. (2013). Dialectical tensions and path dependence in international joint venture evolution and termination. *Asia Pacific Journal of Management*, *30(2)*, 577-600. https://doi.org/10.1007/s10490-011-9267-3.
35. Peirce, C.S. (1931, 1958). *Collected works*. Cambridge: Harvard University Press.
36. Poole, M.S., Van de Ven, A.H. (1989). Using Paradox to Build Management and Organization Theories. *Academy of Management Review*, *14(4)*, 562-578. https://doi.org/10.5465/amr.1989.4308389.

MOST WIEDZY Downloaded from mostwiedzy.pl

37. Pressey, A.D., Vanharanta, M. (2016). Dark network tensions and illicit forbearance: Exploring paradox and instability in illegal cartels. *Industrial Marketing Management*, *55*, 35-49. https://doi.org/10.1016/j.indmarman.2016.02.009.
38. Reddi, K.R., Moon, Y.B. (2013). Modelling engineering change management in a new product development supply chain. *International Journal of Production Research*, *51(17)*, 5271-5291. https://doi.org/10.1080/00207543.2013.807954.
39. Remneland Wikhamn, B. (2020). Open innovation change agents in large firms: How open innovation is enacted in paradoxical settings. *R and D Management*, *50(2)*, 198-211. https://doi.org/10.1111/radm.12389.
40. Rey-Garcia, M., Mato-Santiso, V., Felgueiras. A. (2021). Transitioning Collaborative Cross-Sector Business Models for Sustainability Innovation: Multilevel Tension Management as a Dynamic Capability. *Business and Society*, *60(5)*, 1132-1173. https://doi.org/10.1177/0007650320949822.
41. Rouyre, A., Fernandez, A.-S. (2019). Managing Knowledge Sharing-Protecting Tensions in Coupled Innovation Projects among Several Competitors. *California Management Review*, *62(1)*, 95-120. https://doi.org/10.1177/0008125619885151.
42. Runge, S., Schwens, C., Schulz, M. (2022). The invention performance implications of coopetition: How technological, geographical, and product market overlaps shape learning and competitive tension in R&D alliances. *Strategic Management Journal*, *43(2)*, 266-294. https://doi.org/10.1002/smj.3334.
43. Schad, J., Lewis, M.W., Raisch, S., Smith, W.K. (2016). Paradox Research in Management Science: Looking Back to Move Forward. *Academy of Management Annals*, *10(1)*, 5-64. https://doi.org/10.5465/19416520.2016.1162422.
44. Schmidt, A. (2019). Tensions and Dilemmas in Crisis Governance: Responding to Citizen Volunteers. *Administration and Society*, *51(7)*, 1171-1195. https://doi.org/10.1177/0095399719836734.
45. Sjögren, P., Fagerström, B., Kurdve, M., Lechler, T. (2019). Opportunity discovery in initiated and emergent change requests. *Design Science*, *5(5)*, 1-23. https://doi.org/10.1017/dsj.2019.4.
46. Skrandies, W., Chiu, M.J. (2003). Dimensions of affective semantic meaning—behavioral and evoked potential correlates in Chinese subjects. *Neuroscience Letters*, *341(1)*, 45-48. https://doi.org/10.1016/S0304-3940(03)00137-X.
47. Smith, W.K., Lewis, M.W. (2011). Toward a theory of paradox: A dynamic equilibrium model of organizing. *Academy of Management Review*, *36(2)*, 381-403. https://doi.org/10.5465/AMR.2011.59330958.
48. Stadtler, L., Van Wassenhove, L.N. (2016). Coopetition as a Paradox: Integrative Approaches in a Multi-Company, Cross-Sector Partnership. *Organization Studies*, *37(5)*, 655-685. https://doi.org/10.1177/0170840615622066.

MOST WIEDZY Downloaded from mostwiedzy.pl

49. Stjerne, I.S., Svejenova, S. (2016). Connecting Temporary and Permanent Organizing: Tensions and Boundary Work in Sequential Film Projects. *Organization Studies*, *37(12)*, 1771-1792. https://doi.org/10.1177/0170840616655492.
50. Sułkowski, Ł. (2012). *Epistemologia i metodologia zarządzania*. Warszawa: PWE.
51. Tabesh, P., Vera, D.M. (2020). Top managers' improvisational decision-making in crisis: a paradox perspective. *Management Decision*, *56(10)*, 2235-2256. https://doi.org/10.1108/MD-08-2020-1060.
52. Tavčar, J., Duhovnik, J. (2005). Engineering change management in individual and mass production. *Robotics and Computer-Integrated Manufacturing*, *21(3)*, 205-215. https://doi.org/10.1016/j.rcim.2004.07.017.
53. Tóth, Z., Peters, L.D., Pressey, A., Johnston, W.J. (2018). Tension in a value co-creation context: A network case study. *Industrial Marketing Management*, *70*, 34-45. https://doi.org/10.1016/j.indmarman.2017.08.015.
54. van Duijn, S., Bannink, D., Ybema, S. (2021). Working Toward Network Governance: Local Actors' Strategies for Navigating Tensions in Localized Health Care Governance. *Administration and Society*, *54(4)*, 660-689. https://doi.org/10.1177/00953997211033818.
55. Vangen, S. (2017). Developing Practice-Oriented Theory on Collaboration: A Paradox Lens. *Public Administration Review*, *77(2)*, 263-272. https://doi.org/10.1111/puar.12683.
56. Wang, T., Libaers, D., Park, H.D. (2017). The Paradox of Openness: How Product and Patenting Experience Affect R&D Sourcing in China? *Journal of Product Innovation Management*, *34(3)*, 250-268. https://doi.org/10.1111/jpim.12359.
57. Zaheer, A., Hernandez, E. (2011). The geographic scope of the MNC and its alliance portfolio: Resolving the paradox of distance. *Global Strategy Journal*, *1(1-2)*, 109-126. https://doi.org/10.1002/gsj.6.

MOST WIEDZY Downloaded from mostwiedzy.pl