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A Maturity Model for Intraorganizational Online Collaboration

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ABSTRACT

The capability to collaborate successfully within and between organizational units using online media supports organizations in addressing the increasing complexity of work tasks of knowledge workers. However, organizations are struggling to develop and sustain their intraorganizational online collaboration (IOC) capabilities organization-wide. Hence, holistic approaches to effectively manage this capability are needed. This paper addresses this problem by introducing a maturity model for intraorganizational online collaboration. The model builds on related maturity models and research of the domain. In a four-round ranking-type Delphi study, essential capability areas for IOC were identified and refined, and a general maturation path was developed. Compared to related maturity models, the presented maturity model addresses the specific domain focus of online collaboration within an organization from an organization-wide perspective. The model provides a framework for design elements for intraorganizational online collaboration and a highly reliable general maturation path.

KEYWORDS

Collaboration Capability, Collaboration Performance, Collaborative Problem-Solving, Delphi Study, E-Collaboration, Maturation Path, Online Collaboration, Online Teamwork, Ranking-Type Delphi

INTRODUCTION

The increasing complexity of work tasks of knowledge workers represents a central 21st-century challenge and requires collaborative knowledge work (Burrus et al., 2013; Graesser et al., 2018; Marsh et al., 2022; Nelson & Squires, 2017). Furthermore, organizations are confronted with large data quantities that need to be processed to distribute available information to relevant recipients. By utilizing digital technologies and actively engaging in the digital transformation process, organizations can address this challenge (Mergel et al., 2019; Vial, 2019). The effective use of technologies is crucial for organizations, and their ability to engage in intraorganizational online collaboration (IOC) must be addressed. Organizations across all sizes provide their employees with collaboration platforms to tackle these challenges (Moore, 2016).

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However, organizations struggle to establish IOC (Jansz, 2016; Kiron et al., 2016) as it exceeds providing the technical solution and must be addressed holistically, incorporating different perspectives (Mergel et al., 2019; Nitschke et al., 2019; Orellana, 2017; Puklavec et al., 2018; Reeb, Dilefeld, et al., 2021). Therefore, control tools for IOC should be implemented to provide a more objective and universal view of the organization's status and identify problem areas (Chenhall, 2003; Langfield-Smith, 1997). One approach is maturity models (MM), which have already been applied in related domains (Alonso et al., 2010; Boughzala & Vreede, 2012; Friedrich et al., 2016; Jansz, 2016; Magdaleno et al., 2008).

However, existing models differ in several aspects like domain focus (Boughzala & Vreede, 2012; Jansz, 2016), target audience, and perspective (Friedrich et al., 2016). Furthermore, new findings and developments have emerged over the past decade (Reeb, Clauss, et al., 2021). Accordingly, the question arises how an MM for IOC can be designed.

This study explores the future of online collaborative work within organizations focused on knowledge work by developing an intraorganizational online collaboration maturity model (IOC-MM). Therefore, relevant aspects, summarized in capability areas that an organization must consider when designing IOC, are explored. Given the complexity of the domain, it is crucial to provide organizations with a maturity path, enabling them to derive their current state and the resulting opportunity for improvement.

Following the guidelines for MM development by Becker et al. (2009), related MMs are identified and used for initial model development. The literature-based capability areas are evaluated and refined by a modified ranking-type Delphi approach, and a maturation path is developed. The Delphi method was chosen because its iterative approach fits the goal of identifying and narrowing down essential capability areas and developing a corresponding maturity path. The result is an IOC-MM corresponding to the basic MM design principles (DP) according to Pöppelbuß and Röglinger (2011). This results in two central research questions for this paper:

- What capability areas are relevant (important and impactful) for effectively implementing IOC in an organization?
- How is a general maturation path for effectively implementing IOC in an organization designed?

THEORETICAL BACKGROUND

Intraorganizational Online Collaboration

Various terms for IOC exist (e.g., virtual collaboration, e-collaboration, smart collaboration), which are not consistently used in the literature and are therefore partly used synonymously or differently (Chi et al., 2016; Godin et al., 2017; Reeb, Clauss, et al., 2021; Rosenzweig, 2009; Ubell, 2011). All represent collaborative processes utilizing electronic media in business or education. This paper's underlying understanding is presented below, and a definition is provided to delimit IOC and the research domain.

Schrage (1990) defines collaboration as a "process of shared creation: two or more individuals with complementary skills interacting to create a shared understanding that none had previously processed or could have come to on their own. Collaboration creates a shared meaning about a process, a product, or event". To better understand what IOC is, it is beneficial to look at the dimensions of time and space (Johansen, 1991) and delineate what collaboration is not. Collaboration is repeatedly distinguished from cooperation relating to the interaction time (Dillenbourg, 1999; Haythornthwaite, 2006; Lee & Paine, 2015; Neumayr et al., 2018).

Cooperation refers to assigning tasks to participants, independently working on them, and creating a final product by aligning the individual parts (Holsapple & Joshi, 2000). On the other hand, collaboration is referred to as synchronous coordinated actions or interactions (Azab, 2013;

Haythornthwaite, 2006; Holsapple & Joshi, 2000). This distinction is not as simple as it first appears, as there is a continuum between synchronous and asynchronous (Lee & Paine, 2015; Neumayr et al., 2018). Hence, collaboration can be viewed as a continuous coordination process of various interactions reaching from synchronous to asynchronous (Lee & Paine, 2015). Continuous interaction is considered more fitting as a distinction than synchronous interaction.

Due to the COVID-19 pandemic, scholars have focused on the dimension space and its importance in recent years (Marsh et al., 2022; Reindl et al., 2022; Tønnessen et al., 2021). The space dimension can be differentiated into the same (co-located) or different (remote) place (Johansen, 1991; Neumayr et al., 2018). Neumayr et al. (2018) argue that the space dimension should be viewed as a continuum, as collaborators can change their location or be partially co-located and remote at the same time. The term online was used to differentiate it from pure remote collaboration (e.g., virtual collaboration, e-collaboration). Accordingly, hybrid collaboration settings are deliberately included in the dimension of space. Hence, space is seen as the place through which at least part of the data and interaction exchange occurs. This space is set to be online for IOC to enable a flexible and physical independent collaborative work setting.

Lastly, collaboration can happen between different organizational units, e.g., teams or organizations. This paper focuses on online collaboration within one organization. While common goals between organizations can lead to inter-organizational collaboration, an organization should be naturally connected by common goals and collaborate intraorganizational (Chudoba et al., 2005).

Thus, the term intraorganizational online collaboration is proposed, which summarizes the above-discussed analysis and the relevant research domain of this article. IOC describes a creation process, in which at least two people work toward common goals through continuous interaction within an online environment and organization.

Maturity Model

Applying a corresponding maturity model for IOC enables companies to determine their current development state, identify improvement potential and implement respective actions (Mettler, 2011; Pöppelbuß & Röglinger, 2011). A MM describes the development of capabilities for a domain in a discrete sequence of maturity levels (Becker et al., 2009; Stelzl et al., 2020). MMs consist of several central constructs for which no uniform terminology exists in the literature (Bley et al., 2020; Lasrado et al., 2015; Stelzl et al., 2020). Therefore, an understanding of the terminology used in this paper relating to the MM meta-model by Bley et al. (2020) is shown in Table 1.

Initial IOC Maturity Model

In this paper, a domain-specific MM for IOC following the design principles by Pöppelbuß and Röglinger (2011) is developed. Pöppelbuß and Röglinger (2011) distinguish between basic, descriptive,

Table 1. Terminology and understanding of central MM constructs

Used terminology for construct	Construct according to Bley et al. (2020)	Understanding of construct
domain	domain	field of analysis of the model
maturity level	maturity level	organizational maturity rank as an archetypal representation of attributes and conditions of a development stage
dimension	dimension	area of interest representing a coherent group of capability area
capability area	factor	object of investigation combining various facets of a content-related area
characteristic	indicator	intended condition as a measurable trait of a capability area contributing to a significant improvement

and prescriptive DP, which are sequential and extend the functionality of the MM. Hence, this paper investigates the field of IOC and elaborates on fundamental MM elements according to the basic DPs. The scope of the intended model is presented hereafter.

The MM is intended for all types of organizations, focusing on knowledge work and providing a framework for adapting a top-down management tool for IOC. Hence, it is supposed to report aggregated and analyzed data from the operative collaborative working process within the organization to managers on the organizational and team level. Further research can utilize this fundamental MM to extend its functionalities for descriptive and prescriptive use to provide organizations with a framework for assessing and improving their IOC capabilities.

Following the scope, the constructs maturity level, dimensions, capability areas, and maturation path are elicited in this paper, focusing on the maturation path. According to the methodological approach for MM development of Becker et al. (2009), related MMs are analyzed. In this regard, a study by Reeb, Dilefeld, et al. (2021), who analyzed MMs for collaboration, is used.

This publication identified five MMs with different strengths and weaknesses that could benefit an IOC-MM. An examination of the models showed that four focus not exclusively on IOC but also on offline (Boughzala & Vreede, 2012; Magdaleno et al., 2008) or inter-organizational (Alonso et al., 2010; Jansz, 2016) collaboration. The MM by Friedrich et al. (2016) concentrates on IOC. However, it focuses on the team level and excludes the organizational perspective. Furthermore, Reeb, Dilefeld, et al. (2021) identified the MM of Jansz (2016) as a particularly appropriate foundation due to its complexity and primary shortcomings in practicality and comprehensibility.

Hence, the MM by Jansz (2016) is used as the structural basis for the development process. Additionally, the CMMI (Team CMMI Product, 2006) is investigated and utilized as it builds the foundation of Jansz (2016). Following the CMMI, it was defined to use equivalent staging for the maturation path. Applying this approach enables organizations to continuously assess and improve on a detailed level with the possibility of a staged maturity presentation (Team CMMI Product, 2006). Following Jansz (2016), maturity and capability levels are proportional. Only the capability areas (CA) assigned to the maturity level (ML) are relevant and must achieve the corresponding capability level (CL) (e.g., ML 3 is reached when all CAs assigned to ML 1, 2, and 3 reach CL 3). The structural separation into five ML with five CL and the fifth ML containing no additional capability areas is adopted from Jansz (2016). Based on this study's findings, a description is derived for each ML, presented in Table 5 in the section Capability Area Refinement. Although the construct characteristics are used to elaborate the capability areas, the characteristics are not evaluated and examined from a practical perspective and explored regarding their operationalization as metrics. Consequently, the design of the CL is not part of this research contribution and should be considered in a prescriptive extension of the model.

Although the MM by Jansz (2016) was identified as a suitable basis for the model content, new developments in the IOC domain occurred within the last decade (Reeb, Clauss, et al., 2021), which need to be considered. Accordingly, the literature reviewed by Reeb, Clauss, et al. (2021) (limited to literature since 2011) and five MMs were analyzed to develop an initial literature-based model. Hence, according to Elo and Kyngäs (2008), a content analysis was conducted to identify IOC-specific characteristics and group them into corresponding capability areas.

Table 2 provides an overview of the capability areas and respective exemplary sources from which characteristics were elaborated. Furthermore, the capability areas are clustered in dimensions to improve comprehensibility (Cowan, 2001). The capability areas marked with a * are part of the final MM and are described in Table 5. The initial MM with the detailed review is presented as a list of capability areas and corresponding characteristics and sources in Online Appendix OA1. In addition, after the Delphi study was conducted, the literature was reviewed for new findings that were not included in the initial maturity model (Online Appendix OA1), using the search string by Reeb, Clauss, et al. (2021). The identified literature is consistent with the capability areas and goals of the initial maturity model and provides complementary information for some goals (e.g., Chatterjee et al.

Table 2. Sources and elements of the initial IOC-MM

Dimension	Capability Area	Magdaleno et al. (2008)	Boughzala and Vreede (2012)	Alonso et al. (2010)	Friedrich et al. (2016)	Jansz (2016)	Exemplary additional sources
Strategy and Change	Collaboration Vision*		X			X	Chaudhuri (2015), Guinan et al. (2014), Uysal (2016)
	Targeted tool usage*			X		X	Ovcak (2017), Großer and Baumöl (2017), Bitzer and Werther (2019)
	Change Management*	X	X	X		X	Morley et al. (2015), Aboelmaged (2018), Ovcak (2017),
	Data-driven optimization*			X		X	Pillet and Carillo (2016), Langen (2015), Cetto et al. (2018)
Processes and Structure	Information Management*		X		X	X	Anders (2016), Kalra and Baral (2019), Kauffeld et al. (2016)
	Teamwork*		X	X	X	X	Chastain and Nathan-Roberts (2016), Kauffeld et al. (2016), Uysal (2016)
	Meetings				X	X	Anders (2016), Kolberg et al. (2013), Siegel and Madni (2019)
	Organizational structure*					X	Hill and Bartol (2016), Sievert and Scholz (2017), Bettoni et al. (2016)
	Flexibility	X				X	Aboelmaged (2018), Kauffeld et al. (2016), Quack (2013)
Technology and Infrastructure	Software Design			X		X	Anders (2016), Ovcak (2017), Kolberg et al. (2013)
	Infrastructure*					X	Wilms et al. (2019), Bitzer and Werther (2019), Kauffeld et al. (2016)
	System interoperability*			X		X	Kolberg et al. (2013), Bitzer and Werther (2019), Wu (2019)
	System security*			X		X	Kauffeld et al. (2016), Alreshidi et al. (2018), Wilms et al. (2019)
	Support				X	X	Cetto et al. (2018), Wilms et al. (2019), Schulze and Krumm (2017)
Employee and Culture	Employee competencies*			X		X	Anders (2016), Guinan et al. (2014), Hill and Bartol (2016)
	Motivation*	X	X		X	X	Aboelmaged (2018), Pillet and Carillo (2016), Kalra and Baral (2019)
	Mindset*			X	X	X	Sievert and Scholz (2017), Kalra and Baral (2019), Anders (2016)
	Participation	X				X	Anders (2016), Guinan et al. (2014), Eisenberg and Krishnan (2018)
	Individual support	X				X	Hill and Bartol (2016), Kauffeld et al. (2016), Guinan et al. (2014)

* Capability Areas that are integrated into the final IOC-MM

(2022) – employee competencies, motivation, and individual support, ' (2022) – teamwork, mindset, and participation, Horsley and Anton (2022) – teamwork, flexibility, mindset and individual support, Sjølie et al. (2022) – targeted tool usage, change management, teamwork, and flexibility, Martin and Borup (2022) – information management, and individual support, Szelwach and Matthews (2021) – change management, teamwork, meetings, infrastructure, support, and participation).

An adequate and reliable development by a literature review is unlikely beyond the structural depth of the dimension, argues de Bruin et al. (2005). Thus, the theoretical elaborations must be evaluated and refined to obtain reliable results. Given the complexity, an analysis of the characteristic construct is of limited feasibility and should be carried out separately for individual capability areas. A detailed examination of the capability areas should build on the descriptive DPs by Pöppelbuß and Röglinger (2011) to enable an assessability. Furthermore, Jansz (2016) identified four types of organizations that differ in their maturation path from the general one. To provide preliminary indications of whether these types apply to IOC were examined in the last round.

RESEARCH DESIGN

Central Design Decisions

This paper aims to develop a maturation path and refine and evaluate the developed capability areas. An empirical approach is pursued to obtain this objective as a literature-based development beyond the dimension layer is unlikely (de Bruin et al., 2005). The Delphi method was selected to incorporate the research topic's complexity, recent empirical insights (e.g., caused by the COVID-19 pandemic), and different perspectives. This approach is suitable for tackling weaknesses in the development process (Pereira & Serrano, 2020), exploring and presenting complex issues (Okoli & Pawlowski, 2004), combining different perspectives (de Bruin et al., 2005) without creating social pressure bias (McKenna, 1994; Rowe & Wright, 1999), and in areas with a shortage of empirical evidence (Murphy et al., 1998).

Given the primary objective of creating a development path, a modified ranking-type Delphi is applied, comprising the brainstorming, narrowing-down, and ranking phase (Delbecq et al., 1975; Paré et al., 2013; Schmidt, 1997). Following the research design by Schriek et al. (2016), the ranking type was chosen to develop the maturation path as it represents the relative importance of the capability areas within a maturity model. Although the constructs dimension and capability area are derived from the literature, the phases of brainstorming and narrowing-down are used to refine and evaluate these constructs. This step facilitates the integration of the latest insights and a more precise and consistent understanding of the capability areas across all experts, improving the model's practicality. The study's design process is primarily based on the analysis and findings of Paré et al. (2013).

A knowledge resource nomination worksheet (Delbecq et al., 1975; Okoli & Pawlowski, 2004) was used to select experts in a reproducible and transparent procedure based on defined criteria, through which 60 potential German-speaking experts were identified. The experts were contacted via e-mail and given a short introductory questionnaire to validate their expertise and ensure their interest and enduring participation. Furthermore, they were asked to nominate other potential experts to identify additional ones through personal networks. Regarding their knowledge background, the experts were divided into the groups "academics "(A), "practitioners with academic experience "(PA), and "practitioners "(P). Experts from groups A and PA have several to many years of experience in research, a doctoral degree or higher. Additionally, experts from groups PA and P have several to many years of experience in the IOC domain and actively design IOC within their occupation. To ensure a proficient and practical IOC knowledge base, in the introduction survey, all invited experts indicated on average a good to very good knowledge across all dimensions and collaborate with their colleagues via online media on at least 80% of the working days. To minimize linguistic

misunderstandings (since communication is conducted in writing), all experts are German native speakers and have international work experience to ensure generalizability.

As various suggestions regarding the panel size can be found (Dalkey & Helmer, 1963; Delbecq et al., 1975; Linstone et al., 1975), an overall of ten to 15 experts with an initially equal distribution across the expert groups was intended. Nineteen of the introductory questionnaire participants were identified as adequate experts and invited to the Delphi study, with a response rate of 74%. The distribution of experts across the groups throughout the Delphi study is shown in Table 3, with a continuous decrease from 14 to ten experts.

A maximum and a minimum number of iterations and stopping rules were defined to achieve an adequate level of consensus. As the study is structured into brainstorming (B), narrowing down (ND), and ranking (R), each phase comprises at least one iteration and a maximum of over all five rounds. For the brainstorming and narrowing down phase, it was assumed that one round would be sufficient. The experts were provided with the literature-derived model's dimensions and capability areas to achieve sufficient data within one round of brainstorming. Schmidt's (1997) recommendation of 20 or fewer items for a ranking was followed as a stopping rule for the narrowing down phase. Furthermore, the decision was made that in need of a second round, the second narrowing down round and first ranking round would be conducted in one questionnaire. Although one round was sufficient, through a modification (compare Pretest and Modification (Rounds 3 and 4)), a content-related item reduction (merging capability areas) occurred in round three. Hence, the results of round three were first reduced and then analyzed. As different data sets were used for one construct, assumptions needed to be made, leading to a certain bias. It was set that the ranking phase comprises at least two rounds as the primary part of the study, and the experts should have the possibility to adjust their opinion to the deliberations of other experts. Furthermore, the ranking should be stopped when a Kendell`s W of 0.8 is achieved, representing a reliable high agreement, or after the third round.

Following Paré et al. (2013), all rounds followed a similar structure of:

- sending a knowledge base (theoretical input and/or results of the last round) to the experts
- time for optional feedback/ comments/ questions on the knowledge base
- sending instructions and surveys to the experts
- receiving survey results
- aggregating results

By following this structure, each expert is provided with aggregated feedback on the panel's opinions through an iterative process, securing the anonymity of each expert as they never receive information on a personal level.

Brainstorming (Round 1)

A comprehensive overview of the capability areas was compiled to define the development path in the brainstorming phase. The experts were first asked to list as many capability areas as possible for the different dimensions without further guidance to reduce the influence bias (e.g., creativity). Furthermore, they were asked to illustrate their understanding of the capability areas by describing

Table 3. Panel composition throughout the Delphi study

Group	Round 1	Round 2	Round 3	Round 4
Academics	5	5	3	3
Practitioners with academic experience	4	3	3	3
Practitioners	5	5	4	4

the associated characteristics as goals. Afterward, the experts were asked to reflect on the capability areas to reduce the number of rounds and evaluate the initial model by stating if the capability area should be kept or deleted and adding further characteristics. If more than 60% stated this answer, the capability area was kept.

The results were coded using an inductive content analysis following Elo and Kyngäs (2008). The results were then compared with the theoretical model to identify additional or restructured capability areas. The consolidated list of capability areas and their characteristics was sent to the experts. Before sending the following questionnaire for narrowing down, the experts were given one week to review the results and feedback differing opinions.

Narrowing Down (Round 2)

As only vital aspects of designing IOC should be incorporated into the MM, the capability areas were narrowed down based on their importance and impact. The experts were asked two independent questions on the importance and impact. First, they were provided with a randomly ordered list of the capability areas and asked to rank them regarding their importance for designing IOC. Secondly, they were asked to provide their assessment of the impact of designing IOC using a five-point Likert scale. If the mean rank is in the lower third (14 – 21) and the mean value of the impact is below three, the capability area is considered not vital and was eliminated for further iterations. This decision was validated in the next round by asking whether the capability areas should be kept or deleted.

Pretest and Modification (Rounds 3 and 4)

As the primary objective of this research is to define a validated development path, a pretest with six participants was conducted for the ranking phase. The pretested questionnaire was composed as a greenfield approach regarding the development path, providing the list of capability areas, their respective characteristics, and the number of maturity levels. Resulting from this pretest, it was evident that designing a complete development path without further information is too complex and overcharging, and a compact understanding of the capability areas is needed. Hence, the questionnaire was redesigned by providing an initial development path. Furthermore, a description of each capability area is provided to recall the panels' opinions and increase the construct validity.

As some comments regarding clarity and differing understanding of some capability areas occurred, a decision was made to use the recalling part to refine the understanding of the capability areas. Hence, the ranking phase was modified by including an initial part for refining the content aspects using a classical Delphi approach. The experts were presented with a description of each capability area's understanding and asked to rate them regarding their characteristics on a five-point Likert scale. Furthermore, they were asked to comment on what should be adjusted to achieve a more characterizing and complete description.

Ranking (Rounds 3 and 4)

The experts were asked if they would use or recommend using the development path to elaborate on the practicability. Furthermore, they were asked to rank the capability areas to refine the development path and comment on their decisions. As each capability area must be allocated to one maturity level, a ranking with ties and four ranks (=four maturity levels with new capability areas) was used. The mean rank and Kendall's W were analyzed to aggregate the results and give the experts feedback on the results. Furthermore, the experts were provided with their responses and a summary of the comments, and an interpretation of Kendall's W (Schmidt, 1997; Skinner et al., 2015). Additionally, in the fourth round, four specific company types for collaboration from the literature were presented and evaluated whether the general development path differs.

RESULTS

Overview

A summary of the key outcomes of the Delphi study is provided in Table 4. All findings are initially in German and are translated into English for this paper. Some increase in the description satisfaction of the CAs from round three to four is due to linguistic improvements, as no content-related comments occurred. Hence, the presented descriptions in Table 5 might have a slightly lower satisfaction due to a translation bias.

The study started with 19 CAs from the literature and extended to 21 through the brainstorming phase. These were reduced to the 17 with the most importance and impact. As a result of content-related considerations, four CAs have been restructured, resulting in the 15 CAs within four dimensions illustrated in Figure 1. These 15 CAs were evaluated and refined regarding their content description. The results show that a rating of 4.4 out of 5 was obtained. Hence, high satisfaction and agreement between the experts regarding the content of the relevant CAs were achieved. Finally, the 15 CAs were used to develop a maturation path on which a high consensus (0.8) was reached, ending the Delphi study as the stopping rule was met. Furthermore, in the fourth round, 60% of the experts reported using the maturation path unchanged, and 40% reported using it with minor changes. This is a significant improvement over the third round, as 80% of experts would have used the proposal with minor changes and 20% with significant changes.

CAPABILITY AREA REFINEMENT

A table of IOC characteristics of a mature organization was created by analyzing the results of the brainstorming phase. These are structured into dimensions and capability areas and are presented in Online Appendix OA2. All literature-based capability areas were confirmed to be relevant for IOC. Four further capability areas (digital leadership, financial resources, community management, learning process chains) were identified and four capability areas were restructured into two (IT support and individual support into support system; teamwork and meeting into teamwork).

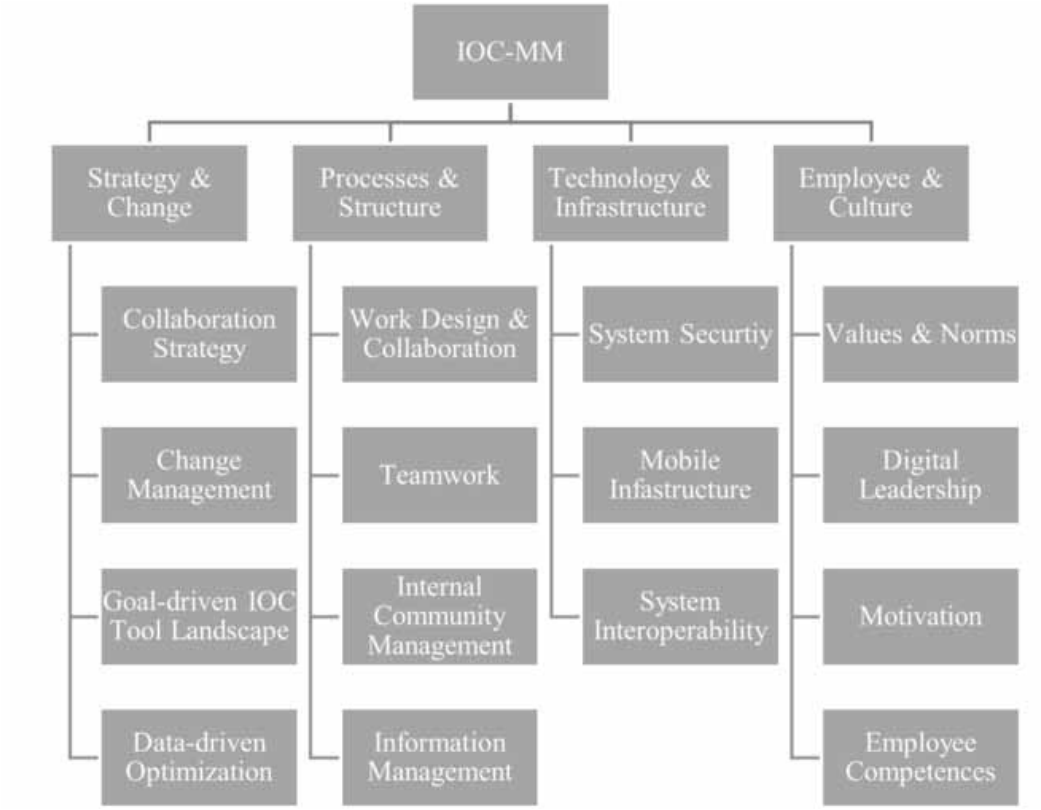
These findings functioned as a base for the narrowing down phase and were refined using descriptions. Four of the twenty-one capability areas did not reach the set threshold of importance

Table 4. Results overview of the Delphi study

Round	1 (B)	2 (N)	3 (R)	4 (R)
Number of complete responses	14	13	10	10
Number of capability areas**	19*	21	17	15
Satisfaction capability area description overall (mean)***	-	-	3.9****	4.4
Satisfaction capability area description overall (standard deviation)***	-	-	1.0****	0.8
Kendell´s W maturation path	-	-	0.72	0.80
Use/ Recommend maturation path as-is	-	-	0%	60%

B – brainstorming
N – narrowing down
R – ranking
* from theory
** beginning of the round
*** likert scale 1 to 5
**** two additional experts answered this part

Figure 1. Overview of the IOC-MMs´ capability areas



and impact and were excluded (support system, flexibility, financial resources, learning process chains). Throughout the refining process in the third round, four capability areas were restructured into two (motivation + involvement ® motivation; goal-driven tool application + software design ® goal-driven IOC tool landscape), as their content overlapped, leading to a final number of 15 capability areas for the ranking phase. Furthermore, four capability areas were renamed (collaborative vision ® collaborative strategy; infrastructure ® mobile infrastructure; mindset ® values and norms; organization structure ® Work Design & Collaboration). Furthermore, the experts evaluated and confirmed each restructuring and exclusion of a capability area in the following round.

This final list of capability areas and a description is shown in Table 5, along with the experts' final votes in the refining process. For this study, the capability areas represent an intermediate outcome and a secondary contribution, which enabled the derivation of a development path.

MATURATION PATH

The experts assigned the CAs to a maturity level over two rounds to develop the maturation path. The results were combined with the theoretical consideration of a proportional relation between CL and ML (Jansz, 2016) and are shown in Table 6. The mean level indicates which ML the experts assigned the CA on average. As the degree of consensus was calculated using Kendell's W, a rank was calculated for each expert (ranking ties by mean), resulting in the mean rank across all experts. Although the narrowing down phase was finished, the with * marked CAs were restructured in the

Table 5. Description of the IOC-MMs´ capability areas

Capability area (Description Satisfaction Mean / SD)	*Description*
Collaboration Strategy (4.6 /1.0)	The organization has developed a collaboration strategy that describes the future of online communication and collaboration within the organization. The employees understand the strategy and have internalized it. Operational goals are derived from the strategy and continuously adapted to current developments.
Change Management (4.5 / 0.7)	A targeted, holistic development process of the organization's IOC capability exists, aligned with the collaboration strategy. Employees are involved in the development and change process, informed about the value proposition and participate proactively in the change process. Responsibilities are known throughout the organization, and changes are sustainably embedded. Guidelines and recommendations for collaboration are continuously developed, and problems are actively addressed.
Goal-driven IOC Tool Landscape (4.3 / 0.9)	The organization has implemented online collaboration tools based on the functional requirements of the employees. The organization regularly analyzes and reflects on the current tool landscape regarding continuously updated requirements and possible applications for IOC and adapts them if necessary. The organization ensures that the tool selection is known company-wide. The employees are aware of the benefits and usage possibilities and can make a tool selection that aligns with the role profile. The employees can use these to increase mobile teamwork, independent of location and device.
Data-driven Optimization (4.5 / 0.5)	The organization has a data-based control system for IOC (e.g., based on people analytics), which is part of the overall corporate control. Different data types and data collection and analysis methods are used to identify potentials. The findings and potentials for improving IOC are communicated to decision-makers and stakeholders.
Work Design & Collaboration (4.3 / 0.7)	The organization has developed an IOC-fostering structure reflecting a goal and topic alignment limited to the most necessary hierarchical depth. The employees can work in a self-organized manner at the lower levels of the hierarchy through decentralized decision-making processes (scope according to the organization's specifics) and have established specific roles along the organizational structure to promote collaboration.
Teamwork (4.5 / 0.7)	Teams in the organization structure themselves for IOC, in a targeted, heterogeneous manner and in line with competency requirements. Teams network and support each other (e.g., via communities). They have the freedom to design IOC and manage their competence development, goal orientation and processes independently. Collaboration practices are developed within teams, are aligned with the collaboration strategy and shared throughout the organization.
Internal Community Management (4.4 / 0.7)	The organization has defined requirements and processes for networking and knowledge sharing. The employees are familiar with the organization's internal online community functions and content. Internal community management facilitates internal community planning, establishing, operating, and growing and provides targeted, phase-specific support to promote proactive participation and communication. Specifically trained employees for internal community management are available.
Information Management (4.5 / 0.8)	The handling of information is described in the organization. The organization has defined suitable system infrastructure and processes for maintaining and structuring information and has established appropriate methods for searching and structuring information, and a digital content management system exists.
System Security (4.5 / 0.7)	The organization continuously reviews and incorporates legal regulations for the IT landscape regarding system security and ensures unauthorized external access prevention. IOC requirements are included in the IT governance, and the employees are aware of them and their responsibility.
Mobile Infrastructure (4.6 / 0.7)	Employees are provided with a portable technological infrastructure for IOC that is largely independent of spatial restrictions. Workplaces are designed for flexible and hybrid working.
System Interoperability (4.1 / 0.7)	The organization has clustered all online collaboration tools and linked them in the company-wide information infrastructure in a meaningful way and is continuously checking for necessary changes. The platform offers interfaces to other IT systems in the organization, and the application systems are interoperable.
Values and Norms (4.3 / 0.9)	The organization has a corporate culture that promotes IOC, and the employees are willing and trustful to share knowledge and change. IOC values and norms (e.g., transparency, openness, fault tolerance, willingness to learn) are defined, transparently presented and known to the employees. Employees reflect on their behavior regarding the organization's aspired values.
Digital Leadership (4.4 / 0.8)	The organization's leaders embody IOC values and promote IOC through digital leadership and collaboration practices. Leaders are trained through individual and specific support and education programs and acquire the required competencies (e.g., open to digital innovations, situational & participative leadership style) to lead successfully and purposefully in the digital space.
Motivation (4.6 / 0.5)	Incentive and reward systems with extrinsic and intrinsic elements exist to support the willingness and motivation to collaborate. The organization actively involves all employees in designing the collaboration strategy, goal setting and collaboration practices and encourages new ideas. Employees' willingness to experiment and sustainably deal with new opportunities is fostered.
Employee Competences (3.9 / 0.9)	The organization develops customized training plans to support and develop each employee's required technical, cultural and functional IOC competencies. Employees have the skills and time flexibility to collaborate online and learn from each other informally. Critical competencies for successful IOC are considered as early as the hiring process.

third round. Hence, the assumption was made that the restructured CAs are equal to the mean of the respective original CAs.

After the third round, some CA (e.g., motivation) could not be conclusively assigned to one ML. The tendency towards one ML comparing the third to the fourth round was used to decide on the final ML. As a result, three CAs were assigned to ML 1, seven to ML 2, four to ML 3, and one to ML 4. A very high agreement between the experts (Kendall's W 0.8) and thus high confidence in the ranks was achieved (Schmidt, 1997; Skinner et al., 2015).

Finally, the maturation path with the corresponding descriptions of the assigned capability areas was used to develop a description for each maturity level. Each ML was assigned a scale for an immediate indication of the current maturity status. Furthermore, following Jansz (2016), ML 0 was added for organizations unaware of or not addressing IOC. The ML and their descriptions are presented in Table 7.

DEVIATING ORGANIZATION TYPES

Finally, the maturation path was evaluated regarding its suitability for specific organization types from the literature. The experts were provided with a description of the organization types following Jansz (2016). Table 8 shows the experts' assessment of a deviating maturation path for the respective organization type. The elaborated maturation path is fitting for small or medium-sized manufacturing/ service organizations and knowledge-based organizations. The results indicate ambiguous opinions regarding automated, factory-like / processing organizations and innovative small organizations, with the latter tending to follow a divergent maturation path. Accordingly, further studies are called for to ascertain how deviating maturation paths are structured.

Table 6. General maturation path of the IOC-MM

Capability Area	Mean Level (Mean Rank) / Standard Deviation		required capability level of the maturity level				
	Round 3	Round 4	CL 1	CL 2	CL 3	CL 4	CL 5
Work Design & Collaboration	1.1 (3.35) / 0.3	1.0 (2.45) / 0.0	ML 1	ML 2	ML 3	ML 4	ML 5
Values and Norms	1.1 (3.45) / 0.3	1.1 (2.80) / 0.3					
Collaboration Strategy	1.0 (2.75) / 0.0	1.1 (2.80) / 0.3					
System Security	1.5 (5.30) / 0.7	1.8 (6.35) / 0.8					
Teamwork	1.7 (6.15) / 0.7	1.8 (6.35) / 0.8					
Change Management	1.9 (7.65) / 0.3	1.9 (6.75) / 0.3					
Digital Leadership	1.7 (6.40) / 0.5	1.9 (6.90) / 0.6					
Internal Community Management	1.9 (7.20) / 0.6	2.0 (7.25) / 0.0					
Goal-driven IOC Tool Landscape*	1.9 (7.35) / 0.3	2.1 (7.90) / 0.3					
Motivation*	2.4 (9.50) / 0.7	2.2 (8.20) / 0.4					
Mobile Infrastructure	2.6 (10.45) / 0.8	2.7 (10.90) / 0.5					
Employee Competences	2.8 (11.60) / 0.4	2.9 (11.85) / 0.3					
Information Management	2.9 (11.95) / 0.6	3.0 (12.35) / 0.0					
System Interoperability	2.9 (12.00) / 0.3	3.0 (12.35) / 0.0					
Data-driven Optimization	4.0 (14.90) / 0.0	3.9 (14.80) / 0.3					

* calculated as the mean value of the original CAs

Table 7. Maturity level description

Maturity Level	Scale	Description
ML 0	*Unaware*	*Organizations of this level are unaware of or do not address IOC*
ML 1	Beginner	Completed planning & piloting of an IOC work practice: Organizations at this level have analyzed essential aspects of collaborative work via online media within the organization, developed target profiles and a corresponding IOC strategy, and communicated this to the workforce. Individual teams work together collaboratively via online media (as pilot projects).
ML 2	Advanced	Active and central support of employees regarding an IOC way of working: Organizations at this level have analyzed IOC tools solutions and staff requirements, selected appropriate ones and provided them to the workforce, but they are used sporadically. Organizations actively promote IOC as an essential way of working with the employees and actively involve them in the designing process.
ML 3	Expert	Organization-wide IOC practices & proactive individual improvement: Organizations at this level are primarily successful in collaborative working via online media. The employees know their competencies, strengths and weaknesses for an IOC way of working. They proactively develop these further and predominantly possess the necessary working materials. Collaborative work across IT system boundaries is actively improved.
ML 4	Optimizer	Optimization of successful IOC way of working: Organizations at this level successfully work collaboratively via online media and have established systems to optimize and sustain the motivation of an IOC way of working within the organization.
ML 5	Designer and Innovator	Designing new ways of IOC working: Organizations at this level seek and develop new ways to collaborate online. Employees proactively develop their skills and collaboratively design the future of IOC within the organization.

Table 8. Expert assessment regarding a diverging maturation path for different organization types

Organization Type	Yes	No	Unsure
Automated, factory-like/ processing organization	40%	40%	20%
Small or medium-sized manufacturing/ service organization	0%	60%	40%
Knowledge-based organization	20%	80%	0%
Innovative small organization	60%	40%	0%

LIMITATIONS AND FUTURE RESEARCH

The research area will remain important (Camp et al., 2022; Kolm et al., 2022; Standaert et al., 2022) and offers further research potential. This study has certain limitations which should be considered in the further use of the MM. The study was conducted in German, using German-speaking experts working primarily in international organizations. Therefore, generalizability in an international context is restricted. Although Kendall's W of 0.8 was achieved, indicating a high level of agreement among the experts and reliability of the results (Schmidt, 1997; Skinner et al., 2015), there is a certain bias since the experts were given an initial development path. Furthermore, the development within the capability areas (which capability level at which maturity level) was not examined and adopted from Jansz (2016). Further research should therefore investigate the development within the capability areas. To this end, descriptive and prescriptive functionalities should be investigated by elaborating capability assessments, targeted data collection, and action derivation considering the DPs of Pöppelbuß and Röglinger (2011). Descriptive and prescriptive extensions could be investigated through case studies or scenario-based research. The MM´s application areas are multifaceted and complex, and in this author's perception, it can be best investigated in a practical context using real-world scenarios.

Currently, the model is explored in terms of a process for involving employees in deriving and implementing improvement actions for IOC maturation. The use of an employee suggestion system is being investigated as prescriptive part of the MM. The IOC-MM will be realized as a prototypical instantiation with mocked data and evaluated regarding its practicability and the suitability of an employee suggestion system for deriving improvement actions. This study contributes to the design of the prescriptive part of a MM and a first evaluated prototype of the IOC-MM for practical application.

The model should be applied and evaluated in a practical context. The IOC-MM results should be presented in a customizable way, and assessment should be done on an individual or team level and aggregated on an organizational level enabling intraorganizational comparison. Additionally, utilizing different data types and perspectives for the assessment tool is recommended. Lastly, differing maturation paths of organization types should be further investigated, building on the provided first insights. The development of a prototype is recommended, which should be evaluated by experts and users and afterward implemented and tested in practical contexts, e.g., through case studies or scenario-based research. Since a practical implementation and scientific investigation of the IOC-MM is very complex, the author suggests that a laboratory-like environment (e.g., realistic scenarios) may be beneficial as a first practical implementation and evaluation. The perspectives of domain experts and the different potential users should be integrated to develop realistic scenarios.

CONCLUSION

This paper developed and presented a MM for the effective implementation of IOC. An initial model was developed from literature, evaluated and refined using a Delphi study. The capability areas of the IOC-MM provide a balance between complexity and comprehensibility, based on their perceived importance and impact, to meet real business needs. The model provides a structured approach to collaborative problem-solving in an online setting as a central 21st-century competency to address the increasing complexity of work tasks of knowledge workers.

The IOC-MM was developed according to the basic design principles (DP 1) of Pöppelbuß and Röglinger (2011). The subsection "Initial IOC Maturity Model" presented the application domain, the purpose of use, target group investigated entities and related MM. The initial model was refined throughout this study and thereby empirically evaluated by experts. The MM was not applied in practice, which should be done in future research. Hence, DP 1.1 is entirely met by providing all relevant basic information about the IOC-MM. Building on related MM, the central constructs were defined (DP 1.2), with this study focusing on refining the capability areas and developing a maturation path. Relevant capability areas to effectively implement IOC are evaluated, refined, and a description is reported (Table 5). Furthermore, a general maturation path is elaborated and presented (Table 6), and first insights into deviating organization types are given. Hence, central constructs regarding maturity and maturation are defined (DP 1.3), and the MM is documented and presented (DP 1.4).

This paper contributes to the prevailing literature by presenting a comprehensive and practical understanding of the domain through a MM. The IOC-MM defines a holistic and extensive set of elements that must be considered to facilitate implementing and improving IOC. The most relevant IOC aspects are identified and evaluated, providing researchers with a systematic overview of the topic. Consequently, the IOC-MM can be used for collecting relevant data to evaluate the IOC development status.

The basic elements of the IOC-MM provide a reliable and holistic framework for utilization and context-related adaptation in practice. A maturation path of high reliability is presented as the most vital contribution. The maturation path provides insights on what topics should be addressed depending on the current maturation status. Hence, practitioners can use the IOC-MM to understand what must be addressed to design IOC, enabling an organization-wide and holistic maturity evaluation to establish IOC in the organization. Additionally, utilizing the model facilitates the evaluation of the current IOC development status and the derivation of improvement potentials. Therefore, insights

into a control tool for IOC as a MM are given to provide a more objective and universal view of the organization's IOC status and identification of problem areas. Finally, the results can be used to derive a descriptive and prescriptive model.

DATA AVAILABILITY

Since the data may contain information jeopardizing the privacy of the research participants, they are only partly publicly available in the online appendix. However, further data from the Delphi study supporting the findings of this study are available upon request from the author.

CONFLICT OF INTEREST

The author of this publication declares there is no conflict of interest.

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ONLINE APPENDIX

OA1: Initial capability areas with corresponding references
OA2: Capability Areas and Goals after the First Round of the Delphi Study
OA3: Delphi Study Raw-Data

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