



Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 196 (2022) 305–313

Procedia
Computer Science

www.elsevier.com/locate/procedia

CENTERIS - International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies 2021

Enterprise Collaboration Platforms: An Empirical Study of Technology Support for Collaborative Work

Petra Schubert*, Susan P. Williams

University of Koblenz, Center for Enterprise Information Research, Universitaetsstr. 1, 56070 Koblenz, Germany

Abstract

Collaboration and communication technologies are increasingly transforming work, bringing changes in the work processes and practices of individual employees and organisations. In the absence of a single technology solution to provide support for collaborative work, organisations are combining multiple systems, tools and applications to form an Enterprise Collaboration Platform that provides comprehensive support for the different forms of collaborative activities. In this paper we present the findings of a study that i) examines the complex collaborative technology landscape in order to characterise and understand the evolving portfolios of collaboration software currently in use in organisations; ii) develops a framework to visualise and analyse the assemblages of tools that are being combined to form emerging enterprise collaboration platforms. The framework is then applied to visualise and compare the emerging ECPs for two organisations and the findings are discussed in the context of the long-term management of information.

© 2021 The Authors. Published by Elsevier B.V.

This is an open access article under the CC BY-NC-ND license (<https://creativecommons.org/licenses/by-nc-nd/4.0>)

Peer-review under responsibility of the scientific committee of the CENTERIS –International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies 2021

Keywords: Enterprise Collaboration Platform; Enterprise Social Software; collaborative work; tool portfolio; CSCW

* Corresponding author. Tel.: +49 261 287-2525; fax: +49 261 287-100-2525.

E-mail address: schubert@uni-koblenz.de

1. Background and motivation

Collaboration technologies are increasingly transforming work and organisations, bringing changes in both the work processes and practices of individual employees and organisations [1] and the spaces where work takes place [2]. This has been especially noticeable in the past two years as organisations respond to i) the short-term challenges presented by the *Covid-19 pandemic* and the increased requirement for working from home [3] and ii) the longer-term requirements driving organisations to offer more mobile and flexible working arrangements to support *Work from Anywhere* [4]. In parallel to these changing work arrangements, the range of tools and systems that are available to support collaborative work has grown rapidly. These trends are also reflected in global market forecasts for collaboration technologies. In 2021, the global collaboration technologies market is forecast at \$US4.5 billion, representing an increase of 17.1% from 2020 levels, with upward growth predicted to continue into 2022 to \$US5.1 billion, a further increase of 14% from 2021 levels [5]. The diversity in i) the availability of a wide range of tools and systems to support collaborative work and ii) evolving designs for the digital workplace presents a number of challenges for both researchers and practitioners. In this paper we examine these challenges and focus attention on the diverse range of collaboration technologies in use in organisations. Our goal is to identify and understand the different types of collaboration technologies in use, and to examine how they are being combined to provide a platform for collaborative work. The current study builds on our previous work to identify use cases and scenarios for collaborative work [6] and designs for the digital workplace [7] and is part of a long-term university-industry research program exploring collaboration technologies and the design of the digital workplace in leading organisations in the DACH area [8].

The paper is organised as follows: in the remainder of this section, we elaborate on the challenges of diverse types of collaboration tools and evolving designs for the digital workplace. We provide an overview of related literature and our prior work to provide the background and motivation for the current study. This is then followed by an outline of the research design guiding this study, a discussion of the study's key findings and implications. The final section presents the study conclusions and outlines imperatives for future research.

1.1. Portfolios of collaboration tools

Providing technology support for collaborative work across the entire organisation and bringing together a suitable collection of tools is proving challenging for several reasons. First, collaborative work is not one single thing, but comprises many different use cases, activities and tasks that need to be supported digitally to meet the diverse needs of employees [6]. Second, there is currently no classification of collaboration activities to comprehensively represent these different areas of digital work that can be used to guide the selection of appropriate collaboration software. Unlike the core business processes that are supported by ERP Systems, there is no “standard” Enterprise Collaboration Platform (ECP) that a company can implement that covers all aspects of collaboration. Instead, the market for collaboration software is heterogeneous, comprising a multitude of commercial collaboration tools with both overlapping and disjoint functionality [9]. Software vendors compound the problem by using disparate terms and descriptions for the same functionality, making it difficult to compare different tools. In the absence of a standard collaboration system, IT professionals struggle with the selection of appropriate solutions as unclear product descriptions, overlapping functionality and missing technical integration of commercial collaboration tools making it difficult to build a platform that covers all the necessary functionality and is intuitive and non-redundant in the functionality it provides.

Our long-term research program into collaboration technologies and the digital workplace (IndustryConnect) has, for the past ten years, focused on the adoption and use of Enterprise Collaboration Systems (ECS) in organisations. Enterprise Collaboration Systems (e.g. HCL Connections) provide a purposefully developed selection of applications/tools that are fully integrated and appear to the user in a workspace under a uniform interface. They are typically implemented in large organisations to provide support for employee collaboration and the coordination of digital work [7,10–12]. Rich in social software functionality (e.g. wikis, blogs, social profiles, activity streams, likes, tags) they span multiple global regions, business divisions and workgroups and support the collaboration, communication, coordination, content and knowledge sharing activities of many and diverse users [10,11]. However, currently no single ECS provides all the functionality to support collaborative work, thus requiring organisations to complement

the ECS with additional tools and systems. It is this *assembling of a collaboration platform* that is the focus of this paper.

Preliminary insights from our industry case studies and research workshops [7] confirm that organisations operate a portfolio of collaboration tools often with multiple tools serving the same purpose. As a consequence, many companies have implemented a heterogeneous range of tools (from different vendors) with overlapping (redundant) functionality forming a portfolio of collaboration software ranging from lightweight tools for specific tasks such as file sharing or simple message exchange to more complex enterprise collaboration systems (ECS). This situation makes it difficult for employees to understand which tool to use for a specific collaborative task and the problem is further exacerbated by employees introducing shadow IT (software that is not officially supported by the IT department of the organisation), which they are familiar with from their private lives [13]. Against this background, this paper presents the findings of a study that examines the complex collaborative technology landscape in order to characterise and understand the evolving portfolios of collaboration software currently in use in organisations. The overarching goal is to develop a framework for the analysis of Enterprise Collaboration Platforms and to provide a basis and foundation for tracking how these portfolios of tools are evolving over time as organisations extend their digital workplace and collaborative work processes. In doing so, to contribute to the deepening of theorisations about collaborative work and enterprise collaboration platforms.

1.2. Varying designs for the digital workplace

The digital workplace is not one single thing, but varies according to different business strategies and objectives. As part of our prior work with IndustryConnect organisations, we developed in-depth case studies of their digital workplace and collaboration technologies projects. From these case studies we analysed use cases and collaboration scenarios in 13 organisations to identify emerging designs for the digital workplace [7]. The analysis revealed six typical DWP designs; three people-focused designs and three process-focused designs at increasing levels of functionality and aggregation of activity. The DWP designs were reviewed, evaluated and elaborated in a research workshop with IndustryConnect participants and revealed two additional findings: i) that workplace designs are evolving as organisations seek to increase the degree of functionality and comprehensiveness of their digital workplace to support a wider range of use cases, and ii) ECS and Collaboration Suites are increasingly emerging as a core part of large-scale integrated Enterprise Collaboration Platforms (ECP), forming a new type of information infrastructure [14] providing a unified space for digital work [10,11,15]. Built in modular form, a platform ecosystem comprises a *core system* of shared infrastructure and functionality, complemented by subsystems (add-on apps and extensions) [16]. The research workshops on DWP designs identified that these organisations are seeking to create an *integrated collaboration platform* around their central ECS or Collaboration Suite(s). This paper presents the next phase of this research, with the aim of investigating these emerging Enterprise Collaboration Platforms to identify how ECS and Collaboration Suites are being extended and how different types of collaboration technologies are being combined.

2. Research design

This section describes the study's, research aims and objectives, data collection and data analysis methods.

2.1. Research aims and objectives

The aims of this study are to investigate and understand the portfolio of collaboration technologies currently in use in ECS using organisations and to provide a framework for understanding the structure of enterprise collaboration platforms (ECP) and how this technology landscape is evolving over time. Specifically, our research objectives are:

- **RO1:** to identify and categorise *different types of collaboration technologies* currently used in organisations;
- **RO2:** to develop a *framework and method* for mapping the collaboration technology landscape
- **RO3:** to apply the framework in an empirical study to gain insights into *emerging ECP configurations*

To achieve these objectives, an empirical study of enterprise collaboration platforms was conducted with a group of 34 ECS using companies. The participating organisations are all members of IndustryConnect and are mostly large organisations from different industry sectors (e.g. manufacturing, engineering, services) in the DACH area who are early adopters of the integrated ECS HCL Connections and leaders in the development of the digital workplace [8]. Whilst HCL Connections has a broad range of modules it does *not* cover *all* areas of Enterprise Collaboration and thus we were interested to identify which other (complementary) collaboration tools our respondents are using to build their complete Enterprise Collaboration Platform.

2.2. Data collection and data analysis

A mixed method research approach using an exploratory-sequential design was applied [17], which combines tool analysis, interactive practitioner workshops and survey methods to gather data. The study is organised into two sequential phases of data collection and data integration described in the following.

Phase 1: Tool analysis, categorisation and framework development

In Phase 1, we examined and categorised the different types of tools and systems for supporting collaborative work in organisations (RO1) and used the resulting categorisation to structure a framework for mapping the organisational technology landscape (RO2). Data was collected using an online questionnaire to survey the 34 IndustryConnect members and identify the collaboration tools currently in use in their organisations. The survey response rate was 53% (18 responding organisations). An inventory of all the tools reported by organisations was created and the consolidated inventory was analysed in order to identify i) *types* of tools and ii) level of *functionality* within tools and *degree of integration* between tools. Four distinct types were identified: Enterprise Collaboration Systems, Collaboration Suites, Applications and Tools (see Section 3, Fig. 1) and the tools were visualised in the resulting framework (technology landscape map) to show the four types and the level of functionality and degree of integration between the tools (see Section 3, Fig. 2). The categorisation and tool inventory were reviewed and consolidated in a research workshop with the study respondents. Our objective was to review (and if necessary to extend) the tool inventory and the categorisation of tool types.

Phase 2: Application of framework and analysis of emerging enterprise collaboration platform designs

In Phase 2, the framework developed in Phase 1 was used to synthesise the survey data about the types and range of collaboration technology in use in the responding organisations and the collaboration technology landscape for each organisation was visualised. The results were then examined to gain insights into different collaboration platform designs and to identify implications for the design of the digital workplace (RO3). The findings from two organisations are presented and discussed in Section 3 below.

3. Findings

3.1. Software types and framework

As discussed above, the research workshops on DWP designs identified that organisations are seeking to create an *integrated collaboration platform* around their ECS or central Collaboration Suite. As part of this work we developed an inventory of the main enterprise collaboration tools currently available on the market and classified them in order to identify i) types of tools and ii) the level of functionality within tools and the degree of integration between tools. An analysis of the data collected revealed four distinct categories of tool types: (1) *Enterprise Collaboration Systems*, (2) *Collaboration Suites*, (3) *Applications* and (4) *Tools* with varying degrees of functionality and integration, from stand-alone tools supporting a single function to highly integrated enterprise collaboration systems with a broad range of functionality. Further analysis of the four categories was conducted to identify differences in scope of functionality and scope of integration between the four distinct types of collaboration software. The resulting *typology of collaboration software* and their characteristics are described in Table 1.

Table 1. Typology of collaboration software

Type	Description
Enterprise Collaboration System (ECS)	A purposefully developed selection of applications/tools that are fully integrated and provided to the user in a workspace under a uniform interface (e.g. HCL Connections).
Collaboration Suite	Bundle of applications/tools (often under a joint license) that can be used independently. Provide a certain degree of technical integration because they have been designed to work together (e.g. the collaboration suites by Google, Atlassian and Microsoft).
Application	Standalone software product with a range of collaboration features (e.g. TeamViewer with screen sharing, video conference and file transfer).
Tool	Lightweight desktop or mobile software/plug-in/functionality with a central focus on one feature (e.g. chat in WhatsApp). High focus on one/few features.

These findings are also presented as a visual framework, a generic version of which is presented in Fig. 1. The framework provides a method for displaying the assemblages of tools that different organisations are combining to form their enterprise collaboration platform. This framework was used to present the emerging enterprise collaboration system designs for each of the organisations participating in the study.

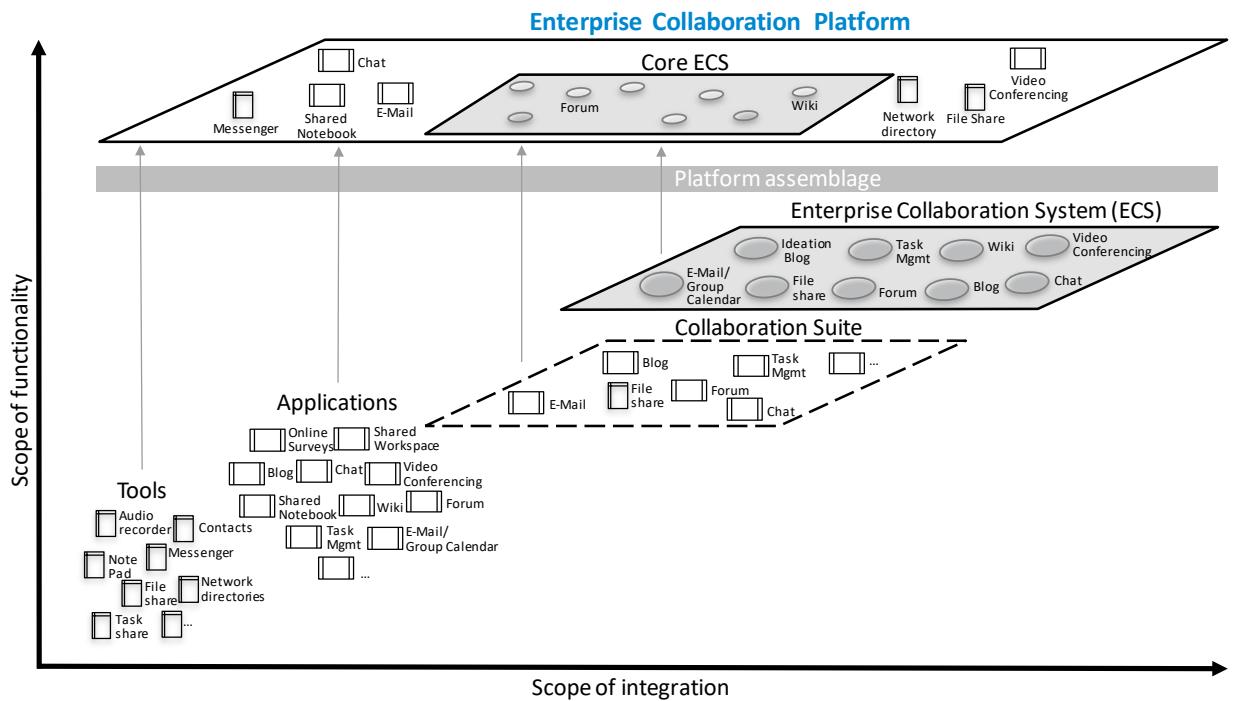


Fig. 1. Building blocks of an Enterprise Collaboration Platform (ECP)

In summary, our research identified that in companies that already have an ECS, this system is used to provide the *core* of an *Enterprise Collaboration Platform* that brings together multiple additional systems, tools and applications to provide more comprehensive support for collaborative work. From the analysis and visualisation of the survey and research workshop data a number of additional findings were identified; these are outlined below.

3.2. ECPs comprise a multitude of different tools

One of the findings was that the organisations involved in the study have implemented a substantial number of *different* commercial software products to build their complete Enterprise Collaboration Platform (ECP). 61 different software tools/modules were identified in a sample of 18 organisations, which represents an *average of 20 tools/modules per organisation*.

Fig. 2. shows the tools that were identified in the survey grouped by the software types described above. The results are based on the aggregated responses from the 18 participating organisations. The position on the x-/y-axis is used to indicate assignment of the tools to one of the four categories. The order within the boxes was arbitrarily chosen and does not reflect specific data points. The relative size of the bubble indicates the number of organisations in which the named tool/module is in use. To give an example, network directories are in use in almost all organisations (14/18), MS Kaizala (part of the Microsoft Collaboration Suite) on the other hand, is only in use in one organisation.

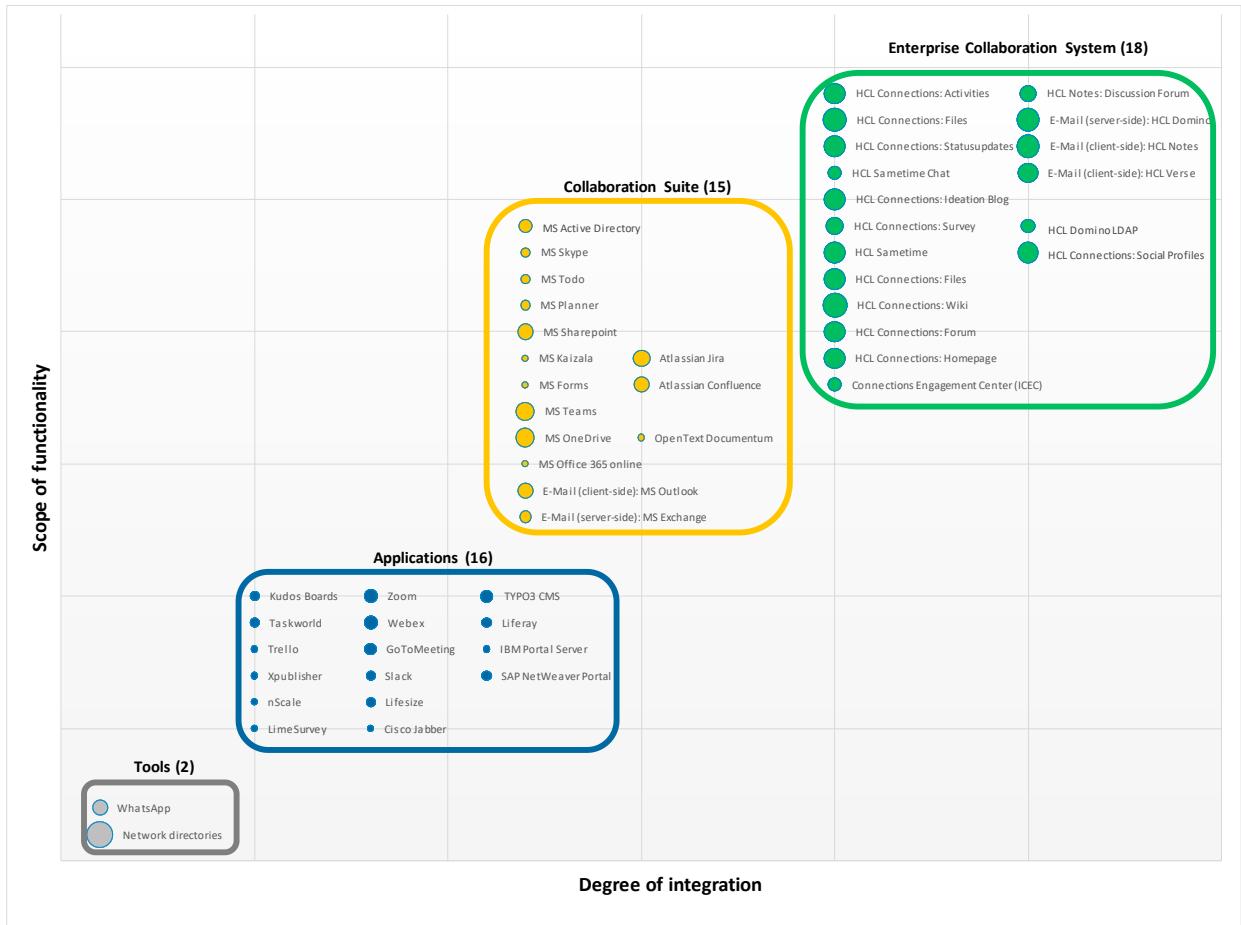


Fig. 2. Most important tools identified in the survey grouped by tool type (N=18)

The high number of tools in use in the study organisations presents challenges for both *IT managers* and *users*: the *IT department* has to operate and support a large range of different tools from different vendors and *users* need to constantly make choices and decisions about what is the right tool for a specific task and are required to handle different interfaces.

3.3. Emerging ECP configurations and case comparison

Fig. 3 shows a visual comparison of the assemblages of tools comprising the emerging enterprise collaboration platforms for two selected case companies. They are both large international manufacturing companies with a focus on B2B customers. The visualisations reveal the different enterprise collaboration platform design strategies that the two organisations are following.

Case Company 1 is following a strict **core ECS approach**. The company is using all functional modules of the integrated ECS. Only where functionality is missing or insufficiently provided, are they making use of complementary tools (e.g. in this case the company is doing this to support synchronous communication through video conferencing).

Case Company 2 is following a **broad portfolio approach**. The company is only using selected modules in the core ECS and is complementing the functionality of the platform with applications from two other collaboration suites. Whilst this configuration provides the users with a broad range of options for collaboration support it also creates the problem of redundancy (e.g. in this case there are three different software products supporting Wikis).

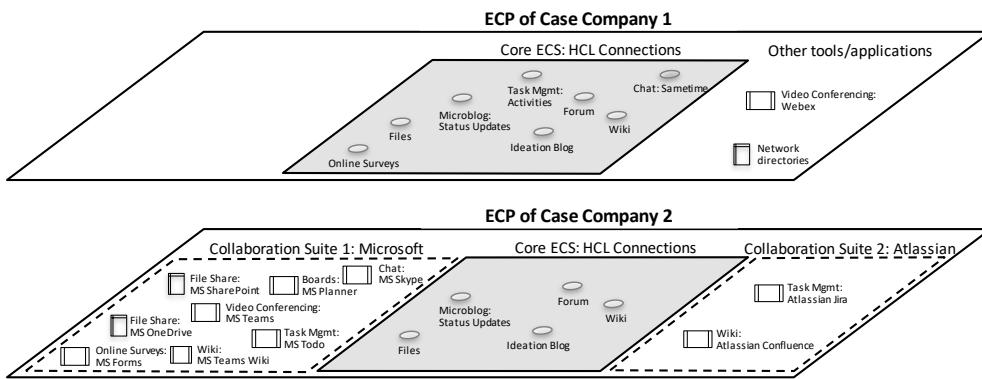


Fig. 3. Comparison of the ECP configurations of the two case companies

Table 2 gives an overview of the most important functional modules and their location in the ECP. Case company 1 has built its ECP almost entirely on the core ECS. They have only two additional software components: network directories for the storing of files in simple directories; and Webex as a specialised software for video conferencing since the ECS (HCL Connections) did not provide a solution for this requirement at the time of the survey. Case company 2 follows a broad and heterogeneous approach to the building of their platform. Their ECP provides redundant functionality in almost all areas. There are multiple places for files and the management of tasks and Wiki functionality is provided by all of the available software products.

Table 2. Location of functional modules in the ECPs of the case companies

Module	Case Company 1	Case Company 2
Files	ECS and network directories	In all 3 places (no network directories)
Chat	ECS for text and Webex for video	2 chat/video tools in MS Suite
Surveys	ECS	MS Suite
Tasks	ECS	Both Suites
Wiki	ECS	All 3 places (ECS and both Suites)
Forum	ECS	ECS

These preliminary findings reveal that there are multiple emerging platform strategies and designs. The two presented above show two distinct approaches, one of more strict control over the number of tools in use by focusing on the functionality of the core ECS, the second more open, making less use of the functionality of the core

ECS and offering multiple tools to support the same functionality. The next phase of this research study is directed towards a more in-depth analysis of the platform designs for all the study organisations to identify the range, structure and nature of the different strategies and designs.

4. Discussion of Findings and Concluding Remarks

In this paper attention is focused on the large-scale provision of collaboration software in organisations. Our research examines emerging ECP designs and the assembling of collaboration technologies to provide the technology infrastructure for a digital workplace within organisations. We present the findings from a survey of the current state of ECPs in practice.

The findings address our three research objectives in the following ways. In *ROI* the goal was to identify and categorise the *different types of collaboration technologies*. To achieve this, we developed an inventory of the collaboration software tools in use in organisations and developed a typology of collaboration software (Table 1).

For *RO2* the goal was to develop a *framework and method* for mapping the collaboration technology landscape. An empirical investigation of 18 user companies enabled us to develop a framework and method for mapping the collaboration technology landscape and to identify in more depth how the different software types are currently being assembled to build ECPs in organisations (Fig. 1 and Fig. 2). Our findings show that the ECPs in the responding organisations comprise an average of 20 different collaboration tools/modules. More interestingly, the findings also reveal different emerging ECP strategies and designs.

The framework was then applied (*RO3*) to illustrate and compare the emerging ECPs in two selected user companies (Fig. 3). The comparison showed that there are different configurations/strategies for the building of an ECP demonstrating notable differences in the landscapes of the participating organisations. To date, limited research has been focused on the design of enterprise collaboration platforms and the digital workplace strategies that lie behind these platform designs. Existing studies are frequently focused at the micro-level largely limited to studies of a single type of social software (e.g. blogs, wikis) [18,19] or to a specific type of collaborative activity (e.g. knowledge sharing, expert search) [20,21] and lack the scale and scope to address the wider, meso/organisational and platform level transformations to the organisation-wide support of collaborative work.

These findings have implications both for the design of ECPs as well as for information governance and the long-term management of the information and collaborative content created within the various tools and components that make up the platform. A key use of collaboration tools is to enable individuals and teams to work together to coordinate work, to share information and to capture and codify project and organisational knowledge [22]. As such, these systems become repositories of huge volumes of social content (blog and forum posts, wiki entries, notifications etc.) and extensions to these artefacts in the form of, for example, comments, attachments, tags etc. [23,24]. In situations where organisations are supporting a multitude of competing tools and multiple tools that serve the same purpose (e.g. Company 2 above) there is the potential for increasing information risks. For example, uncontrolled and uncoordinated information that is fragmented across multiple systems may lead to information integrity, information quality and information accessibility risks. Without clearly defined, platform-wide information governance strategies to ensure information compliance, the collaboration platform, instead of supporting improved information and knowledge sharing by breaking down information silos may actually be producing more information silos and introducing new information risks. Moving forward, digital workplace strategies need to focus not only on the design of the ECP as a platform to offer functionality to support collaborative work but to ensure they also meet information governance and compliance requirements and are capable of effectively storing, managing and preserving important business documents and corporate knowledge in the form of social content.

The work presented in this paper provides a first step and a foundation for future work to examine the design of ECPs. The next phase of the empirical research is currently underway to trace how these platforms are evolving and how the information governance requirements of collaborative content are being addressed by organisations.

References

- [1] OECD. New Forms of Work in the Digital Economy. OECD Digital Economy Papers, No 260, Paris: OECD Publishing; 2016.
- [2] Flecker J. Space, Place and Global Digital Work. London: Palgrave Macmillan; 2010.
- [3] World Economic Forum. Resetting the Future of Work Agenda: Disruption and Renewal in a Post-COVID World. 2020.
- [4] Choudhury P. Our work-from-anywhere future: Best practices for all-remote organizations. Harv Bus Rev 2020;2020:1–11.
- [5] Gartner. Gartner Forecasts Worldwide Social Software and Collaboration Market to Grow 17% in 2021 2021:Press Release. <https://www.gartner.com/en/newsroom/press-releases/2021-03-23-gartner-forecasts-worldwide-social-software-and-collaboration-market-to-grow-17-percent-in-2021>.
- [6] Schubert P, Glitsch JH. Use Cases and Collaboration Scenarios: How employees use socially-enabled Enterprise Collaboration Systems (ECS). Int J Inf Syst Proj Manag 2016;4:41–62.
- [7] Williams SP, Schubert P. Designs for the Digital Workplace. Procedia Comput. Sci., Lisbon, Portugal: Elsevier B.V.; 2018, p. 478–85.
- [8] Williams SP, Schubert P. Connecting Industry: Building and Sustaining a Practice-based Research Community. 50th Hawaii Int. Conf. Syst. Sci., Hilton Waikoloa Village, HI, USA: 2017, p. 5400–9.
- [9] Gartner. Market Guide for Content Collaboration Tools. 2020.
- [10] Haefliger S, Monteiro E, Foray D, von Krogh G. Social Software and Strategy. Long Range Plann 2011;44:297–316.
- [11] Leonardi PM, Huysman M, Steinfield C. Enterprise Social Media: Definition, History, and Prospects for the Study of Social Technologies in Organizations. J Comput Commun 2013;19:1–19.
- [12] Kügler M, Smolnik S, Kane G. What's in IT for employees? Understanding the relationship between use and performance in enterprise social software. J Strateg Inf Syst 2015;24:90–112.
- [13] Warr WA. Social software: Fun and games, or business tools? J Inf Sci 2008;34:591–604.
- [14] Monteiro E, Pollock N, Hanseth O, Williams R. From Artefacts to Infrastructures. Comput Support Coop Work 2013;22:575–607.
- [15] de Reuver M, Sørensen C, Basole RC. The digital platform: a research agenda. J Inf Technol 2017:1–12.
- [16] Tiwana A. Platform Ecosystems: Aligning Architecture, Governance, and Strategy. Walham, MA: Morgan Kaufmann; 2014.
- [17] Creswell JW, Plano Clark VL. Designing and conducting mixed methods research. 3rd ed. Thousand Oaks, CA: SAGE Publications Inc; 2018.
- [18] Holtzblatt LJ, Damianos LE, Weiss D. Factors impeding wiki use in the enterprise: A case study. Proc. 28th ACM Conf. Hum. Factors Comput. Syst., 2010, p. 4661–76.
- [19] Richter A, Riemer K. Malleable end-user software. Bus Inf Syst Eng 2013;5:195–7.
- [20] Mäntymäki M, Riemer K. Enterprise social networking: A knowledge management perspective. Int J Inf Manage 2016;36:1042–52.
- [21] Hacker J, Bodendorf F, Lorenz P. Helper, Sharer or Seeker? – A Concept to Determine Knowledge Worker Roles in Enterprise Social Networks. 13th International Conference on Wirtschaftsinformatik, St. Gallen, Switzerland: 2017, p. 668–82.
- [22] Majchrzak A, Wagner C, Yates D. The impact of shaping on knowledge reuse for organizational improvement with Wikis. MIS Q Manag Inf Syst 2013;37:455–69.
- [23] Williams S, Mosen J, Schubert P. The Structure of Social Documents. 53rd Hawaii Int. Conf. Syst. Sci., Maui, HI, USA: 2020, p. 2825–34.
- [24] Mosen J, Williams SP, Schubert P. Visualizing Social Documents as Traces of Collaborative Activity in Enterprise Collaboration Platforms. 53rd Hawaii Int. Conf. Syst. Sci., 2020, p. 5369–78.