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Work 4.0 and the Need for Boundary-Spanning

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ABSTRACT

The evolution of a digital world driven by and generating substantial volumes of data is also changing the way people work and associated specializations, characterized as 'Work 4.0' in Europe. Smart devices and the use of data analytics is getting work done more effectively but new skills are needed to develop and use these tools. Agility is a requisite capability. Different communities of practice need to work together, possibly with new kinds of users, introducing a need for enhanced boundary-spanning skills and tools. Boundary-spanning activities take place at multiple organizational levels. Teams use boundary object tools as alignment mechanisms, but also create boundary objects (e.g. prototypes) to test alignment. Case observations from agile IS projects associated with large and small firms highlight the influence of context, a need for the use of multiple complementary boundary objects and for learning to use them effectively.

Keywords

Work 4.0, Boundary Spanning, Competency Sets, Boundary Objects

INTRODUCTION

The accelerating introduction of cyber-physical systems and data analytics is changing the way business and work is done, including what kinds of information systems are needed and how they are developed. A German study of the impact of digital transformation on professions (W4.0, 2017) referred to 'Reimagining Work - Work 4.0'. By way of example, it was noted that the proportion of the global population with mobile phones exceeded the proportion with access to other assets like electricity, running water or cars, facilitating new ways of working. Six challenges were identified. Three related to societal influences: employment effects, flexible work arrangements and company organization structures (e.g. network forms of organization and agile operations). Three related to technological influences: digital platforms facilitating access to new markets and new forms of work, 'Industry 4.0' and human-machine interaction, and 'Big Data' that may facilitate decision-making provided matters of data integrity / security are addressed. In an earlier study (Beckett and Daberkow, 2019) we had also noted the influence of agile practices on the nature of work, and taking an employer viewpoint (e.g. Meredith et al, 2019), had considered new competency set requirements. Whilst some of these related to knowledge about emergent technologies, others related to the ability to use new kinds of tools, to boundary-spanning capabilities, and to the ability to creatively adapt to changing work environments. Our research question is: how might boundary spanning capabilities be characterized and what implementation issues might emerge in practice? In this practitioner-oriented exploratory study we start by considering the topic of boundary-spanning capabilities and the use of associated tools that are viewed as boundary objects. We subsequently compare ideas from the literature with practitioner agile project experience in two different environments.

SOME OBSERVATIONS FROM THE LITERATURE: BOUNDARY-SPANNING CAPABILITIES AND BOUNDARY OBJECTS

We draw boundaries to sharpen our focus on things within the boundary: our family, our region, or our community of practice, but this can lead to a myopic world-view. Regardless of where the boundary is drawn, we are embedded on a larger community, and the management of interactions across boundaries can be complex. Vashist et al (2014) have noted that the business analyst role emerged as a mechanism to address concerns about a gap between technical IT staff and users in developing information systems. Along with others, they noted that spanning that gap provides an opportunity for all parties to learn and "more effectively interact with their constituents". Two learning domains were identified. The first was described as a socio-spatial domain where boundary-spanners have to be accepted as both user and IT staff representative. This domain is strongly associated with the application of personal competencies. The second was an instrumental-developmental domain where documents and collaboration tools helped reach common understandings. In the boundary-spanning literature these are referred to a boundary objects, which we will discuss further later.

Boundary-Spanning Roles and Competencies for IS Development and Deployment

From a study of 136 IS projects in a global firm, Fisk et al (2010) showed that boundary-spanning roles positively influenced success. They characterized such roles as ambassador, coordinator and scout, Enactment of these roles helped provide access to business, technical and business information systems competence sets within and external to the team. Successful teams could accumulate experience related to language usage, business network connections, business contacts and cross-organizational activities (described as an acculturation process). Prifti et al (2017) undertook a combined literature review and focus group study of new and traditional competencies required in a Work 4.0 environment. They considered information system, computer science and engineering competencies that were applied to the development and support of operational systems. The most commonly mentioned competency sets were firstly, communicating with people, secondly technology affinity, big data and problem-solving, and thirdly life-long learning and working in interdisciplinary environments. Eight generic competency sets with a total of 20 sub-tier competency dimensions were identified. Some technology dimensions showed computer science - engineering overlaps and some showed computer science - information systems overlap. An IIBA (2018) study identified three different kinds of extended roles a business analyst might be expected to undertake in a digital world context:

- Strategist – Focuses on digital strategy and business outcome;
- Specialized – Utilizes in-depth technology competencies to implement and validate digital goals; and
- Renaissance Professional – Cross-functional role that cuts across multiple disciplines (e.g. Product Manager/BA).

Levina and Vaast (2005) observed that whilst boundary spanning activities may be formally nominated as an aspect of a job description, there are three conditions for an agent (nominated or not) to become a boundary spanner in practice. The requisite competencies were firstly, an ability to develop and maintain social capital, secondly have a high legitimacy as both a participant and as a negotiator, and thirdly have a personal interest in spanning boundaries.

IS Boundary Objects

Fox (2011) described boundary objects as " entities that enhance the capacity of an idea, theory or practice to translate across culturally defined boundaries, for example between communities of knowledge or practice." He observed that: "it was the active work of participants that made the boundary object effective". This suggests boundary objects may be viewed as both a resource and an outcome of a boundary-spanning activity. In their foundation work Star and Griesmer (1989: 410-411) provided the following examples of boundary objects as resources:

- Repositories indexed in a standard fashion, enabling access by people from differing communities of knowledge or practice (for example, a library catalogue).
- An ideal type, representation or abstraction that is 'good enough' to serve different communities (for example, a blueprint or circuit diagram) even though it lacks detail.
- Coincident boundaries: an object whose boundaries are the same for different communities, although the content that is bounded differs (for example, a map that summarizes political or natural features of a landscape).
- A standardized form that can be completed by actors within differing knowledge communities.

In studying the use of boundary objects in computer supported collaborative work, Lee (2007) observed that the original boundary object concepts evolved in a relatively stable project environment. Their study of a more uncertain, complex case suggested that 'each type of artifact is entangled in a mesh of practices' brought to the project via the prior experience of individual team members. Individual team members proposed and created different kinds of boundary negotiating objects including physical artifacts.

Some Matters of Context

From a review of literature, Marrone (2010) noted that boundary-spanning activities may take place in different contexts at an organizational, team and team member level and there were specific kinds of antecedents and specific kinds of targeted outcomes associated with each level. They viewed organizational level activity as a network level bringing together different professional interests. Higher-level antecedents may also support lower level boundary-spanning, e.g. a network providing linkages a team may draw on. Achieving lower level goals may support the achievement of a variety of higher-level goals.

Team member contributions should also be considered. Marrone (2010) had suggested that boundary spanning was characterized by three kinds of activity:

- Representation of the views / requirements of the parties involved (an ambassador role). Sub-tier activities were identified based on the work of Ancona and Caldwell (1992) who also suggested that for effective outcomes the representation activities had to be linked with coordination activities.
- Coordination of task requirements (a coordinator role), which included helping to share specialist domain knowledge and team member knowledge, supporting the use of boundary objects as tools, and adaptation and learning consistent with the project goals.
- General Information Searching (a scout role). Whilst this is an important activity, Ancona and Caldwell (1992) observed that undue emphasis on it could detract from overall team performance.

In summary, we observe there are three generic boundary spanning activities, but each one has sub-components and there are interactions between them.

Boundary spanning activities in action

We constructed an IDEF(0) functional model (figure 1) of these activities (e.g. Beckett, 2015; Li and Du, 2015) to show how they supported desired project outputs and identified the nature of linkages between the sub-tier elements.

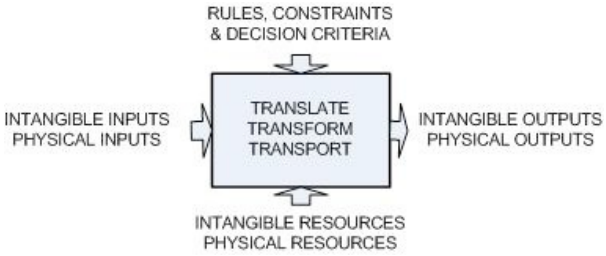

Figure 1. A representation of an IDEF0 modeling element

Project goal and project acceptance criteria were represented as activity rules / constraints. Clients, the team, individual team members, subject matter experts and boundary objects were represented as resources. The activity hierarchy emerging from this modeling where requisite sub-tier activities were identified with reference to the literature (Ancona and Caldwell, 1992; Marrone, 2010) is shown in figure 2. Some background research was also done to map boundary-spanning application competencies in a work 4.0 environment drawing on both industry and academic sources. Whilst space does not permit elaboration of that study, we observe that specific competencies could be associated with each of the figure 1 activities.

SOME OBSERVATIONS FROM PRACTICE

Drawing on our project involvement as practitioners, direct observations of agile development project boundary-spanning practice were accumulated from two sources over periods of several months in each case:

1. Three projects in different large business units within the finance sector. Two involved one team and the other involved multiple teams. All business units were pursuing agile principles, but were at different stages of maturity and had utilized different adoption strategies. One project involved a transition from a historical IS platform to an on-line tool. Another was a large project to establish an internet sales tool to replace an existing system. The third involved the customization of a vendor application for streamlining knowledge-oriented internal business processes.
2. Forty micro-projects linking small business client firms with IT Masters student project teams utilizing agile project management practices. There were commonly two types of project undertaken, but in all cases an as-is and to-be situation had to be developed. The most common could be described as a research project where a client wanted to explore the potential application of a new technology like blockchain and other digital age technologies / techniques. These clients, who supported multiple projects, were commonly small specialist consulting firms who had their own client's interests in mind. The activities undertaken could be viewed as examples of the Strategist and Specialist Business analyst roles referred to in IIBA (2018). The second kind of project involved coding to produce prototype software, some being developed as smart-phone apps. The clients here were most commonly small service sector firms.

Observations were accumulated using JIRA Cloud where each project was described as an epic having associated user stories and issues. This provided each observation with a unique ID and the researchers could add clarifications and discuss each entry via associated comments.

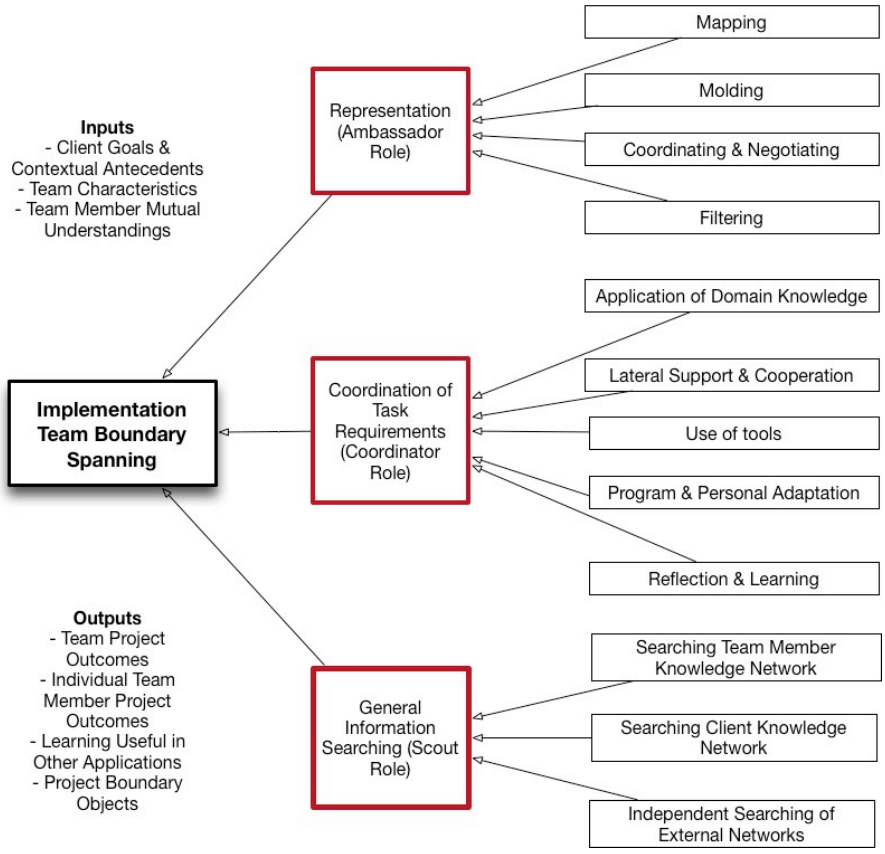

Figure 2. A hierarchy of activities involved in team-level boundary spanning

For analysis purposes, extracted data were tabulated in the context of figure 1 (which had been derived from the literature) with rows for ambassador, coordinator and scout roles and columns representing boundary-spanning activities and boundary object use. Boundary-spanning activities supported the projects in different ways. Each entry in the table could be linked back to source observations using the associated JIRA ID.

In the large company cases a business analyst performed boundary spanning activities, sometimes in conjunction with a product manager. This could be viewed as an example of the Renaissance Professional role referred to in IIBA (2018). In one of those cases a co-located team was established. In the other cases the teams had distributed internal and external members, which influenced both team dynamics and the nature of the representation and coordination activities undertaken. User stories and user acceptance test plans were the most common type of client-team boundary objects. However the need for supplementary objects was recognized (shared repositories, overarching business requirements descriptions, responsibility maps and MVP descriptions). Microsoft Teams was used as an on-line collaboration tool, and the business units provided access to subject matter experts as required, sometimes being provided with requisite logic in Excel spreadsheets.

In the small company cases a WIL coordinator was the boundary spanner, supporting all projects. Individual client micro-projects were formulated first. Subsequently client context and unresolved issues were shared with the teams and vice-versa. The student academic program was organized as a series of ‘sprints’ simulating agile management where template-based team reports signed off by the client had to be submitted every few weeks, representing a kind of boundary object. Other boundary objects were firstly, a one- page storyboard providing project organizational and IT context, goals completed in conjunction with the client before a project was started and secondly user stories. Clients were generally not familiar with the user story idea and needed help in their development. Teams undertaking research studies had some difficulty working with user stories. Software development teams were often provided with client knowledge in Excel spreadsheets. The teams also

felt a need for additional boundary objects such as use case diagrams. The teams had access to an on-line collaboration tool that included a record repository (Basecamp) but uptake was variable.

CONCLUDING REMARKS

Different communities of practice need to work together, possibly with new kinds of users in a Work 4.0 environment, introducing a need for enhanced boundary-spanning skills and tools. Agility is a requisite capability. Our research question was: how might boundary spanning capabilities be characterized and what implementation issues might emerge in practice? We contribute to the literature by representing capabilities as a set of interlinked activities shown in figure 1, with three primary functions: ambassador, coordinator and scout each having 3 – 5 associated sub-functions. A study of related competencies was initiated, but space does not permit the representation of findings here. The literature review also indicated that teams use boundary object tools such as user stories as alignment mechanisms, but also create boundary objects (e.g. prototypes) to test alignment. We drew on our experience as practitioners with five cases to consider potential implementation issues. Case observations from agile IS projects associated with large and small firms highlighted the influence of context on boundary spanning activities (goal clarity, team characteristics, team member mutual understandings) consistent with the literature, plus a need to use multiple complementary boundary objects (e.g. user stories plus minimum viable product requirements) and for learning to use them effectively. This is a topic for further research. In some cases where client requirements were unclear to the team, the ambassador function was most important in forming a bridge. In other cases, particularly when timing and synchronization was important, the coordinator function was more dominant. In one case where options for potential 'to-be' scenarios had to be developed, the scout function was more dominant. The relative importance of the three functions could vary as a project progresses, requiring flexibility on the part of the boundary spanner(s).

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