Exploring the Utility of a Multi-level Collaboration Modeling Framework

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ABSTRACT. There are current pressures to seek innovative solutions to problems associated with environmental sustainability, and in this context, it is likely that SMEs will have to collaborate with a wider variety of specialist partners. In 2009 three Dutch Universities joined with an Australian and Swedish University to compare their experience in this context, and planned a research project to address potential barriers and opportunities. One of the project goals was to implement techniques to foster effective collaboration in joint innovation projects. In this paper we consider a particular reference modeling framework (ARCON) as a candidate tool to both plan projects and identify some emergent issues. Some observations about the utility of the framework and supplementary matters of agency and participant experience are made.

Keywords: Industry-University collaboration, ARCON modeling framework.

1 INTRODUCTION

Our on-going research interest is in improving the success rate in turning innovative ideas into applications and new business models. In 2009 three Dutch Universities joined with an Australian and Swedish University to compare their experience in the context of innovation associated with sustainability, and developed a research project to address potential barriers and opportunities for industry participants entering unfamiliar management domains and new areas of business opportunity. Two technological themes are being explored by industry partners linked with each university using the action research approach to both support the industry partners and collect case material. One theme is related to opportunities for internal enterprise process improvement that reduces energy consumption and effluent emissions. The other is related to opportunities to develop technologies and products that provide local area energy generation from waste feedstock. The intent of this development is to turn the technologies into new business opportunities.

One of the project goals is to implement techniques to foster effective collaboration in joint innovation projects, and in this paper we consider an approach to collaboration modeling that we might use. It is reported that the success rate of collaborative ventures is not high (Speckman et al, 1996; Dacin et al, 1997; Das and Teng, 1999, Dyer et al, 2001). Some researchers (e.g. Karvonen et
al, 2004) believe that the use of a grounded model or framework that helps address potential issues will improve the effective operation of collaborative ventures. We start by discussing some candidate collaboration modeling approaches and then frame our international research project as an application of a particular modeling framework (ARCON) to explore its utility.

2. CHOICE OF COLLABORATION MANAGEMENT MODELS

Our project is utilising intersecting social networks and technology networks to get the job done. A formal management network entity has not been established as a virtual enterprise however we need to manage access to project-specific IT facilities to support the work done through the network members. Also collaboration relationships and tasks have to be managed to support participants in achieving the desired outcomes. Here we briefly explore some candidate collaboration management models.

The IMP Group of researchers, (IMP, 2010) who are interested in the characterization of markets and the position of firms in them, see markets as intersecting networks of activities, resources and actors. Each of these networks may not change very fast, but linkages within and between them can, which may be a source of disruption or a means of supporting enterprise agility. This model can be used in a hierarchical way, for example to characterize a business environment, a cluster of firms or operations within a firm. Using the same concept for different purposes helps with sense-making in complex environments. The common focus is on the external linkages of the entity being studied.

Activity Theory has been used to focus on an instance of a Collaborative Network Organisation (CNO) (Beckett, 2004). Activity Theory has it's origins in situated learning where with some objective in mind, a subject undertakes an activity to achieve this outcome using tools. The objective is achieved by some kind of division of labor. And how it is achieved is influenced by the associated community and some operating rules. There are interactions between all aspects of the model and it may be used as a way of thinking in a hierarchical sense. For example, the identification of tools to be used, or the identification of the community involved may be a sub-project objective with the same set
of Activity Theory attributes. Activity Theory can provide both internal and external views of a collaboration. Its use requires resources to be considered as ‘tools’.

Work on clusters (Enright, 2000) has suggested the following dimension may be used to characterize networked operations; geographical scope, density of participants, breadth of activities, depth of activities, activity base - rich or poor, growth potential, innovation capacity, industrial organisation, coordinating mechanism, and maturity stage (wishful thinking, potential, latent, working). This set of attributes has been found helpful in comparing different clusters.

The tools discussed to date have been typically used to characterize a CNO at a conceptual level, and have been found useful to researchers wishing to better understand a particular case. In our opinion however, they are not so useful to practitioners wishing to design and implement collaborative ventures. ARCON (A Reference model for Collaborative Networks) is a generic reference model that embodies some of the ideas featured in the models we have discussed so far (internal, external and maturity stage views), and has been developed with both conceptual and implementation perspectives in mind. On the basis of its strong empirical foundation, we chose to study this model to characterize collaboration activities in our international project involving both the research partners and the business partners.

3. THE ARCON MODELING FRAMEWORK

The ARCON reference modeling framework described here was developed by a large team of researchers from many countries working on the ECOLEAD project (European Collaborative networked Organizations LEADership initiative). Reflection on a decade of EU-funded collaboration projects had identified a need to build on the substantial knowledge base obtained by developing a flexible, integrated model (Bacquet et al, 2004, Camarinha-Matos et al, 2005). A sixty-four page document (ARCON, 2007) details the framework and associated definitions that were developed. In this section we outline some of the concepts presented in that document.
It is suggested that Collaborative Network Organisations (CNO’s) may be established to share information or to create something through collaborative efforts or some combination of these goals.

In the ARCON view, levels of engagement are defined as follows:

- **Networking**: involves communication & exchange for mutual benefit
- **Coordinated networking**: involves communication & exchange for mutual benefit plus a complementarity of goals - aligning activities for mutual benefit
- **Cooperation**: involves communication & exchange for mutual benefit plus a complementarity of goals - aligning activities for mutual benefit, plus compatible goals with individuals working apart (with some coordination)
- **Collaboration**: involves communication & exchange for mutual benefit plus a complementarity of goals - aligning activities for mutual benefit, plus compatible goals with individuals working apart (with some coordination) plus having joint goals, joint identities and joint responsibilities (creating together) and inter-organizational teams.

Collaborations may be established for long-term strategic purposes or to achieve a shorter-term goal. A ‘breeding environment’ exploring future opportunities and a ‘professional virtual community’ accumulating and sharing knowledge are cited examples of long term CNO’s. Project teams assembled to grasp a particular opportunity and extended enterprise arrangements are cited examples of shorter-term goal-oriented networks.

CNO’s are assumed to have a finite life that may be extended by evolutionary change or by metamorphosis in response to internal and external changes. The ARCON framework utilizes four generic stages: creation / operation / evolution / dissolution or metamorphosis.

It is observed that both internal and external interactions influence the operation of a CNO. Each of these is characterized at three levels of detail as follows:

- **Internal (endogenous) elements** having structural (who is involved and how), componential (tangible/intangible assets utilized), functional (processes and procedures) and behavioral (governance rules and values) dimensions. Each of these dimensions has four subsidiary categories: the active entity, passive entities, action and concepts.
• External (exogenous) elements having market (who are the customers or potential beneficiaries), support (services provided by third parties), societal (the broader community) and constituency (potential new participants and supporters) dimensions. Each of these dimensions has three subsidiary categories: network identity, interaction parties and interaction types.

An overview is shown in Figure 1.

4. APPLYING THE ARCON FRAMEWORK TO THREE INTERACTING NETWORKS

Our research methodology involved using different features of the ARCON framework as a kind of top-down checklist that we compared with our project proposal to characterize our case study project in a narrative style. We reflected on what kind of collaboration we were embarking on, its stage of maturity, and its internal and external attributes. In this context, our project could be regarded as a goal-oriented network in that it is established for one project, even though it has been funded for long-term strategic reasons. We are setting up a virtual team - “a temporary group of professionals that work together towards a common goal----” (ARCON 2007 p13), not a virtual enterprise entity, even though there might be agreements and contributions at the organizational level. In terms of life-cycle, at the time of writing, we are between the creation and operation stages. This means moving from a conceptual modeling layer to an implementation modeling layer. Again, in an ARCON context, we have complimentary goals in that the researchers wish to explore different facets of the project research question and in that the intention is to deliver benefits to the industry participants (coordinated networking). We have compatible goals in that the universities and the industry partners want to establish communities of practice (cooperation). We have joint goals in that we want to support company-specific technology projects (collaboration), but we do not intend to have a joint entity from a market perspective. Drawing on the earlier ideas presented on networking, cooperation etc, in the ARCON model this combination of goal types means the underlying basis of the project should center on effective communication exchange and aligning benefits for mutual advantage. The first point means that we must have a communication tool that suits a variety of needs. The second point has been clearly reinforced in recruiting industry participants (what is it in it for me - what is the
value proposition). Beyond that, we take the view that we have to manage three intersecting actor networks, and a discussion of the endogenous/exogenous interactions of each one follows.

4.1. The International University Network

4.1.1. ARCON Internal (endogenous) elements. One university has responsibility for project management, for interaction with the major project sponsor, and for the establishment of a project web portal (Green Co-innovation Lab) to facilitate communication and learning. The other universities have formal agreements with the lead university. Each university has responsibility for exploring specific aspects of the project research question and for engaging with its regional industry participants. The researchers involved are experienced in working collaboratively and will draw on the resources of their individual universities. This also imposes some formal and informal rules. Both social networking (meetings, events) and ICT tools are being used. An action research strategy has been adopted.

4.1.2 ARCON External (exogenous) elements. The project organization as such does not seek commercial market engagement. This is to be done through the industry participants, who are also potential beneficiaries. Researchers and students involved are also potential beneficiaries in terms of what they may learn and linkages they may make. A Dutch Government agency is providing major funding to the coordinating Dutch university and has set some rules in relation to reporting and knowledge diffusion. The infrastructure of each university is being used to support the project members, whose activities are consistent with university support for international collaboration. The broader community is engaged in two ways: in seeking to encourage industry-university linkages, and in relation to innovation initiatives focused on environmental sustainability.

4.2 The Regional University-Industry Networks

4.2.1. ARCON Internal (endogenous) elements. Within each of the three countries involved, at least five industry participants with an interest in the project environmental sustainability focus areas are being recruited by the regional universities. The university researchers will help plan, implement and
learn from industry projects. Small teams made up of management and technology students will work between the university and its industry partners to support the action research strategy adopted. The focus here is on knowledge exchange, and it is intended that virtual communities of practice (Wenger, 2002) be established. A number of instruments are to be used to assess the initial capabilities of industry participants and to identify areas where support may be needed in the context of their nominated sub-projects. Regional meetings and events are to be organized to facilitate knowledge diffusion. Governance rules and codes of behavior are to be negotiated at this regional level.

4.2.2. ARCON External (exogenous) elements. There are no plans to set up regional market entities, but to pursue market engagement through the individual industry participants. Other regional firms may benefit from the linkages established and from post-project employment of the students involved. From this point of view, there has also been some support from regional government and industry organizations/associations in helping to identify candidate participants and, depending on the extent of alignment with their own initiatives, providing additional resources to support the project. Where this happens, there are additional obligations/rules associated with that support to be managed by each university. The broader community in each country is interested in the particular environmental sustainability innovations being pursued and how that impacts the community. This may influence the nature of the engaged constituency as the project proceeds.

4.3 The Industry Partner Networks

4.3.1 ARCON Internal (endogenous) elements. Individual projects will involve more than one industry partner. From our observation, it is likely environmental sustainability initiatives will require inputs from specialists not normally retained in support of industrial market innovations, and access to supplementary technologies may be required. The industry participants will provide the resources to support this activity. Identifying the internal innovation management processes used and making suggestions for improvement is a broader project objective. Normal contract mechanisms are to be used between the industry partners, meaning that the sub-project must make economic or strategic sense to the participants.
4.3.2. **ARCON External (exogenous) elements.** The industry participants intend to enhance their market position either through improving internal processes and/or developing new products which may lead to new business models. In doing this they will draw on their traditional supply chains, and may supplement them as needed. Potential beneficiaries are the participating firms, their clients, some established suppliers and new suppliers. These firms may have to access support services from regulatory authorities and technology researchers outside of the project team to achieve certified status for their individual innovations. It is expected that the participating firms will engage with their local communities where they hope to have a positive environmental impact, however it is also expected that their dominant constituency will be drawn from their economic network.

5. **WORKING TOGETHER: THE INFLUENCE OF PARTICIPANT COLLABORATION EXPERIENCE AND THE EXTENT OF COMMITMENT**

Drawing on the ARCON model seemed to emphasise structural aspects of collaboration. However, in our experience as practitioners, we observe that matters of agency are also important and can play a role in facilitating the transition between stages in the innovation process (Bessant and Rush, 1995; Hyland and Beckett, 2009). In this section we shift the discussion to focus on the participants, who need to be competent in a number of ways to achieve the goals of the CNO. Universities are the drivers of our case study project. Consistent with the national ambitions of government project sponsors, one of our project goals is to increase the frequency of collaboration between academia and industry.

Some IMP Group researchers take the view that firms are continuously embedded in networks in their day-to-day operations, and have considered this engagement from the perspective of the firm (Håkansson and Ford, 2002). This might suggest industry participants should be good at managing in networks, but we observe (Berendsen, 2004; Berendsen et al, 2009) this is not necessarily the case. Ford et al 2003 introduced the idea that an individual firm’s perspective is influenced by three interlinked things: the nature of networking activities, the nature of outcomes from networking and the firm’s “network pictures” (or “Netpics”) - how they think about networks (Figure 2). Netpics may
be influenced by perceived antecedents and focus, relative importance, content (scale and scope), and to apparent coherence.

In our project, we want to deliver concrete outcomes for the industry participants, creating an attractive focus of relative importance. From an antecedent perspective however, our experience with many other cases suggests that firms not only have different views of collaboration, but they have different capacities to benefit from it. The current position of a firm may be assessed in terms of their relative collaboration engagement maturity level: awareness, exploration, commitment, expansion and exploitation (Berendsen, 2004). This has parallels with the literature on absorptive capacity (Cohen and Levinthal, 1990; Zahra and George, 2002) which suggests that firms need both the capability to explore opportunities and to exploit them to benefit from new ideas, and that there are evolutionary stages in building absorptive capacity.

These stages of engagement are like the ARCON framework life cycle stages, but we would like to make a point about synchronization - that individual participants may be at different stages of their personal journey to extract benefit from collaborating at any stage of the collaboration project life-cycle. We have presented commitment here as a stage, but we also observe that the extent of commitment varies between firms, and between individuals within firms, and this influences the role they may take. They may become project champions or focal firms, or they may be relatively passive participants. In our experience, trying to manage a collaboration of passive participants is a tough job.

6. DISCUSSION

We start our discussion with some reflections on using the ARCON framework. In section 4 of this paper we worked our way from the top down through the ARCON framework to develop a relatively succinct description of our project. This helped us to position the project in the CNO space, and to consider a lot of things that need to be attended to. We have also worked our way from the bottom-up in support of the implementation phase. We made spreadsheets for each of the three networks described in section 4 that mapped the four endogenous interaction dimensions (structural, componential, functional and behavioral) against their lower level categories (active entity, passive
entity, action, concept) to look at potential interactions. We did the same thing for the exogenous elements. We found this quite time-consuming, and in broad terms, we found ourselves constructing a re-formatted version of our (23 page) project plan submitted to the funding authorities (before we considered using the ARCON framework). We might simply conclude from this observation that the ARCON framework and the requirements of the funding authorities represent compatible views of how to organize a ‘good’ project. Both require some attention to detail that makes sense to experienced project managers.

In section 5 of the paper, we were essentially considering the inclination of key people to collaborate and their related knowledge and experience - what are their “network pictures” (Figure 2). In the ARCON framework this is represented as a passive knowledge asset - “an actor’s competency is the actor’s capability to perform (business) processes (in collaboration with partners)” (ARCON, 2007 p34).

From the point of view of networking (Figure 2), we have intersecting social and information networks. From the point of view of network outcomes, (Figure 2) we have intersecting information and technology networks that support the innovation activities of the industrial partners. An information network having both social and technology content should be an effective linking tool. This is broadly identified as a passive ICT software entity in the ARCON framework - “In addition to management services, it often includes collaboration support functionalities” (ARCON, 2007, p34).

From the project management point of view, the key actor is the lead university for applied sciences with a regional orientation. From an implementation perspective, the regional universities are the key actors as intermediaries between the international university network and the industry participants. It is important that the regional universities take ownership of and utilize the project information network, regardless of who develops and operates it.

7. CONCLUDING REMARKS

Collaborative Network Organisation modeling tools can help researchers better understand such organisations. Not all of them will necessarily help a project manager design and operate a complex
collaboration, but the ARCON framework has this potential. We have used the framework in a top-down fashion to construct an overview of our project, and we have used it in a bottom-up fashion to help develop project implementation details. We described the project as three intersecting kinds of Collaborative Network Organisation, each of which had different objectives and different kinds of complexities, and we plan to establish a form of learning laboratory IT portal as a linking mechanism.

For the industry participants, ARCON project mapping may beneficially influence the “network pictures” (Figure 2) of the enterprise and the practice of networking, but it is the network outcomes that matter. This puts a focus on the endogenous functional dimension of the ARCON framework in the pursuit of concrete outcomes. This dimension has active components of fundamental network management processes and participant internal operational processes, and has conceptual components related to interaction methodology and approach. In our project we intend to use previously developed instruments to assess the needs of industry participants in this context – what are they already good at, and where is there scope for improvement. The ARCON framework document (ARCON, 2007) also provides a substantial list of practical things to consider, such as IP management within the functional dimension.

Whilst the ARCON framework provides a comprehensive checklist of things to consider, three issues emerged in this study of its application. Firstly, we consider that some prior experience in the management of Collaborative Network Organisations was needed to separate the critical factors from those likely to have less impact in a particular case. Secondly, the framework presents a structural view that needs to be complemented with consideration of agency matters, such as the level of prior collaboration experience of the participants. We suggest an enterprise ‘network pictures’ perspective (Figure 2, Ford et al, 2003) can help consideration of agency matters. Thirdly, matters of synchronization between participant capability development and the CNO life-cycle stage need to be considered in considering the nature of interactions between the participants.

This paper makes two contributions to the literature on Collaborative Networks Organisations. We present findings from a real-world application of a newly developed model, ARCON; and we propose that a participant agency perspective is needed to supplement the primarily structural (but insightful) view provided by ARCON.
8. LIMITATIONS AND OPPORTUNITIES FOR FURTHER RESEARCH

This paper presents a single study using a single collaborative network organization modeling framework. We have not attempted to use alternative models and compare them in the paper but this represents an opportunity for further research. In addition, there will be an opportunity to re-visit this topic in a few years, when our international collaboration project is completed.

REFERENCES


**FIGURES**

**Figure 1.** An Overview of the ARCON Reference Modeling Framework

**Figure 2.** A View of Collaboration from within an Individual Enterprise (Adapted from Ford, Gadde, Håkansson & Snehota, 2003)