Enhancing inter-organizational resilience by loose coupling concept and complexity paradigm

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Abstract. During a co-design project, we modeled formal and informal cooperation which are expressions of tight and loose couplings. Our findings confirm that loose couplings are crucial since they enable self-organization and emerging processes which often underlie success of co-design. We offer new insight into management and organization theories by presenting an *inter-organizational resilience model* which explains how non-deterministic couplings can enhance inter-organizational resilience.

1 INTRODUCTION

To achieve a long-term competitive success, firms need to work with several partners to have the capacity of generating common knowledge and applying it in the form of innovation. By this way, architecture of design in aeronautical domain has become more and more complex in recent years and its management is no longer confined to the inside of the firm since linkages cross its boundaries [Lalouette, 2007]. For implementing resilience between organizations, both project level cooperation and firm level linkages need to be taken into consideration. The aim of this article is to enhance inter-organizational resilience by proposing a conceptual framework which combines loose coupling [Weick, 1976] and organizational learning [Argyris, Schön, 1978] concepts within the complexity paradigm. To this end, we show how formal and informal cooperation are expressions of tight and loose couplings within a complex socio-technical system. Loose coupling and organizational learning underlie the reputation of HRO, the High Reliability Organizations school [Weick, Sutcliffe, 2007]: when they are enabled the resilience is enhanced [Bierly, Spender, 1995]. Unlike tight couplings, the outcomes of loose couplings are non-deterministic. How can non-deterministic couplings enhance resilience? This question is controversial for management and organization theories which deal classically with deterministic models. After an analysis of empirical data, we present an argument for an *inter-organizational resilience model*

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which answers this question by using a systemic approach. First, we proposed a way to improve the loose coupling conceptualization to assist with our specific research objectives. Then, we examined a co-design project (*i.e.* a *common design of joint partners*) and conducted semi-directed interviews by employing a qualitative analysis method on the information and knowledge flows. After that, we used our loose coupling conceptualization to instantiate loose couplings that we have recorded. Finally we modeled co-design in order to understand relationships between loose couplings and their outcomes. The empirical part of this study concerns a co-design from an aeronautical company and one of its risk sharing partners. Our findings confirm that loose couplings are crucial in complex socio-technical systems since they enable self-organization and emerging processes which often underlies success of co-design.

2 RELATION TO EXISTING THEORIES AND WORKS

Summing up prior studies, Williams points out that inter-organizational cooperation lies mainly in the sustained contractual linkages and social relationships among partners [Williams, 2005]. Co-design is a specific inter-organizational cooperation which enables products to emerge from multiple design interactions between organizations. During a co-design, actors from different organizations work within a single spatial location – commonly called a *plateau* – whose aim is to enable informal cooperation. Examining such projects during the past decade, we observe a significant increase in uncertainties, project risks and complexity [Choi, Krause, 2006; Williams, 2005]. We mobilize the concept of loose coupling as a way of studying complexity of such projects. Loose coupling has been mainly developed in Weick's work on loosely coupled systems [Weick, 1976]. More recently this latter phrase was more clearly conceptualized by Orton & Weick [Orton, Weick, 1990]. The loose couplings include implicit and non-deterministic interactions [Rochlin, 1993], flexible routines [Grote, 2006] or self-organizations and emerging processes [Pavard *et al.*, 2007]. As opposed to loose coupling, the tight coupling concept is characterized by strong dependencies between elements of a system [Perrow, 1984]. The tight couplings include explicit and deterministic procedures, official reviews or contractual commitment. We try to understand how loose couplings enable organizational learning; and particularly learning across multiple organizations [Chena *et al.*, 2007]. Organizational learning is a characteristic of an adaptive organization whose actors are able to sense changes in signals from their environment. Actors try to change organizational functions and structures of their organization according to these signals. Three level of organizational learning have been considered. First, single-loop learning is a simple error-and-correction process. Then, double-loop learning is an error-and-correction process modifying organization's underlying norms, policies or objectives. Finally, deutero-learning is learning about how to carry out single-loop and double-loop learning. Organizational phenomena are sometimes discussed in terms of complex systems because the complexity paradigm is the only theoretical framework which is able to explain self-organization and emerging processes [Pavard et *al.*, 2007]. By definition, complex systems are non-linear and non-deterministic: their elements interact in a systemic way with both positive and negative feedback which can lead to strong and

unforeseen effects in other parts of the system [Weick, Sutcliffe, 2007]. When organizations are complex, research suggests that there is no simple way to take control over development. To hope that more formalization could resolve this issue can be rather fruitless. This is why managers need to accept and to cope with complexity: a wiser strategy might ensure more organizational learning that could in turn enhance resilience.

3 RESEARCH APPROACH

We conducted a literature review to establish the state-of-the-art and to propose an improved conceptualization of the loose coupling according to four parameters:

1. The cause(s)[2] of the loose coupling (e.g: authority delegation or culture).
2. The consequence(s)[2] (e.g: innovation or information buffering).
3. The category[2] (e.g: intra-organizational or inter-organizational).
4. The organizational learning level (from single-loop one to deutero-learning).

For documenting formal and informal cooperation, and to study tight and loose couplings, we employed a qualitative analysis method on the information and knowledge flows [Wybo et *al.*, 2003]. This methodology is to closely examine tasks, activities and work of the actors in order to determine: a) the actions inside and between organizations; b) the links between the sequences of events; c) the sense-making of actors concerning artifacts, events and environment. Our *corpus* of gathered empirical data includes: a) discourse from semi-directed interviews; b) pictures and notes from field observations (contexts, actions, behaviors, *etc.*); c) and official companies documentation such as legal contracts and procedures. We analyzed the data according to the three spheres of continual interaction existing within socio-technical systems: the technical, the human and the organizational spheres. Data then has been treated according to two modeling dimensions. First, the *inter-organizational modeling* allowed us to represent where and how the actors worked and networked. Then, the *co-design workflow modeling* allowed us to reconstitute the various steps of the co-design between organizations. Finally we instantiated loose couplings according to parameters determined based on our conceptualization. During an observation on a *plateau*, 30 semi-directed interviews, lasting approximately one hour each, were conducted with engineering and management executives of the aeronautical company and its risk sharing partner under study.

4 FINDINGS

The empirical data enabled us to identify tight couplings, to instantiate loose couplings and then to describe the relationships between theses couplings and their outcomes.

4.1 Inter-organizational and co-design workflow modeling

Hereafter we describe data as examples of part of the *corpus* that we have analyzed.

Ex. A - Interview with a stress engineer: “Due to the size of the organizations [both

[2] This parameter comes from the conceptualization of Orton & Weick [Orton, Weick, 1990]

partners], to look for and find – then to talk with – the right person is more and more difficult. We haven't other choice: we use our personal network to find the information we need, even if we have always to overstep hierarchical and organizational marks."

Ex. B - Observation of an informal management meeting: A says "You know that your team shall be organized as a mirror of ours?", B replies: "We shall… but we can't work with a work package organization as you. We can't change a life long way of working! Our overall thought is definitely component-focused, not package-focused.", A concludes: "OK, OK, so that means we'll just have to coordinate differently together."

Ex. C - Interview with a stress engineer: "When a guy from our partner has to ask us a question, my boss [the stress leader and official responsible] always says to him to go directly to talk with me. We gain so much time without this hierarchical relationship."

Ex. D - Interview with a design engineer: "Even if it's not my job, when they have an idea that we have already test, I say to them 'Hey, we've try this way but without success because (…). I would forget it if I were you'. Plateau is done for this kind of action."

Ex. E - Interview with a program manager: "The PPM – the Project Progress Meeting – is a weekly but unofficial meeting. It's written nowhere to do a PPM; you can't find any information about PPM since it's not expected by contract, nowhere. However we wished to build it – together – to have a brief overview of where we are / where we go."

Ex. F - Interview with a design engineer: "I know it's the beginning… but too many designers of our partner work outdoors so that means that we do twice the same work."

Analysis of these examples shows empirical evidences about loose couplings outcomes:

A) An inter-organizational social network emerges to cope with the complexity of the joint organizations: simple but powerful practices shortcuts official boundaries.

B) An organizational interface is collectively built by project managers to articulate cooperation: the formal organization is modified and enables actors to converge.

C) An informal settlement is agreed between partners to be more efficient: actors do not modify formally their hierarchical policy but they learn the point in delegating.

D) Knowledge and advises are freely shared because a membership feeling appears: this outcome customarily found within *plateau* is the most basic but efficient one.

E) Events are self-organized according to the inter-organizational coordination needs: this meeting is become a quasi-official event thanks to its short-term benefits.

F) Cooperation opportunities are rather inexistent and the work is done twice: actors of both organizations work more – for less results – and each in his own way.

The instantiated loose couplings for both modeling are summarized in Tab. 1 and Tab. 2.

Table 1. Instantiated loose coupling for the *inter-organizational modeling*

Ex.	Cause	Consequence	Category	Organizational learning
A	Complexity	Hierarchical shortcuts	Inter-organizational	Single-loop
B	Needed convergence	Behavioral discretion	Inter-organizational	Double-loop
C	Authority delegation	Efficiency	Intra-organizational	Single-loop

Table 2. Instantiated loose coupling for the *co-design workflow modeling*

Ex.	Cause	Consequence	Category	Organizational learning
D	Membership feeling	Increased advices	Inter-organizational	Single-loop
E	Needed coordination	Ensured cooperation	Inter-organizational	Double-loop
F	Limited cooperation	Ineffectiveness	Inter-organizational	Ø

4.2 Co-design workflow and inter-organizational models

From this data analysis, we observed that loose couplings have positive (Ex. A to E) or negative consequences (Ex. F): they enable – but sometimes hinder –organizational learning. From a systemic point of view, the three first examples are structural regulations: new structures emerge for restoring the initial co-design functions. On the other hand the two following examples are functional regulations: negative feedback and facilities emerge for bringing back the co-design functions to their initial stage. The two figures below are illustrative instances of our two modeling. The *inter-organizational model* presents structural regulations between organization (*cf.* Fig. 1) and of the *co-design workflow model* presents functional regulations during co-design (*cf.* Fig. 2).

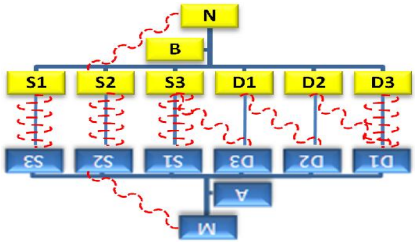

Fig. 1. Inter-organizational model

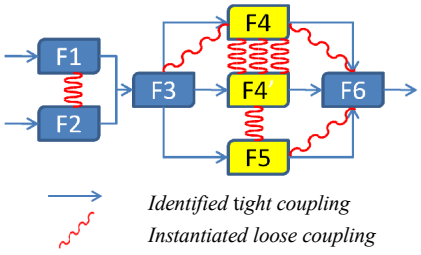

Fig. 2. Co-design workflow model

4.4 Inter-organizational resilience model

From the whole analysis of our *corpus*, we found empirical evidences about tight couplings and loose couplings. By formalizing organizational structures and functions, tight couplings enable employees – and especially managers – to foresee process outputs and to plan projects in an idealistic optimized way: they clearly improve co-design effectiveness. By enabling informal cooperation, self-organization and emerging processes, loose couplings often underlie the success of formal cooperation; they clearly

improve co-design efficiency. Loose couplings are the foundation for co-design performance, from day-to-day work to resolution of complex problems, since they ensure more organizational learning that in turn enhances resilience. In fact, organizational structures and functions evolve thanks to both kinds of coupling: this provides the balance between control and freedom required during co-design. Besides, we can notice that deutero-learning is also implemented within the studied *plateau* by at least two means: a *lessons learnt process* whose aim is to improve expected technical issues for further programme and a *learning organization process* whose aim is to do continuous improvement about unexpected organizational issues for current programme. These organizational learning are respectively long-cycled and medium-cycled; we define them *foreseen resilience* (*i.e.* resilience for adaptation). On the other hand, very few things are done within *plateau* to promote and spread short-cycled organizational learning; we define it *emerging resilience* (*i.e.* resilience for adaptability). We consider all these findings into an *inter-organizational resilience model* for co-design (*cf.* Fig. 3).

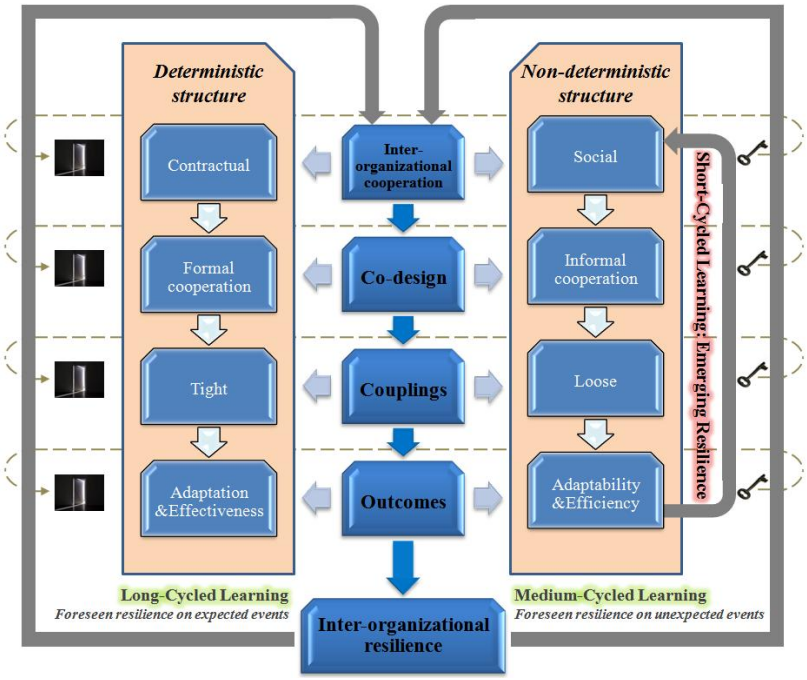

Fig. 3. Inter-organizational resilience model

5 CONCLUSION

Inter-organizational cooperation is getting complex and complex: to manage holistically becomes merely impossible. Unplanned events often take place during co-design and, in most cases, only relying on the existing knowledge basis cannot develop appropriate problem-solving solutions. In this study, we explained that loose couplings create self-

organization and emerging processes enabling actors of different organizations to make functional and structural regulations. The model that is introduced goes beyond a mere description of the system by offering a new insight into cooperation and management: this model shows why managers have to increase loose couplings. Actually, partners of an extended enterprise need to freely learn relevant knowledge from each other. To this end, they need to combine their knowledge by a distributed and bottom-up control to improve organizational learning and ensure decision-making. But how can we theoretically combine a top-down centralized control with a bottom-up distributed cooperation? Our next step will be to provide dialectic thanks to complexity paradigm on this different comment about organization theories. After the completion of this final step, we will develop and test the application on co-design of newly developed material and process artifacts, with specific outcome objectives, informed by the holistic understanding of loose couplings. Actors will be able to use these artifacts at their discretion, according to their operational needs and opportunities [Pavard et *al.*, 2008].

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