A systemic approach for BIM-based collaboration study in Construction

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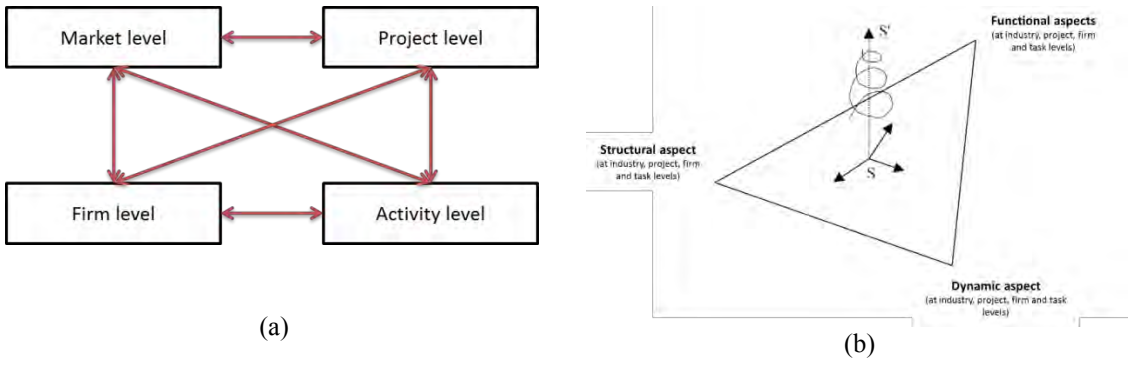
Extended abstract:

One of the main issues in the construction industry is related to collaboration and information exchange [4] and collaboration in the industry remains problematic despite much effort devoted to understanding and improving it. The increasing adoption of the Building Information Modeling (BIM) approach highlights contradictions related to current methods of managing collaboration in construction projects (e.g. discontinuity between information flow and activity flow). An important problem of research in the construction sector has been the lack of theoretical basis [1]. Several seminal works laid the foundations for the study of information technologies in construction [2,3]. The study of BIM-supported collaboration must take into account not only its technological aspects but also the procedures and organizational dynamics [4,5]. Four theoretic levels are generally used to study the construction industry: the market, project, firm and task levels. Some theoretical approaches exist and are of course very relevant for each of these levels. For example, while the TFV [1] approach is very relevant to study the construction production at a project level, the recent work from Succar and Kassem [6] is full of potential and provides new avenues to study construction at the level of the industry, and Halin et al. [7] have shown that understanding the collaborative activities can be helpful in order to adapt IT tools to the practitioners' business needs.

The current missing links in the study of collaboration in the construction industry seem then to lie, not in the understanding of these four levels themselves, but in the complex relationships between the levels. Indeed it appears necessary to explore how and to what extent the formal and informal processes and structures (re)created by construction projects [8] could be explained in a large proportion by the bidirectional relationships between some factors from the different levels considered (Figure 1a). In order to understand these relationships, a systemic triangulation can be particularly helpful if it can integrate the structural, the functional and the historical aspects [9] and be declined according to the four main levels described above: the industry, the project, the firm and the activity levels (Figure 1b).



(a) (b)

Figure 1: (a) Bidirectional relationships between the different levels and (b) construction systemic triangulation adapted from [9]

Table 1 shows a resulting matrix from such systemic triangulation and provides a view of the different elements to consider. The main aim here is to identify the main elements and factors that could explain the complexity of the relationships between the different levels.

Table 1: Matrix of functional, structural and dynamic aspects according to the different levels

	Functional aspect	**Structural aspect**	**Dynamic aspect**
Industry level	Environmental changes	Market (as fragmented social network)	Industry policies and techniques evolution
Project level	Building (as a product)	Project (as temporary supply chain)	Project lifecycle evolution
Firm level	Firm strategy	Firm (as permanent organization)	Firm historical evolution
Activity level	Building (as a process)	Activity (as practice)	Generally accepted practices evolution

At the industry level, the role of the construction market as part of the local and/or global economy is considered. According to Sunke "it is a major sector in most national economies and a major contributor to environmental changes, both in terms of designing the built environment as well as in terms of anthropogenic effects on the environment" [10]. At this level, the system is structured as a social network made of integrators bodies (all architects, engineers and contractors), superstructure bodies (all clients, regulators and professional institutions) and infrastructure bodies (all trade contractors, specialist consultants and component suppliers) identified by Gann [11] and Winch [12]. This network evolves according to the industry policies but also according to the bidirectional interaction between the technological innovation drivers.

At the project level, the purpose of the system is the building as a product. At this level, the system is structured as temporary supply chain made of some of the bodies identified above. The common goal of this supply chain is the beginning of the life of the product (planning, design, and construction phases). Depending on the specific project delivery method used, the different bodies will be temporarily involved in different activities during the product lifecycle stages. They have to combine their effort in order to achieve the overall common objective: the product. But besides this common goal, it is important to note that each firm involved has its specific objectives and perspective of the product.

At the firm level, the strategy of a firm is considered. The strategy here encompasses both corporate strategy and business strategy. According to Cheah and Garvin [13], the corporate strategy is related to the entire organization operations while the business strategy is about individual business units' ventures. In its historical evolution, the firm is working to achieve and to maintain a competitive advantage [14]. In the framework of a construction project, the firm perspective is intrinsically linked to this competitive advantage and not only to the instant economic interest. It could be a matter of acquiring new experience or technology, of improving reputation and portfolio, of developing or experimenting new processes and technologies. This also contributes to the way the firm is perceived and perceives other in the community, with some consequences on the inter-firms dynamics.

At the activity level, the building (as a process) is considered. The activity here can be seen as a subset of the project in the form of a collaborative practice. Halin et al. [7] defined collaborative practices as "the behaviors of groups of actors working together in various organizational situations according to business objectives". Some generally accepted practices exist in the industry and are the basis of the collaborative practice. They evolve according to the evolution of construction techniques and technologies.

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