Megaprojects, due to their CAPEX size, duration, impact on human communities and the environment demonstrate unique requirements for delivery organizations. Coping with such requirements requires addressing multidimensional environment of technology, local regulative and institutional setting, financial industry, employment market and above all the holonic nature of these categories. A sum of the above dimensions forms determinants of local project environment. From the contractor viewpoint, operating in multiple environments means facing the challenge of balancing the global and local practices (Bartlett and Ghoshal, 1989). Megaprojects meet a variety of pressures and demands from local environments (Floricel and Miller, 2001; Oliver, 1991). Such changing nature of capabilities is conceptually described as dynamic capabilities. The term dynamic refers to the ability to reconfigure firm’s capabilities and create responses to requirements of complex environment - they are needed to adapt to or evolve in line with the external environment (Teece and Pisano, 1994; Teece, Pisano and Shuen, 1997). For project business, this means adaptations and modifications of routines, processes and polices in order to transfer firms knowledge and capabilities in the project itself. Therefore, in addition to firm focused dynamic capabilities, a structural requirement in project business is project capabilities (Davies and Brady, 2000). By nature, projects operate in more or less independent mode of the firm therefore, transfer of capabilities from firm to project is critical.

Prahaland and Doz (1987) describe a challenge of multinational corporations that try simultaneously to pursue local responsiveness and company-wide integration of activities. Lasserre (2003) delivers the push factors for localization i.e. local responsiveness by stratifying pressures for responsiveness in four categories; technical, cultural, commercial and legal factors. Technical factors refer to regional standards, spatial presence, transportation and language that can all reduce economic logic behind the business model e.g. standardization; cultural factors include regional attitudes and tastes, behavior and social codes that can also influence the outcome of standardization; commercial factors cover variety of supply and sales networks e.g. customization; legal factors that encompass regulations, are actually the most explicit constraints.

Project-based organizations (PBO) (Whitley, 2006; Hobday, 2000) use projects as their production units, integrate heterogenous resources for temporary collaborative action (Lundin and Söderholm, 1995). Project-based firms are found in a broad array of industries, such as consulting and professional services, cultural industries, high technology and complex products and systems (e.g., construction, transportation and telecommunication) (Sydow et al., 2004). Scott (1992) describes the requirement of project business for simultaneous adaption within multiple technological and societal dimensions and the role firm plays to designing systems that retain sufficient unity and coherence to operate as a common enterprise yet, at the same time, to allow sufficient reach and flexibility to adapt to variety of circumstances.
Dynamic Capabilities

PBOs deliver projects in diverse institutional environments. As described earlier, firms often encounter local conditions and circumstances they are not prepared for and they need to respond to such requirements posed by the external factors. Considerable literature stream deals with capabilities that firms need to transform themselves for addressing the opportunities and threats on markets. The concept of dynamic capabilities entails changing nature of local market and the industrial competition (e.g. Teece et al. 1997; Eisenhardt and Martin, 2000; Helfat, 1997; Makadok, 2001; Winter, 2003; Zollo and Winter, 2002; Zott, 2003). Key concept behind dynamic capabilities is renewal and reconfiguration od resources. Teece, Shuen and Pisano (1997), taking form the resource-based view (e.g., Barney, 1991; Wernerfelt, 1984), introduce the concept of dynamic capability referring to those capabilities that enable adaptation to external environments characterized by rapid or discontinuous change and which are linked with competitive advantage. Eisenhardt and Martin (2000) recognize moderately dynamic or high-velocity markets and correspondingly different features of dynamic capabilities. Eisenhardt and Martin (2000: 1107) point that dynamic capabilities are processes embedded in firms used to integrate, reconfigure, gain and release resources – to match and even create market change. A side of processes, dynamic capabilities include policies, routines and or collection or routines (Winter, 2003), i.e. a learned and stable pattern of activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness” (Zollo and Winter, 2002: 340). Helfat and Winter (2011) defines dynamic capabilities as the capacity of an organization to purposefully create, extend, or modify the resource base” Functioning and evolvement of dynamic capabilities has been a theme of number of reports (e.g. Helfat, 2000, Helfat and Petegraf, 2003, Benner and Tushman, 2003). Aside from dynamic capabilities, literature recognizes functional capabilities Chandler (1990) and operational capabilities (e.g., Winter, 2003; Helfat et al., 2011) that support firms’s existing competitive position and allow performance on an ongoing basis (Helfat and Winter, 2011). Longitudinal perspective explain the coexistence of dynamic and operational capabilities i.e. for future survival firm needs dynamic capabilities to explore future opportunities and respond to threats while keeping operative capabilities for daily business (Helfat and Winter, 2011). However, it has been noted that the distinction between dynamic and operational capabilities is blurred, due to the fact that change is always present to some extent and it is impossible to objectively distinguish radical and non-radical change as well as new versus existing business (Helfat and Winter, 2011).

Project Capabilities

In regards of capabilities concept in project business, PBOs, have created core capability in managing projects (Söderlund, 2005). A standard dynamic capability in non-project organizations is learning while at the same time, due to the local nature of knowledge, temporality and non-repetitive character of projects learning remains a challenge in PBOs (Prencipe and Tell, 2001; DeFillippi, 2001; Keegan and Turner 2001; Scarbrough et al., 2004; Grabher, 2004). These may cause problems for learning on projects, and transferring knowledge in the organization (Söderlund and Tell, 2009). Project management literature (Morris, 1994; Iansiti, 1995; Shenhar and Dvir, 1996) is used as a startpoint for concept of project capabilities that Davies and Brady (2000) define as the knowledge and experience required to engage with customers, suppliers and other project stakeholders, to develop bids and offers, and set up and implement projects. Among core activities of engineering PBOs are bidding for and delivering projects within budget, on time and to unique specifications. This is achieved through design
and deployment of complex socio-technical systems in low volumes to fit specific dynamic requirements of the market and institutional setting.

In a broader sense, PBO need to assemble a project resources for successful project selection, engagement with customers and suppliers and the ability to manage the activities involved in project implementation, hand-over to the customer, and provide after-sales support (Davies and Brady, 2000). For previously described problem of learning and capability building in PBOs Brady and Davies (2004) provide solution in terms of two interacting levels of learning; project-led and business-led. March (1991) describes two distinct operational stages in the firm ie. exploration and exploitation. In term of project capabilities building, where exploratory learning is being done while experimenting with single project bid or new work practicites in unfamiliar conditions. Such exploration provides experience and sets successful practices in a human and structural capital of PBO ready to be exploited in similar setting (Brady and Davies, 2004). In addition to project capabilities concept development, Söderlund and Tell (2009) analyze dynamics of project capability at the firm level and learning mechanisms inside a project (Söderlund et al.2008). Ruuska and Vartainen (2003) propose a concept of critical project competences based on finding of exploratory research, by stressing that shared understanding and ability to communicate throughout the project network form collective critical project competences.

MEGAPROJECT - COMPLEXITY LENS IN PROJECT BUSINESS

Number of extremely large engineering projects has been growing rapidly over the last few decades (Flyvbjerg et al., 2003; Grün, 2004; Miller and Lessard, 2000). Literature dealing with megaprojects is substantial and is characterized by diverse contexts and perspectives. Regarding context of the empirical studies, it ranges from organizational change projects to international engineering projects and from arms, energy, power, and transportation to nuclear projects. For the built environment, a megaproject literature can be seen as sum of conceptually converging themes i.e. global projects (e.g. Binder, 2007; Orr, 2005; Orr and Scott, 2008), multinational projects (Ochieng and Price, 2010, Aaltonen et. al, 2010) and international development projects (Ahsan and Gunawan, 2010; Diallo and Thuillier, 2004). Grün (2004) provides analysis on the management of giant international projects that involve multiple organizations. Flyvbjerg et al., (2003) dissect risks and the weaknesses in the conventional approaches to megaproject development. Morris (1994) and Morris et al.(1987) elaborate the role of externalities, institutions and strategic issues in major projects and implications for traditional project management. There is a valuable empirical literature on large projects typically in international project contexts (e.g. Flyvbjerg et al., 2003; Grün, 2004; Miller and Lessard, 2000; Morris and Hough, 1987). Institutions, risks, stakeholders and governance frameworks in large projects are Also analyzed in literature (e.g. Flyvbjerg et al., 2003; Grün, 2004; Floricel and Miller, 2001) In the end, IMEC research program analyses changes occurring in the set-ups and environments of large international engineering projects with a focus on strategic front-end phases (Miller and Lessard, 2000)

In traditional discourse in project management, a large majority of the team members are working for the same organization and share single location (Binder, 2007) while megaproject typically include diversity of agents bringing in various institutional perspectives. Mega projects in the built environment are implemented in dynamic organizational networks and involve a variety of internal and external local stakeholder organizations with their institutionalized values, norms, practices, expectations, socio-cultural backgrounds and demands.

Following the above Binder (2007) interprets project complexity with locations distance, different organizations, country cultures, different languages, and time zones. This is a
descriptive approach to complexity that focuses on complexity factors by mere project characteristics. In addition to Binder (2007), Vidal et al. (2011) Bosch-Rekveldt et al. (2011) with TOE framework set even more granulated pot of complexity factors that surround major categories of Technology, Organization and Environment. This stream of research has a strong foothold in technically oriented “control and planning approach” to projects. Opposing to descriptive view of complexity, here comes complexity lens or complexity theory which draws from biology and cybernetics. A key concept behind is a complex adaptive system with its key characteristic of emergence, feedback mechanism, non-linearity, out-of equilibrium and interconnectivity (Urri, 2005; Cilliers, 1998; Eve et al., 1997; Prigogine, 1997; Barabasi, 2002). Complexity theory evolved in natural sciences and has been recognized by scientist as applicable in studying organizations and management principles. A so called “Complexity lens" is being recognized as a powerful tool for understanding behavior of large population systems (Tsoukas, 1998, 293). For the last twenty years, it has caught a grip in management science. Topics like complex strategies and have contributed to development of decision theory (Witte et al, 1972, Klein et al, 1993), strategic management (Rivkin, 2000) and project management (Pryke and Smyth, 2006). All stated above reveals that current literature does not consider resources and respective capabilities of the Megaproject contractors in relation to complex behavior of project based socio-technical delivery systems. Sharing that perspective, this research considers features of complex adaptive systems in megaproject contractors organizations. By using theory based research framework, complexity supporting policies, routines and processes are captured and assessed against their origin.

Further deliverables to be expected as in Work plan:

In this research, expected deliverables are reports to SPE working group and academic papers published with acknowledgment to COST Megaproject. Reports will contain processed findings based on empirical data and current theory. Initial report can be expected as early as May 2014.

Literature

Bosch-Rekveldt M., Jongkind Y., Mooi H., Bakker C., Verbraeck A., Grasping project complexity in large engineering projects: The TOE (Technical, Organizational and
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