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A social-behavioural approach to project work under uncertainty

Hajnalka Vaagen*. Eirik Borgen Mathias Hansson*****

** SINTEF Technology and Society, Department of Applied Economics and Operations Research, Trondheim, Norway(Tel:+47-97000139; e-mail: hajnalka.vaagen@sintef.no); Molde University College, Molde, Norway (hajnalka.vaagen@himolde.no)*

*** SINTEF Raufoss Manufacturing, Trondheim, Norway (Tel:+47-47903839; e-mail: eirik.borgen@sintef.no)*

*** The Norwegian Business School, Department of Leadership and Organizational Behaviour, Oslo, Norway, (Tel: +47; e-mail: mathias.hansson@bi.no)*

Abstract: Engineering responsiveness is prerequisite to organisational success in dynamically changing engineer-to-order projects, such as specialised vessel construction. Creating flexibility by solving the true project planning complexity is difficult due to the involved uncertainties and dynamics, and classical models lack the flexibility necessary to adequately handle uncertainty. Model-based approaches are, therefore, frequently replaced by informal team processes and judgmental decision making, often demonstrating innovative solutions not visible within traditional approaches. We suggest that the core practice in handling uncertainty in technologically complex large projects is neither imposed by established hierarchies nor model-based decision support, but evolves from the lower level social-behavioural structures, and extend the scope of research to include behavioural characteristics in social networks of project work. We demonstrate a way to study and better align the social capital to enable project responsiveness; by e.g. identifying symptoms of dysfunctional information transfer, and key influencers which will make a change project successful. The main purpose is to gain familiarity with the social phenomena involved, in order to formulate a more precise problem.

Keywords: Social network, behavioural operations, project planning, responsiveness, uncertainty, shipbuilding.

1. INTRODUCTION

We consider an engineer-to-order (ETO) project based production system, where the planning- and work complexity is defined by short delivery times and frequent technical changes, leading to continuous adjustments in engineering, planning, procurement and execution. One example is offshore shipbuilding (Emblemsvåg, 2014), where engineering responsiveness to quickly adapt technical changes is critical for competitiveness. In Operations Research (OR) terms, this is a complex stochastic dynamic planning problem, stated as unsolved in Jørgensen and Wallace (2000). Attempts to formulate the problem exist (see Jørgensen and Wallace, 2000; Vaagen and Kaut, 2015), but these lead to very difficult models that are even hard to write down. And could the problem be formulated and solved, communicating the results would be a major challenge, due to the dynamic decision structure that emerges. Many of the existing OR solutions ignore, therefore, uncertainty and dynamics, and lack the flexibility necessary to adequately handle project uncertainty (De Snoo et al., 2011; Vaagen and Aas, 2014); i.e. the possibility to make decisions conditioned on new information. Information exchange in these models is generated by pre-planned tasks in the schedule. Re-planning is of course done in practices, usually by rerunning the models with new information. But that is still a reactive approach, with potentially high extra costs and disturbances.

Recognising the shortcomings of existing model-based decision aids, these are, in practices, largely replaced by judgmental decision processes, which often demonstrate good solutions not visible within the traditional models (Bendoly et al., 2006; Chinowsky et al., 2008); e.g. advanced design and engineering taking place concurrently with production, with overlapping activities that do not always follow the logic of sequential order (Emblemsvåg, 2014). To treat the problem judgmentally is, however, not less complex, and the behavioural aspects that may bias the decisions are many. Examples are incentive misalignment (Bendoly et al., 2006), social motivations (Urda and Loch, 2013), natural risk aversion (French, 1988), human limitations in working memory (Hogarth, 1991), invisible & illusory correlations (Schuyler, 2001). The Operations Management (OM) literature on planning through behavioural lenses is limited and relatively new though (Bendoly et al., 2006; Gino and Pisano, 2008), and we know even less about the impact of the social dimension of human behaviour on project performance. Bendoly and Hur (2007) point to 'supportive production management' as a driver of motivated actions and high levels of individual productivity. Cognitive feedback (as opposed to outcome-based feedback) is found by Sengupta and Abdel-Hamid (1993) to drive high performance in product design. For early discussions on communicating system dynamics see Bendoly et al. (2010) and Hämäläinen et al. (2013).

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The gap between practices and classical OR/OM models may stem from fairly basic behavioural assumptions that do not enable handling the biases listed above, but also from modelling approaches that do not consider the team aspect of projects (Emblemsvåg, 2014). We believe, therefore, the *social-behavioural mechanisms that facilitate responsiveness to project uncertainty* deserve more attention from the OM society. Hence this paper, with the main purpose to gain familiarity with the social phenomena arising in project work under uncertainty, in order to formulate a more precise problem and develop hypothesis in a next step, to establish the social-behavioural drivers of responsiveness. For clarity, by 'responsiveness' we refer to the project team's ability to quickly handle technical uncertainty. By this work we suggest a shift away from the classical aspects of project planning, with focus on modelling and optimizing tasks &resources, to the behavioural characteristics in social networks that facilitate performance.

The rest of the paper is organised as follows. The background, leading to the research foundation, is given in Section 2. An initial social network analysis is provided in Section 3. We conclude and indicate future research need in Section 4.

2. BACKGROUND AND RESEARCH FOUNDATION

The research foundation for our social-behavioural approach was developed by a series of incremental steps undertaken through a long term research engagement with a leading offshore vessel supplier. These are discussed below.

Firstly, initial contextual studies, complemented with established bodies of literature, led to the following understanding. The complexity introduced by design uncertainty throughout the construction processes, *along* with concurrency in design, engineering and execution (to continuously reduce lead times), dictates that the planning problem is very difficult. We deal with a complex stochastic dynamic problem (for more details see Vaagen and Kaut, 2015), with the general formulation stated as unsolved by Jørgensen and Wallace (2000). Acknowledging that existing model-based approaches fail to handle project uncertainty and dynamics in an adequate manner, it is intuitive that the drivers of high responsiveness observed in practices, are not connected to these models.

Secondly, the exploratory study led us to 'team abilities to share information and resources' and 'tacit knowledge' as aspects and mechanisms that *are believed* to facilitate responsive capabilities. Literature from the social sciences acknowledges that high performing teams and their ability to achieve synergies *are* increasingly related to project performance (Chinowsky et al., 2008; Mohrman et al., 1995). Such 'team' abilities are associated to the *social capital* of the group that is an indicator not just of the resources provided by interpersonal ties but also the knowledge of how and from where to obtain task related resources and information. Quite often *requesting or retrieving information* between team participants is considered to be a fundamental aspect of project execution (Jaselskis and Ashley, 1991; Katzenbach and Smith, 1993). Teams that are able to utilize on available social capital are characterized by ability to combine individual strengths and knowledge that exceed the capabilities of individual team members. Often effective utilization of social capital is associated with enhanced innovation, learning, and knowledge sharing (Chinowsky et al., 2008). Following the arguments, the network of social connections that exist between people, their shared values and norms of behaviour are critical assets to enable quick response to technical changes in projects. By this we suggest *the intention to work toward a system* to better describe the actual goal of the decision maker; i.e. the common assumption of 'rational decision-making' is violated by the project participants' social motivations, also discussed in Urda and Loch (2013). This recognition led us to the investigation of *social network analysis* (SNA) as a potential theoretical approach and methodology to study the social-behavioural aspects of engineering responsiveness.

Finally, the selection of SNA led to the question of what social-behavioural factors affect responsiveness to project uncertainty and performance, and how to analyse them within the network. The choice of the methodology suggests that these factors are related to the social capital: i.e. the *network of social connections* that enables effective transfer of task related information and resources in the project work, and *norms of behaviour within these networks* (i.e. trust, obligations, risk behaviour) that provide the motivation to combine resources and generate new solutions to emerging changes. These aspects define the micro-level behaviour in the project work, and are features of a social organisation that define organizational *social capital* (Borgatti et al., 2013; Putman, 2000). Social capital is found to be a major driver of high performance teams. The core idea of social capital theory is that social networks have value in contexts where social contacts affect the productivity of individuals and groups. Social capital theory indicates that resources available to one actor within an organization are contingent on the resources available to actors socially proximate to the person. Furthermore, the interpersonal ties that link people together exhibit different influences and behaviours, and directly or indirectly affect decision-making and bargaining power in projects. Therefore, *the manner in which an actor is connected within a social structure says much about available resources* (Burt, 1986; Marsden, 1990).

Our aim is, therefore, to provide insight into what we can learn by applying social-behavioural lenses to conduct empirical evaluations of responsiveness to project uncertainty. Without insight into the social mechanisms, the integration of the human factor into planning and decision-making would be limited to understanding the heuristics involved in these processes, as described by e.g. Kahneman and Tversky (2000), which may differ from those driven by social interactions. Social ties are particularly critical when *tacit knowledge* constitutes a large share of the available resources. While the transfer of explicit resources may (but need not to) follow formal process charts, effective transfer of tacit knowledge requires regular personal interaction and trust (Goffin and Koners, 2011), and can only be revealed through practice in a particular context (Schmidt and Hunter, 1993).

3. SOCIAL NETWORK ANALYSIS