The unexplored brutality of performance recipes

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THE UNEXPLORED BRUTALITY OF PERFORMANCE RECIPES

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Lean, Partnering and BIM are well-known recipes for construction industry improvement. However, the spread of the ideas, principles and technologies from the recipes into the industry is so far limited. This can be attributed to a gap between the persuasiveness of reductionist thinking and linear diffusion models on the one hand, and the realities of complex, messy, and fragmented construction activities on the other. Still, attempts are being made to broaden the appeal and increase the coverage of performance recipes - also by linking them together into a broader, but still vague notion of Integrated Project Delivery. It is unclear whether merging the different performance recipes and their underlying ideas actually makes sense. To address this issue, we develop a systemic perspective of construction and the complexity of construction is highlighted. Reductionist assumptions that the performance recipes build on are exposed as assumptions regarding complexity and complexity management are analysed. The basic relationships and tensions between recipes and the significance of conscientiously directing future innovation efforts, are highlighted.

Keywords: BIM, Integrated Project Delivery, lean construction, partnering, systems

INTRODUCTION

Since researchers at the Tavistock Institute of Human Relations in London during the 1960s drew attention to complexity as a core issue (Building Industry Communications 1966, Foster 1969, Higgin and Jessop 1965) there has been a stream of research on the effects of complexity in construction. Schumpeterian ideas on markets and innovation developed by Freeman and colleagues during the 1980s (Fagerberg *et al*., 2011) have in turn directed scholarly and political attention towards the derogatory effects that complex interactions and dependencies have on innovation in the construction sector, leading to dismal productivity trends and disappointing quality (Dubois and Gadde 2002, Manseau and Shields 2005). The Tavistock researchers recognized that construction communication takes place in a highly complex form of industrial production. Since then, much research has further developed this understanding (e. g. Gann and Salter 2000, Winch 2006), and has analysed in greater detail what the effects are of significant interdependencies between tasks, project phases, and organizations involved in the construction process (Gidado 1996, Kreiner 1995, Winch 2010, Orstavik, Dainty and Abbott 2015).

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In the context of a predominantly managerial discourse, despite recognising complexity innovation in construction tends to be seen as a one-way diffusion process. Innovation is to be facilitated by management and is equated with the beneficial spread of novel technologies and operational ideas to a population of firms: from those that are 'in the know' to those that are not. Innovation is furthermore equated to technological change, as the uptake of new materials, products, equipment or machinery for use in the building process, with little discussion of related adjustments on the side of application, in methods and production process configurations.

Given that the industry’s products and processes are dynamic and complex systems, dealing with the challenges facing the industry (in terms of productivity, quality etc.) cannot but depend on dealing with issues of interdependent systems. Making specific improvements to selected elements is often doomed - they do not make a lasting impact. Some issues can only be dealt with through actions that address structural aspects of the overall system. This we take to be an underlying reason why a number of broad improvement recipes have been devised. Lean Construction, Partnering and Building Information Modelling (BIM) are comprehensive and well-intended recipes for industry improvement and change. Lean Construction together with Partnering and BIM arguably form ‘primary performative improvement recipes’ in the modern construction industry (Sage, Dainty and Brookes 2012). These strategies represent different takes on what is needed, and they have so far been heralded by different people and different communities, making them stand out as diverse “schools” with distinct recommendations for what will deliver a re-constructed construction industry.

Despite rhetoric at times tending towards the euphoric, the actual performance effects of the recipes are more difficult to measure (Ilozor and Kelly 2012). The spread of the principles and related technologies has been slower than many would have hoped for. In part as a consequence, there are attempts made to bridge the conceptual gaps between the different approaches. For example, Sacks and colleagues discuss the potential benefits of combining BIM implementation with Lean Construction principles (Sacks *et al*., 2010), while Ilozor and Kelly discuss how an overall, Integrated Project Delivery approach can integrate with BIM (Ilozor and Kelly 2012). Is the idea of combining Lean, Partnering and BIM into an all-purpose, integrated strategy sound? Do the three approaches lend themselves to being merged with each other so as to align interests, practices and objectives based on a team based approach, based on multi-party agreements and the use of technology - BIM - that allows for much more extensive information sharing and collaboration between project participants? These are the two question posed in this paper, where we take as our starting point that construction processes are fundamentally dynamic and complex.

THE SYSTEMS PERSPECTIVE

From a systems perspective, complexity is a processual property that is derived from the configuration of elements and linkages in a system. In terms of managing systems, complexity poses different challenges in different kinds of systems. Coping with complexity depends in a fundamental way on whether the system is open or closed.

The Inexorable Complexity of Real World Systems

The basic definition of a system is simple: a system is a set of related parts (Bertalanffy 1971: 54-56, Buckley 1967: 9, Luhmann 1984: 41-44). Challenging a tendency to think about systems as more or less stable structures, Luhmann employs a dynamic - process - view when discussing the nature of systems and systemic complexity (Luhmann 1984).

Nicolis and Prigogine (1989) similarly define complexity based on the consideration of dynamic behaviour. For example, they show how naturally dynamic systems such as molecules making up a volume of liquid can display patterned but fundamentally unpredictable behaviour (Nicolis and Prigogine 1989, 8-15). It is this patterned, but in some aspects completely unpredictable behaviour, that they define as complexity (or complex behaviour).

Luhmann pursues a similar line of reasoning, namely that complexity is an attribute of any large, dynamic system. All elements must be connected to at least one other already related element, simply to be part of the system. Many elements and groups of elements are not linked directly but indirectly via other elements in the system. Complexity necessarily arises in systems as the number of possible linkages between elements becomes higher than the actual number of linkages that are established (Luhmann 1984: 45-47). Complexity, therefore, follows from incomplete integration of elements. In addition, elements and linkages, not least in social systems, are prone to influence each other.

A fundamental cause of complexity, then, is that elements have a limited ability to 'multi-bond' (or multi-task), in the sense that each element cannot uphold active linkages to more than a few other elements in the system. If elements possessed an unlimited capacity of multi-tasking, systems could in theory become large without becoming complex, but in any large, real world system there is no way to completely avoid complexity. Complexity can be changed qualitatively (structurally), and can be reduced by limiting the number of elements included in a system. However, as Ashby's law on requisite variety makes clear, this can only happen at a cost: a smaller and less complex system is less able to cope with a complex environment than larger and more complex systems (Ashby 1958, Luhmann 1984: 47-48). Changing the complexity in a given system is certainly possible, for example, when a project organization is reorganized into a more bureaucratic structure, or when one-way traffic is introduced in a logistical system on a building site.

Complexity in Open and Closed Systems

Ashby directs attention to the fact that systems generally exist in an environment, and that there are interactions between the system and the environment that are significant, but in terms of function are distinct from the system. To cope with a challenging environment, a system needs to uphold a significant level of complexity, and must therefore learn to cope with uncertainty and risk. This is different in a closed system, within which functionality can make the system stable and developments predictable. Considering society and organizations as systems, the question is whether these are closed or open. While Parsons (1979 [1951] tended to depict the social system as a closed system in equilibrium, organizational theorists challenged this (Scott 1987). Gouldner (1954) critiqued advocates of scientific management for unduly portraying production systems as closed off from their environment. Efforts to develop comprehensive, self-reliant production systems in his view were doomed.

Part of the problem Gouldner saw was that managerial thinking was reductionist in tending to deal with people as automatons. This kind of reductionism - which for obvious reasons also can be seen as embodying a considerable level of brutality with respect to dealing with workers - was exposed in the Hawthorne studies during the 1950s (Jones 1990), and key insights were re-articulated by Thompson in 1967. The argument he made was that a firm must be an open system. He directed attention towards his contemporary organizational theorists who argued that the organizational complexity that managers have to deal with is caused as much by the environment as it stems from the production system and the administrative system of the organisation itself (e. g. Cyert and March 1963, Simon 1973). While Taylor and his followers saw routines as procedures worked out scientifically and imposed on workers by unforgiving management, the new organization theorists argued that brutally imposed routines will tend to be ineffective. Routines can only provide heuristic templates for action. This difference forms the basis for the second and more comprehensive understanding of reductionism in the present paper. In non-reductionist organization theory routines have been defined as repetitive, interdependent action that emerges from interaction of multiple actors over time (Feldman and Pentland 2003). Pentland and Rueter (1994) similarly describe routines as ongoing and effortful accomplishments, hence as something very different from the management-defined action instructions envisioned by mainstream, reductionist project management theorists.

COMPLEXITY IN CONSTRUCTION PRODUCTION

Systems theory makes it possible to distinguish complexity in terms of the kind of system that complexity arises within. In construction, different forms of complexity arise in the technical systems making up the built object, in machinery and equipment used during the design and building phases, in the economic, contractual and administrative systems, and in the social systems. In all these cases, complexity entails a level of unpredictability and uncertainty, and therefore risk. In any of the systems, complexity has to be taken into consideration when systems are created and elaborated. Limiting the size and heterogeneity of systems; structuring systems hierarchically; and modularization of systems are three approaches to coping with complexity well-rehearsed in construction and building. Risk assessments made during operations is another example of how complexity is managed in practice.

That construction projects are temporary production organizations only strengthens the argument that construction production systems are open systems. Routines are complexity-processing devices that, for example, serve to reduce social complexity by providing functional connections among individuals and groups (Feldman and Rafaeli 2002). Routines also serve to co-ordinate the actions of individuals and groups within a construction project, while providing flexibility and adaptability to cope with the fluidity of situations (Kreiner 1995). By facilitating effective, joint action, routines serve to integrate tacit knowledge available in a project and to trigger motivation and commitment. In this sense, routines are structuring devices used to cope with different forms of technical and social complexity. Routines, furthermore, embody the results of negotiations in design as well as in production.

Lean Construction and Complexity

The term Lean Production was popularized and made widely known by Womack and his colleagues, in their book discussing the challenges facing the American car industry as it seemed to be out-smarted by an emerging and much nimbler Japanese industry (Womack, Jones and Roos 1990). They characterized the Japanese production system as lean mainly for two main reasons: first, fewer workers were needed in the highly automated Japanese factories, and, second, fewer engineers were needed to manage the workers that remained in the plants.

To see why this could be the case, a paramount difference between the Japanese and American versions of mass production has to be considered. The Japanese accepted that car production systems could not ever become closed systems, and that for this reason complexity could never be eviscerated. And since some level of unpredictability, uncertainty and risk therefore would remain, it would be a colossal waste of human resources to ask of employees not to be intelligent, creatively problem solving and engaged workers (Womack, Jones and Roos 1990, 53-58). In the Japanese system, every worker were to be engaged in improving technical systems. At the same time they should be integrated into the social fabric of the production organization and join their co-workers in teams responsible for pursuing improvements and quality control (Ibid. 98-100). In the American system, workers were treated differently, apparently as near-equivalents to machinery. As a consequence, the organization of the factory as a socio-technical production system was seen as the responsibility and domain of professional engineers and managers. In the Japanese version of mass production, empowering workers to take part in the ongoing, distributed process of improvement and innovation, led to a lean production system where engineering oversight of production could be reduced, and were "distributed intelligence" instead of overly centralized management afford a more flexible and responsive production system.

This is not the occasion to go into detail regarding the many and significant developments that have been made in lean construction theory and practice. However, the point can be made that in much of the literature on Lean, the complexity theme is discussed in rather terse terms as an issue regarding the need for "flow" and eschewing "waste". In the influential guide to Lean Construction practice known as the Last Planner system (Ballard 2000), it is made clear that complexity structuring of the work process is to be effected in a collaborative effort between stakeholders. The task of coping with complexity not understood as external to the production process. In a system of joint planning and negotiation, employees become integrated in the overall production system in a more engaged way. Furthermore, in line with Ashby's law of requisite variety, the complexity of the social system and the complexity of the technical system are brought to bear on each other. Employing the Last Planner concepts, the interaction between stakeholders (those contributing to the production process) becomes essential for upholding the dynamism and the efficiency of the whole production system.

Arguably, several contributions to the Lean Construction literature are rather dogmatically concerned with Lean as a productivity enhancing arrangement. By working in a "lean way" waste is thought to be minimized and productivity optimized (i.e. Mossman, Ballard and Pasquire 2011), and reasoning regarding work activity tend to become reductionist. Then, anything a building worker does that is not directly contributing to “user value”, is defined as waste. Workers and project managers are invited to negotiate and find the most effective way to co-produce, but at the same time, it is claimed that a minute spent with co-workers not producing output, for example, building friendships and discussing how to deal with unreasonable employer demands, represents wasted time and is to be eschewed. Arguably, when lean construction is understood in this particular way, this performance recipe does fit the bill of a reductionist ideology.

Partnering and Complexity

According to Womack and colleagues, commitment, loyalty and community orientation are basic features of Japanese mass production workplaces. This, however, also applies externally, in particular in a production organization's active relating to suppliers and customers (Womack *et al*., 146-156). Where the American mass production type relies on market transactions that are in principle instantaneous, the Japanese system is based on business relationships of a more lasting kind. Suppliers and customers become parts of the firm's extended social system. Based on the culture and the values of the company, trust is built. This allows for adjustments being made in order for products to comply with customers' expectations, and for suppliers to be able to deliver goods that comply with the manufacturer's demands.

The literature on partnering has become extensive since the basic ideas were introduced into the industry in 1991. Partnering place trust and collaboration at the heart of efforts to increase performance (Bresnen and Marshall 2000). Early involvement of key actors in early and later project phases is seen as a key factor in successful projects (Cheng, Li and Love 2000, Cheng *et al*., 2004). Similarly, long-term relationships are seen as providing a social context where trust can be established. Trust is conducive to returns on previous learning investments, knowledge exchange and integration, which are in turn important for productivity and innovation (Dubois and Gadde 2002).

Since Partnering is emphasising the social aspects of construction, what stands out regarding this performance recipe is the importance of involvement of different stakeholders in order to mobilize their resources for the project. Importantly, adequate resource mobilization is seen as a much subtler issue than what can be handled effectively for instance by developing formal contracts alone. The scope and heterogeneity of construction projects demand that many different contributing partners jointly engage in 'accomplishing a sophisticated cooperative project task' (Cicmil and Marshall 2005, 534). This makes it obvious that project success depends also on the ability to integrate diverse types of knowledge. As Bresnen and colleagues (Bresnen *et al*., 2003) remark, it is only with a certain level of common understanding that the knowledge of others will be accepted as valid and effectively deployed.

Again, as in the discussion of Lean Construction, this is not the place to go into details regarding theoretical and practical advances in research on partnering. The fundamental point we wish to make here is generic. It is that project integration by way of partnering is a method of coping with and managing complexity, and this in multiple systems at the same time. Partnering serves to integrate social systems of different organizations, and thus to restructure the complexity of these systems. At the same time, partnering effects complexity structuring on the level of technical systems of products delivered, and serves to structure systems of material flows and logistics in general. Hence, technical systems and social systems co-develop to a larger extent than what would have been possible without partnering. The complexity of each system is brought to bear on other systems. Seen from this angle, there is little to support a claim that Partnering is a reductionist recipe for improvement of the construction industry. One could be tempted to draw a contrary conclusion, namely that as a broad strategy of integrating projects technically, socially, logistically and in terms of contracting, it may be encompassing too much, for Partnering to be possible to operationalize as a coherent and practical improvement strategy.

Building Information Modelling and Complexity

Womack *et al*., laud the Japanese form of mass production for its proclivity to develop advanced automation systems in factories, and argue that the general orientation towards empowering employees actually is conducive to further process innovation in the industry. Their argument is the same as the argument employed by other researchers referring to the Nordic socio-economic model, as found in Scandinavian countries. They see Scandinavian workers as empowered and as an active contributing partner in business contributing actively to innovation. A main reason this happens is that workers themselves get a fair share of the benefits from the use of new technology (Barth and Moene 2015).

In construction, building information modelling (BIM) has the potential to contribute in a similar manner as automation technology does in mass production industry. BIM introduces a new, high complexity information system potentially able to match the complexity of existing systems in the built object and in the production system, and to influence the complexity of different systems (social, technical, contractual, etc.) in meaningful and beneficial ways. For a third time, we emphasise that this paper is not the place to detail recent developments, in this case BIM as a performance recipe. It is the generic principles that are of interest here.

BIM is currently envisioned as an overall information system in which a virtual replica of the built object and the production process can be created even before the actual building effort takes place. Advocates of BIM tend to argue that as much as possible of the overall structuring of the complexity of the built object as well as the production process should be effected ex ante, by specialized professionals exploiting their own competence and the powers of software and computers to create detailed models.

The belief seems to be that the total complexity of the built object can and should be modelled and the structure verified before the actual building starts. Furthermore, since the order of assembling all the parts can be clearly defined in the model, the structuring of the entire building project should follow from the logic of the basic BIM instance created for the project. Understood in this way, BIM undoubtedly has a “Fordist” and reductionist bent. The technical systems and their complexity are taken to be primary, and the other systems, not least the social systems involved, are presumed to be secondary and are presumed to be yielding faced with overriding technical considerations and dependencies. Understood in this way, BIM and the conception of complexity management built into it, arguably stands opposed to Partnering and Lean, conceiving of systems as closed and complexity to be technically manageable.

Certainly, there is a significant gap between current BIM practice and such reductionist, grand visions (Harty and Davies 2013, Lindblad and Vass 2015, Miettinen and Paavola 2014). Miettinen and Paavola express doubts as for the usefulness of the idealizing visions of BIM (2014: 88), but they are not explicit regarding the source of this doubt. We would suggest that there has to be fundamental doubt regarding BIM as a reductionist performance recipe. The reason is the same why Ford’s version of mass production proved unworkable and inferior over time to the Japanese version of industrial mass production. Advocates of comprehensive BIM implicitly and erroneously presuppose that the production system for built objects can be set up as a closed system.

CONCLUSION

By developing a systems perspective and considering the way Lean, Partnering and BIM as three broad performance recipes suggest to manage complexity, we have found that the three approaches have clear differences. In its most crude and naïve form, Lean Construction is clearly reductionist. However, a more fundamental message from Lean research and practice is that complexity cannot be handled effectively only up-front and only top down. This corresponds to the conclusion Luhmann arrived at in his discussion of complexity management in organizations. Intelligence has to be distributed, and agency of all involved parties is important to be able to structure operations and work flows in a good way in complex organizations. By focusing on relationships and multiparty contracting, Partnering resembles Lean, but can be seen as addressing complexity structuring of other systems than those commonly addressed in lean practice (which is concerned to a large extent with work processes on-site). In advocating the need for negotiating satisfactory overall arrangements and the development of trust-based relationships, also Partnering is based on the notion that intelligence and decision making powers have to be distributed among partners.

Finally, we have pointed out that BIM in its most naïve, visionary and comprehensive conceptualization form clearly is reductionist. This kind of BIM also embodies a rather obvious element of brutality, since the social have to obey the demands imposed by the technical realm via the BIM model. However, if BIM-development can be directed towards creating tools for empowering workers, then BIM could be made to serve the purpose of empowering those engaged in building; making them better able to understand dependencies, foresee consequences and to avoid unnecessary risk. Lean, Partnering and BIM can all be made to facilitate what Luhmann recommended - distributing intelligence and decision making powers in the complex production organization. Respecting the essential roles of the diverse systems making up the production system, the three performance recipes adding up more than detracting from each other. In this way, the three recipes can even be made to promote brutalism in construction in a non-brutal way; in the precise sense of the word "brutalist" - construction with everything but the functional essentials removed from it.

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