Adventurous non-line assembly –

Multidimensional journeys of project brick stones

by

Magnus Hellström (M.Sc.)
Åbo Akademi University
Slottsgatan 10, FIN-20100 Åbo, Finland
mhellstr@abo.fi

Abstract

The importance of product paths on assembly lines have since long been acknowledged. What if the same idea was applied to the paths of project supplies? Could the description and perception of such journeys, reaching throughout the supply chain to the already operating outcome of the whole project, be of interest in management science? This study aims at implicating ways of facilitating and enhancing site based project management. This is not done in the same way as for an assembly line, but, instead, empirical methods brought about through participant observation will be used.

Key words: management science, descriptions of journeys, value creation, site based project management

Introduction

Taylorism and New Approaches for Project Management

Through his time studies Frederick W. Taylor (1919) acknowledged the importance of the product paths on assembly lines. Since the days of Scientific Management such studies on internal logistics have gradually grown into more holistic views of product lines and thus concepts like supply chain, value chain and, today, value net have been introduced. However, the same has not happened within project management. Project management still uses, in many respects, the same approach by which the scheduling and controlling techniques for large-scale and one-of-a-kind projects in the 1950s were developed. The evolution of the project-based firm obviously calls for a new approach in
which the projects are co-ordinated and seen as value creators contributing to an aggregate corporate strategy (Maylor 2001). Projects shall no longer be viewed as closed and static systems, but as open and dynamic, interacting with the outside environment of the project core itself (Wikström 2000), including e.g. the parent organisation and the customer. In fact it has been argued that many factors causing either success or failure to projects are found in this outside environment of them (Youker 1992). These are facts, which will be acknowledged and considered going further on this subject, regardless of whether the project is considered a product or the means of achieving a product.

When it comes to corporate strategy, the approach might be rather similar for both operations and project management. The development from operations management towards operations strategy should be hoped for in project management as well (Maylor 2000). This should also be the case when it comes to management science or operations research. However, although given the possibility for strategic similarities, it should hardly be a surprise that the same modelling approach as for factories cannot be used on the tactical or operational level in project-based companies. The difference between process-oriented manufacturing and activity-oriented project production is in fact fundamental and should be both managed as well as studied in another way (Wikström & Gustafsson 1999; Wikström 2000). Therefore the approach to this subject will be somewhat non-traditional as quoted below. Still, one of the fundamentals of taylorism, i.e. a careful scientific approach rather than rules-of-thumb (Taylor 1919), shall be honoured in this text as well as the idea of paying attention to product paths.

Modularity and Descriptions of Journeys

One apparent pattern in the project-based industry of today is the trend towards modularization of the end product (Wikström & Storholm 1999; Wikström 2000). Latour’s (1987) first rule of method stipulates that we should study science in the making or in other words, like the title of his book, Science in Action. Translated into the project context, studying installed and operating modules, that is, black boxes, is not as interesting as studying their way to becoming black boxes. Hence, one promising approach to innovative research in project management could be describing the journeys, i.e. the product paths, of such project brick stones. According to Latour (1987) we could alternatively study the re-opening of black boxes, which in this case also brings us further to his second rule of method: to look at the transformations the modules undergo later in the hands of others. Thus, these journeys will be considered as going beyond the project itself. As this study is
concerned with construction projects, the delivery, product path or rather, journey, of a construction module ranges from the factory product line all the way transported over the oceans to a plant assembly site and even further ahead, throughout the lifecycle of the already operating facility and down to its winding up. In this respect a similar life cycle point-of-view to production versus project management as was taken by Chase & Aquilano (1995) will be used here, regarding the project as an initial phase in the life cycle of a production facility (compare with Figure 1).

![Figure 1 Schematic perception of the phases in a typical power plant project](image)

What determines the success of such a module, such a project brick stone or, using the terminology of Wikström & Storholm (1999), such “heavy industrial Lego®”, will not be one single feature, but several which alternate each other and which are more or less black boxed whenever not being consumed (Lindahl 2000). Neither will these features necessarily be technical, but in many cases rather functional or immaterial (Wikström & Storholm 1999). As concepts like mass-customisation are gaining huge victories, not only the technical dimensions of products should be considered, but also the aspect of human value creation associated with them (Gilmore & Pine 1997). Certainly, also services can be modularised (Baldwin & Clark 1997/2000). The notion of descriptions of journeys in such a wider sense also builds on the idea to regard projects as subjects to external
influences (Wikström 2000) as explained above; especially as we know that the success of projects depends on the point of view; i.e. the stakeholder.

To summarise, the intention is to explore the functionality of modules and the possibility to associate modularised immaterial value creation with them. This will be done by means of *descriptions of journeys* and in the light of the entire product life cycle and the corporate environment. However, the empirical material has mainly been collected at the building site, i.e. the factory floor if the project is considered a product¹, or in other words the construction phase in a life cycle perspective as depicted in Figure 1 above. This methodological issue is a conscious choice and will be discussed in detail below. So far the study on descriptions of journeys, as presented in this paper, will mainly argue for the approach and give some notions on future directions of the research.

**Methodological Considerations**

Following Taylor’s example I have chosen to pursue operations studies by observing them *in situ*, or more dynamically expressed, *in vivo*. Namely, my findings are based upon the observations I have made by participating in the construction phase of two power plant projects, one in India as a trainee and the other in Brazil as an employee. My case studies are part of a site management research program initiated by the Research Institute for Project-Based Industry (PBI) in Turku, Finland. PBI employs a cross-scientific approach and a special kind of qualitative research that has been developed in co-operation with the industry. The method can be described as a real time study of ongoing projects. By means of participant observation, field assistants (e.g. undergraduates and/or trainees) provide the organisation with material from construction sites around the world. This material is continuously analysed and feedback given to the sites in order to focus the students’ observations on currently interesting research issues. (M. Gustafsson 1999, p. 98).

Qualitative research places certain contradictory demands on the research process. Ideally the material brought about would be so called “naturally occurring data” (Alasuutari 1999, p. 84), that is data that would exist regardless of the actions of the observer. Taking a holistic perspective on project management the influence of my actions as a member of the construction team can be

¹ Projects could also be regarded as products, which sometimes might be a useful notion.
regarded as small. However, one cannot talk about "unobtrusive measures". On the other hand these are no prerequisites for qualitative research. The point is rather that such data would never be collected without the presence of a participating observer. As discussed further below, the never-ending stream of situations (Popper 1996) and the rapidly growing amount of information available for decision making (Christensen & Kreiner 1998) perfectly justify a qualitative method when studying module journeys. Only by experiencing these situations and the lack of information one can fully understand the actions taken and the decisions made. During my time on the field I have been following the process of black boxing a power plant. The problems that arise during transportation, construction and installation of the modules can hardly be restructured and analysed afterwards unless the process and its environment has been carefully observed and recorded.

Furthermore, it is important not to let prejudices against the research object influence on the studies (Alasuutari 1999, p. 263). On the other hand there is an obvious need for a theoretical framework in order to be able to focus on the right things, since a vast amount of impressions will meet the observer on the sites (Alasuutari 1999, p. 40, 51 and 79). This issue is solved through the above method of letting people not introduced to or involved in earlier research in the field, for instance undergraduates, collect the data and send it for review and analysis to the home organisation, which provides the theoretical framework. It is though important to emphasise that a central aspect regarding participant observation is taking advantage of the possibility to gain a deeper understanding of the studied object. This is inevitably realised using one's own interpretations and pre-understanding. Thus, qualitative research does not aim at coming up with the definitive truth, but with a deeper understanding of complex contexts. In both the studied cases the company delivering the projects was undertaking several other big projects at the same time in the same business area, making them complex contexts with problems reaching throughout the organisation - from a fight on factory floor to a decision on the top management level.

Accordingly my point of departure will be the empirical observations made at the sites during the project execution phase. As my research moves on, my aim is to incorporate a more holistic view of the project as a whole, preferably as perceived in a multi-project environment. In construction projects one is dependent for example on transports and human resources, which in the studied cases were handled from the project office by centralised departments. Consequently, steady communication between the project team, which handled the contact to these departments, and the site was pursued, thus giving the site a good insight into the activities at the project office, too. Figure 1 gives an idea of other project phases going on simultaneously to the construction phase.
Wikström (2000) argues that project theory is living theory and that different phenomena occur all the time in a context, in this case in the project environment. He suggests that these phenomena may interact with certain patterns that thus change and that, if found successful enough, may replace old conformities. For companies one key issue is to identify such phenomena and patterns in order to predict new conformities. The chain context-conformities-patterns-phenomena is also to be regarded as “the structure for intellectual manageability of project knowledge”. (Wikström 2002.) This structure will serve as a base for this study when pursuing the methodological reflections further.

Departing from empirical observations one can choose between induction and abduction. The first requires caution with the above mentioned prejudices, whereas the latter allows some pre-considerations. Abduction is more to be seen as an iterative dialogue between theory and empirical observations and closer to the approach PBI has employed. (M. Gustafsson 2002, pp. 97-100.) Returning from the first project I wrote my Master’s thesis and became familiar with the ideas and approaches of PBI. Thus, heading for the second project I was a lot wiser; now equipped with some further issues to study. These issues are based on earlier studies on similar projects and give me a platform to jump from. From this platform I can start to induce new patterns, phenomena or conformities from my observations (Wikström 2000). Careful notes made during the first project also allow me to return to that project to collect more information. Given the results of the induction, theory needs to be consulted and the results analysed. This iteration may go on until satisfying results are obtained. Certainly, the emphasis so far has been on making the empirical observations.

**Theoretical framework and empirical findings**

In order to pursue the notion of product paths further the arguments for such an approach shall be clarified and a necessary framework provided. It seems that standard or traditional project management relies on computational planning efforts and rigorous deviation control models (Maylor 2000), in other words, departs from a very idealised view of projects. Such a system-focused and control stressing approach is no longer sufficient, but has to be broadened to consider the outside environment and also to be changed by a more action-focused view of project management (Wikström 2000, pp. 20, 45, 223 and 226). Goldratt (1997) points out that one of the
dilemmas with the traditional approach is the great deal of uncertainty inherent in the plans. This is contradictory, since the heavy planning effort in the beginning of projects aims at decreasing uncertainty. But at that time the amount of information is the least (Christensen & Kreiner 1998) and the outcome will be as Goldratt indicates. Popper (1996, p. 27), on the other hand, argued that changing propensities would have nothing to do with the lack of information or knowledge, but with the fact that as the situations in the world change all the time, the propensities vary with them. Indeed, this is the case anywhere you are, not the least in the middle of a chaotic project. Rigorous planning enables one to lock some situations and thereby decrease the “operational uncertainty” as Christensen & Kreiner (1998) puts it, but at the same time one risks to choke the freedom of action when faced with unexpected troubles, i.e. to increase the “contextual uncertainty” (see also Wikström & Gustafsson 1999). In the field of strategy Porter & Siggelkow (2001) have shown that the benefit of certain activity configurations and certain sets of activities depend on the context. This discussion, especially the notion of a more action-focused or activity-based view, is closely linked with immaterial or human value creation as will be shown below.

**Material versus immaterial value creation**

The employment of modularised solutions has shortened delivery times significantly. The above discussed call for increased focus on actions derives from these shorter lead times, but also from the fact that a greater part of the value creation within projects is brought about through human action. (Wikström & Storholm 1998.) Maylor (2001) calls for a shift from “product based measures of quality” to “service based definitions and derived measures”, since many modern projects do not have tangible outputs. Even if the tangible output existed, as in the studied projects, they are still coupled with intangible ones. Clearly, material and immaterial value creation interact during a project delivery. In fact, the technical development of the modules in the studied cases is nowadays more or less brought to an end. As earlier studies within PBI have shown, the areas of improvement on modules seem to a larger extent to lie on socio-technical interfaces rather than on technical-technical interfaces (Lindahl *et al.* 1999). Through a thorough analysis of the modules one is able to explore such interfaces (Lindahl 2000) and thus to implicate further improvements along the whole value chain.

The studied projects were executed on Engineering, Procurement & Construction (EPC)-basis. The design, the equipment purchase and manufacturing, and the main shipments were all handled from the factory in conjunction with the project office, whereas the construction and installation
activities, which include a great deal of the human value creation, were handled from the site. Roughly speaking the latter part amounted for 1/8 of the contractual value in both projects. However, from a cash flow point-of-view, the situation is more or less the opposite, since the customer’s payments are subject to achieved milestones on the site, which nevertheless calls for a smooth assembly. Thus the above mentioned fraction does not give the right idea of the importance of the human value creation in these projects. Furthermore, the above mentioned design phase consists more or less entirely of human action.

At this point there seem to be three interesting tracks to follow through descriptions of journeys. Firstly, the question of which organisational aspects the modularised projects induce will be addressed. Secondly, the shorter lead times and the action focus require new means of project control. Thirdly, modularization implies changes to traditional customer orientation patterns. Only the surface of these matters will be touched below, leaving the rest for in depth case analyses.

Organisational aspects and leadership issues in modern projects

Modularization outside the computer industry has historically consisted mainly of modularization in manufacturing processes and logistics, whereas modularity of design has been an unexplored arena (Baldwin & Clark 1997/2000). However, the contractor company in this study has been applying modularity in both design and manufacturing already for some years. Thus the project engineering and design activities should rather be described as configuration (Wikström 2000). Storholm & Wikström (1998) argue that the true degree of modularization should not only be determined from the degree of equipment modularization, but also from the degree of modularization of human efforts, i.e. for example the degree of common procedures and standardised ways of working etc. Consequently they talk about “heavy industrial Lego® with multiple intelligence”. Baldwin & Clark (1997/2000) approach the same matter from another angle when they suggest that modularity in organisation is the answer to a competitive and rapidly changing world of modularity. Although they are not talking about projects it seems like an interesting track to follow. Obviously the arguments for a shift of focus towards proper activity configurations exist, that is towards modularization of human value creation.

To start on the strategic level, the studied company employs a similar set of activities as shown in Figure 1, with each activity assigned to a corresponding department. Such a set-up corresponds to the holistic view of the project based company. However, it is not all unproblematic either as these
departments lying directly on the value chain, as well as the supporting ones (not shown in the figure), might easily pursue a life of their own optimising their function internally, but together failing in meeting corporate objectives. The problem seems often to be fitting these activities together. Porter & Siggelkow (2001) suggest though that research on fit among a firm’s activities should be conducted on the activity level and based on the notion that activity configurations which yield competitive advantage are likely to be strategy-specific rather than generic. More precisely, research should focus on the boundaries, that is, on the transitions from one activity or system to another (Lindahl 2000). This reasoning goes well with studying description of journeys throughout the life cycle of an intelligent piece of heavy industrial Lego®.

On the operational level, as time schedules have been compressed thanks to modularization, probably also cost estimates for projects are easier to prepare. Even more so, as in projects like the studied, local subcontracting is a necessity both economically and in general. Still though, a large part of for instance the budget deviations are due to change (variation) orders. This supports the idea of modularization of human value creation in order to reduce costs.

In fact one could argue that this already is a fact in the studied projects as the main contractor assigns local subcontractors, usually at least for the three construction project sectors: civil, mechanical and electrical. For smaller entities, e.g. automation and steam system start ups, even special resources such as factory specialists or consultants might be temporarily employed. As far as these resources are familiar with the modules and can be regarded as specialists the risk for change orders is small. However, this does not apply to the subcontractors. Due to tight time schedules the design, or as above, the configuration, is usually not fully completed when the subcontract negotiations are held and consequently the door to unexpected costs is open. However, this issue will not be brought further here, but definitively kept in mind when observing and studying module journeys further.

**New means of managing modularised projects**

Due to the effects of modularization and shorter lead times the earlier serially coupled project phases are nowadays overlapping each other. As a consequence the phases can be considered more and more coupled in a parallel order. Such a change in the structure of the value chain imposes in turn changes in e.g. the information flow as can be seen in Figure 2. (Wikström 2000, pp. 22, 213, 229.)
In order to manage in such a fast track environment fundamental rethinking is required (Storholm & Wikström 1995; Laufer et al 1996). Turner (2000) calls for a return to the use of PBS:s instead of WBS:s in project planning, whereas he suggests that during execution the focus should be on work, or using the terminology of this text, on activities. Applying this idea on the case studies and as activities are going on simultaneously, the traditional division into civil, mechanical and electrical works might for instance gain from a complementary division into the technical systems consisting of modules. This would in turn give more importance to the module journeys and associated activities. Traditionally, the three main sections are fitted together by means of experience of the work managers, which works quite well. Here also 4-D tools are bound to have a lot to give. However, for management control purposes the requirement for a change seems to be more topical. Earned value management and S-curves are experienced to give insufficient and late support for decision making. Instead there is a demand for quicker tools facilitating short-term screening of the project operational environment and thereby for instance taking advantage of all kinds of weak signals present in the project environment (Nikander & Eloranta 1997).

**From Serial to Parallel Management**

Main drivers;
- information technology (4D)
- industrial lego concepts
- supply chains
- market demands

Main information flow
- Lead times
- Main information flow

Figure 2 The evolution of parallel value creation
Customer orientation and modularization

M. Gustafsson (2002) describes meeting customer expectations in the project-based industry as a race on a moving track, thereby drawing a parallel to the story of Alice in the Wonderland. As he shows trust is built up and developed mainly through the actions of the other part, that is, through an ongoing process. Hence, an interesting question arising from modularization is which modules will become customer interfaces and thus influence the interaction between the customer and the supplier.

In a way the customer buys an energy generating facility from the contractor and may even equip it with an operation and maintenance staff (O&M) from the same contractor. In this regard the customer buys two black boxes from the contractor, a mass customised plant and a service module, the input being money and the output being electricity. This view is interesting as such, but in some regards too simplified. For example, the customer may not let a USD 100 million investment pass uncontrolled, as it probably is concerned not to release milestone payments in advance. The customer may also want to secure a politically correct timing of the start-up and a future of lean operation making the black boxing activity of commissioning sensitive. Moreover, many other options are left to the customer besides buying these two “modules”. For instance, the contractor may participate in the financing of the facility or he may provide services smaller than an O&M module. Finally, or startlingly (M. Gustafsson 2002), it is important for the contractor to keep the customer satisfied or confident enough to first of all close the deal. Descriptions of journeys provide an idea for capturing at least some of these situations, activities or features that might induce new patterns for customer orientation.
References

Alasuutari, Pertti (1999):
Laadullinen tutkimus; Vastapaino, Tampere


Chase, Richard & Aquilano, Nicholas (1995):
Production and Operations Management (7. ed.); Irwin, USA

Christensen, Sören & Kreiner, Kristian (1991):
Projektledning – att leda och lära i en ofullkomlig värld; Lund, Academica Acdata


Goldratt, Eliyahu (1997):
Critical Chain; The North River Press, Great Barrington

Gustafsson, Magnus (1999):

Gustafsson, Magnus (2002):
Att leverera ett kraftverk – Förtroende, kontrakt och engagemang i internationell projektindustr (doctoral dissertation); Åbo Akademi University Press, Turku

Science in action; Harvard University Press, Cambridge (Massachusetts)

“Simultaneous management: the key to excellence in capital projects”; in International Journal of Project Management, 14(4), pp. 189-199

Lindahl, Marcus, Karrbom, Tina, Gustafsson, Magnus & Wikström, Kim (1999):
Lean Site Management – Intermediate report (Confidential report); PBI

Lindahl, Marcus (2000):
Maylor, Harvey (2001):
"Beyond the Gantt Chart: Project Management Moving on"; *European Management Journal*, 19(1), pp. 92-100

Nikander, Ilmari & Eloranta, Eero (1997):

Popper, Karl (1996):
*En värld av benägenheter*; Brutus Östlings Bokförlag Symposion, Stockholm

Porter, Michael & Siggelkow, Nicolaj (2001):
*Contextuality within Activity Systems*

Storholm, Stefan & Wikström, Kim (1995):
"Simultaneous Project Care"; in *Project Management*, 3/95, pp. 12-15

Turner, Rodney (2000):

Taylor, Frederick (1919/1998):

Wikström, Kim & Gustafsson, Claes (1999):
“Creative chaos” (in Swedish); in Wikström & Rehn: *Projekt Perspektiv*; Åbo Akademi University Press, Turku; pp. 5-10

Wikström, Kim & Storholm, Stefan (1999):
"Industrial LEGO with multiple intelligence"; in Wikström & Rehn: *Projekt Perspektiv*; Åbo Akademi University Press, Turku; pp. 123-131

Wikström, Kim (2000):
*Det aldrig återupprepades teori – tankar och idéer kring industriella projekt* (doctoral dissertation); Åbo Akademi University Press, Turku

Wikström, Kim (2002):
*Project and Project Management as Living Theory*; internal circular at PBI

Youker, Robert (1992):
“Managing the international project environment”; in *International Journal of Project Management*, 10(4), pp. 219-226