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NOTE

# Re-engineering construction: a new management research agenda

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Construction management as an academic discipline appears to be developing in an evolutionary way based on developments in practice which appear to be largely unaffected by mainstream management theories. There appears to be little two-way flow in construction management thought between theory and practice. There is an increasing range of customer-oriented theories emerging within the management discipline which is finding increasing acceptance and application within other management domains both from a theoretical and practical standpoint. Their application within construction appears to be delayed. This short note argues generally for a wider adoption of innovative, emerging management theories to construction. It specifically attempts to do this through an assessment and analysis of the implications of emerging principles of business process analysis based on information technology. Such an analysis results in an argument being made for the re-engineering of construction processes. Business process re-engineering has been portrayed as a revolutionary set of principles that can be used to achieve large-scale productivity and efficiency improvements. Analysing the place of some of its core principles within the way construction management research is evolving shows there to be many similarities. The contribution of the note is in the suggestion of a new research agenda for construction management and a clarification of the place and significance to construction processes caused by the way that information technology and construction management interact.

*Keywords:* Business process re-engineering, research information technology.

## Introduction

Recent pages of the more widely circulated management journals have described a whole series of new customer-oriented management approaches such as total quality management, concurrent engineering, just-in-time management and bench-marking. Some of these managerial approaches have been consolidated into a coherent theory termed lean production. Lean production has been heralded as the new production philosophy that is the natural replacement of mass production (Womack *et al.* 1990) and the third stage in an evolutionary sequence that began with craft production. The lean paradigm has been widely applied in automotive industries by companies such as Toyota and Rover. There is scant evidence of lean principles being applied in practice in construction although many of the separate approaches are being applied in a construction context. Koskela (1992) has gone further in attempting to develop a theoretical basis for lean construction as a new theoretical model for construction management in the way that it could or should be founded in the future.

This new concept of production management is also referred to as flexible manufacturing and integrated, intelligent manufacturing (*The Economist*, 1994a). As a management philosophy it is seen as being predominantly underpinned by enabling manufacturing technologies. Information technology (IT) is seen as a key feature of these.

It is argued in this short note that innovative theoretical approaches originating from outside of our discipline ought increasingly to inform our research in construction management. The apparent trend is for us to rely on our own discipline for our sources of inspiration (Betts and Lansley, 1993). An increasingly common type of research appears to be our observation, documentation and analysis of current construction industry practice which, from a research point of view, is often seen to be an end in itself. Moreover, we appear to feel justified in describing local common practice rather

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than seeking to find and describe global best practice. One could argue that construction management research is in need of an urgent stimulus of new thinking to prevent it from settling into a stale pattern of parochial observations which are as yet unguided by any substantial theories. There are, of course, a limited number of examples from leading figures in our discipline who, for some time, have looked to theories from outside of construction in developing global visions and understandings of the construction industry. Yet, the argument here is that they are largely the exception.

More regularly looking outside of construction, at theories and practices arising from other sectors, should lead to us exposing our current construction practices to new theoretical paradigms. This note attempts to set our research upon such an agenda at an illustrative level in relation to the emerging management concepts of business process re-engineering (BPR). BPR and many of the other new management approaches described above, have attained a certain 'jargon' status and fashion as the latest 'trendy' terms, but as with many such developments, behind their surface gloss may lie some deeper rooted development in thinking that can genuinely inform our branch of applied management thought. This note attempts to ascertain whether this is the case.

## The BPR philosophy and the history of construction management

BPR is a relatively recent concept that has emerged from management and computer science roots. It has been described in various ways by different authors with one of the first substantial descriptions coming from Davenport (1993a). BPR has become popular in the business and information systems literature to denote organizational transformation and was first advocated as an argument for an alternative rationale for the application of IT beyond mere automation (Hammer, 1990). However, its roots lie in a fundamental reappraisal of the theory of management going back more than 200 years. It argues against the principles of the division of labour first advocated by Smith (1776) in the *Wealth of Nations*.

Its place alongside the lean production philosophy is as timely as the division of labour was to the emergence of the principles of mass production. Smith's (1776) original arguments for specialists to be involved in the many potentially different parts of the process of manufacturing were subsequently extended by Alfred Sloan into a division of labour on management activities resulting in large, specialized, functional organizations. These divisions were on a very large scale and on a different organizational basis from the current fragmented nature of the construction industry. Yet, we could argue that a high division of labour and management responsibility predominates in design and construction to this day. One could go further and argue that the high level of trade and professional fragmentation in construction is evidence of division of production and professional inputs taken to an extreme. It is a situation that would appear to be ripe for re-engineering and changes in structure, procurement and regulation that we can see evolving in construction in different parts of the world support this view. This situation is also common to other industries and organizations which are seldom structured with the possibilities of innovation in general and new IT in particular in mind (Huber and McDaniel, 1986).

The philosophy of BPR argues for 'discontinuous thinking' which is most needed in traditional industries. It requires that the questions researchers and practitioners should be addressing is not how we might do current things better, faster or cheaper, but why we do them in the first place. Very little construction management research appears to address a fundamental question such as this. One could argue that the revolutionary demands of the theory of BPR are more gradually being met by the evolutionary developments in the practice of construction and that is the value of such theories in explaining where our evolution may be leading.

In common with many new managerial approaches, re-engineering requires that a 'process' view be taken of management problems rather than a 'task' or 'function' view. As such, re-engineering is concerned not with how we can perform certain tasks or functions differently but with whether assured, production-driven tasks and functions are necessary to achieve a customer-driven process. It is in this way that process 're-engineering' is distinguished from 'automation' of tasks and functions although both see technology and, in particular, IT as principal drivers.

BPR is presented then very much as a revolutionary concept which, as a body of serious applied management researchers, we may dismiss as being mere jargon and of little relevance to the way our thinking is gradually evolving. An alternative response is for us to critically evaluate the concept of BPR and by mapping its brash objectives to the evolutionary phases through which our own research is moving, to gain a better understanding of the way construction management research is and should be developing. An argument in favour of adoption of the BPR philosophy may be that as a body of researchers, in adopting a new cognitive viewpoint, substantial reappraisals of where our work is taking us may emerge in the way that Louis and Sutton (1991) have advocated.

The re-engineering philosophy is strongly related to the encouragement of innovation and learning organiza-

tions and is in principle well suited to a project-oriented industry like construction. This echoes some of the conclusions that substantial construction management work from the past has long advocated (Tavistock Institute, 1966). The principle of a learning industry is also one that is supported by the moves from the state of single-loop learning (efficiency), through double-loop learning (effectiveness) to the state of deutro-loop learning (capacity) as advanced by Argyris and Schon (1978). Many of these mainstream management views support some of the more recently emerging management thinking such as BPR.

## A definition of BPR

To understand BPR more clearly we should establish some definitions. A process is defined (Hammer and Champy, 1993) as 'a collection of activities that takes one or more kinds of input and creates an output that is of value to the customer'. A definition of BPR offered by Hammer and Champy (1993) is 'the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements on critical, contemporary measures of performance, such as cost, quality, service and speed'. The fundamental nature requires that it should aim to destroy tacit rules and assumptions which may be the stumbling block to substantial improvements of an order of magnitude rather than the incremental savings so much of our limited management ambition dictates. Hammer and Champy (1993) are proponents of what has been termed (Davenport, 1993b) the 'classic' re-engineering view. Davenport (1993b) argues that an alternate 'revisionist' view is beginning to emerge based on the experience gained by companies combining re-engineering approaches with existing change programmes. BPR is clearly a philosophy in formation which can be applied to varying degrees in different circumstances. For our purposes in reviewing the theoretical basis of construction management, neither of these definitions need necessarily be adopted but both may prove useful in reviewing the state of evolution of our discipline.

With regard to the application of BPR, much of the focus within companies such as IBM, Hallmark, Bell Atlantic and Capital Holdings, where empirical studies are documented, has been with the issue of customer ordering and dealing with sales. This experience offers much scope to us in construction management given both the multiple parties typically involved in construction and the observed increasing preoccupation of our research community with tendering and procurement as subject matters (Betts and Lansley, 1993). The point is that we should look to research that re-engineers the procurement issue in a fundamental way rather than continuing to study incremental and non-fundamental and undramatic issues. Other empirical examples showing benefits from BPR are provided by Davenport and Short (1990) and Kaplan and Muirdock (1991). Hall *et al.* (1993) argue from the BPR cases they have studied, that to bring about substantial improvements and to be considered broadly successful in a business context, BPR must be applied to a broad business target rather than small, discrete parts of an industry process or corporate activity. Re-engineering appears to have been much more widely accepted by companies in North America and East Asia than it has in Europe (*The Economist*, 1994b). Examples of its practical application in construction are very rare.

## Common BPR themes and their application to construction

Some of the many themes common to the way that BPR has been applied outside of construction can be distilled and their likely implications discussed, assuming that re-engineering as a cognitive approach eventually does permeate construction management thinking.

One theme is that several jobs or tasks or functions or roles become combined into one. The implications of this at a personal level may be the need for hybrid managers (Alshawi and Skitmore, 1992) and shared built environment education (Centre for Strategic Studies in Construction, 1988). This raises some very important human issues associated with re-engineering. Hammer and Champy (1993) argue that it can be a basis for increasing job satisfaction but Davenport (1993b) cautions that re-engineering can lead to job losses. Given the low level of labour productivity, the apparent shortages of skilled and professional entrants to the industry even during a recession and the need for a new breed of generalist and innovative professional, we would argue that BPR should not be seen as an employment threat. Instead, it should be seen as an opportunity for productivity improvement and competitiveness improvement leading to more secure and rewarding employment opportunities. However, what is clear is the need for the human dimension to begin to permeate our management and technology research more fully in construction management.

At an institutional or corporate level the trend towards design and build and multidisciplinary design practice, as more extensively followed organizational models, would appear likely to be supported by the emergence of concepts such as BPR. We now need research that measures the extent to which this is happening and explores its implications.

Another common BPR theme is that the division of labour has created a pattern of standard and prescribed

ways of doing things which in many ways have been based on a worst-case scenario. Much of BPR is concerned with undoing such standards and replacing them with multiple-process models to suit cases of variable complexity. There seem to be substantial implications here to some dinosaurs of the traditional construction industry that have emerged such as standard forms of contract, standard methods of measurement, codes of estimating practice, plans of work and other standardized, worst-case task models. We appear to have few and insufficient alternative versions of some of these task models to suit the alternative requirements of project, client, procurement, sector and industry types that so substantially affect how processes should be modified and tailored. We now have a need for further research that would provide suggestions for or evidence of alternative multiple-process models.

A further common BPR theme arises from the aim for interenterprise harmony and synergy based on aptitude and mutual benefit and the case is quoted by Hammer and Champy (1993) of Wal-Mart and Procter and Gamble re-engineering the process by which nappies are ordered, stored, delivered and invoiced from distribution centre to retail outlet. This was achieved by allowing the supplier to have access to the retailers' information systems describing stock levels, sales, etc. and by allowing the supplier to use their expertise in predicting quantities, times and methods of supply. The supplier benefited from enhanced and guaranteed sales and the retailer benefited from simplified ordering administration and from stock control and financing being removed from their responsibility. The scope for similar re-engineered solutions between construction firms seems considerable. An example quoted by Daniels (1991) of a UK brick supplier re-engineering their links with architectural buyers through their innovative use of IT shows that such a concept is applicable to us. The new research agenda is for suggestions of potential re-engineered construction processes or further documented evidence of it occurring with measurements and assessments of its success or otherwise.

## Re-engineered working practices in construction

An implication of re-engineered business processes, consistent with our view that re-engineering does not threaten jobs but improves productivity and effectiveness, is that the work of people changes with managers becoming more like coaches and functional departments within organization structures becoming increasingly replaced by process teams. This appears to be a natural progression and formalizing of the emergence of project management matrix situations we have seen in construction and if it does not lead to fundamental industry re-engineering would be supported by concepts such as partnering (Harback *et al.*, 1994) at a corporate level. Hammer and Champy (1993) go so far as to describe a scenario of virtual teams for specific assignments which again would fit well with multidisciplinary design practices and design and build firms.

## The role of IT

BPR is intrinsically linked to the application of IT. The place of IT within construction management research is increasingly finding a home as a fundamental technology whose nature and application must be researched and understood to fully reap the benefits of new management advances. We need research into how IT affects construction management but to treat the two as distinct and unrelated subjects which can be researched in isolation will become increasingly difficult to justify. When considering the place of IT within BPR it is important to distinguish BPR from subjects such as downsizing and software re-engineering. We are talking here of re-engineering construction and not IT tools.

## The need for construction process maps

A starting point to BPR comes with the need to convert typical pictures of companies, such as organization structure charts and data flow diagrams, into BPR building blocks namely, process maps. An example quoted by Hammer and Champy (1993) of the global and diversified activities of Texas Instruments being representable as seven processes centred around 'the customer' and the way that this frees the mind for management change is indicative of the difference in approach. Business process maps can and must, of course, be drawn at much greater levels of detail for practical re-engineering studies.

## The new research agenda

The argument in this short note has been of the need for a new research agenda in construction management in general. This is illustrated for IT in construction in particular by examining the potential application of the BPR philosophy. The specific agenda that arises from doing so is that BPR research is needed to perform the following.

1. Address the high fragmentation, low productivity problems of construction.

2. Produce efficient interfaces in the procurement of products and services between the multiple participants of construction projects.
3. Redesign professional roles and job tasks and functions in line with a view of generalist and innovative professionals and design new educational models to support these new roles.
4. Describe how BPR changes the balance, attractiveness and effectiveness of alternative procurement and organizational models with the hypothesis being that further impetus will be given to the current market moves towards design and build and multidisciplinary design practice.
5. Find alternatives to standard, worst-case task models, such as standard forms of contract and to produce a range of multiple-process, non-standard process models.
6. Document global best practice in innovative inter-enterprise harmony and synergy and to use these examples to suggest others.
7. Initiate the documentation of construction business process maps as a mechanism for benchmarking and comparative study.

These are the research possibilities that are suggested by an analysis of the application of BPR to construction. The dominant external influence to all is the human dimension and the need to recognize that the implications of this type of research on people in construction may be greater than has been the case with the style of research we have conducted in the past. The challenge to us as a research community is to ensure that we can realize some of the research needs whilst accommodating the human nature of the subject area.

To some extent, such an agenda for future research has been partially set by earlier studies (Centre for Strategic Studies in Construction, 1988). It is also an agenda that is increasingly being underpinned by new UK construction research funding proposals. The new Innovative Manufacturing Initiative of the UK Government Research Councils (Engineering and Physical Sciences Research Council, 1994) will have business process analysis as a fundamental basis to the large funding programme that is to emerge with 'construction as a manufacturing process' being one of its five main themes.

As a counterargument to this we could conclude that some aspects of BPR are not new at all and that Argyris and Schon (1978) and the Tavistock Institute (1966) have advanced ideas some time ago which reflect many of the basic propositions of BPR. It seems less important to us to argue over where the origins of such thoughts lie as much as recognizing the need for us to continuously revisit the foundations and bases of construction management as a discipline.

## Conclusion

This short note has been written as an immediate response to recently reported work in this and other journals and its place in the context of a rapidly changing and innovative theoretical business context. It argues for the range of new customer-oriented theories and for BPR, in particular, to be seriously considered in construction and to be related to the existing body of construction management theory to the extent that this has developed. Further research is required describing the extent to which theories are being applied in practice and prescribing the means and benefits of doing so. To do so will require that we establish a two-way flow between theory and practice in construction management. It is argued in this note that it is of potentially great consequence to readers of this journal that such theories and their application to our discipline become the object of our research if our discipline's academic health and industrial relevance are to be ensured.

We can conclude from the review within this note that while the ideas behind BPR are not entirely new within construction, at least as a revolutionary concept it mirrors many of the evolutionary market-driven changes affecting construction. Yet, this may be easy to conclude after making such an analysis and what we suggest is that continuously re-examining the latest management advances, despite their apparent reliance on jargon, may prove enlightening as a means to continuously re-evaluate where our discipline is going.

The more specific implications of the BPR philosophy to practice may be seen in terms of the effects of IT on the organization of construction. Our analysis here suggests that changing job roles, more flexible organization structures within companies, professional deregulation, changing sizes and geographical spheres of operation, all within the context of a learning industry are more likely to be seen. This mirrors many of the observations of Brochner (1990) who suggests that the use of IT by a construction firm leads to improvements in coordination, inspection and translation, enabling the organization to offer greater employee incentives and reduce transaction costs. Firms using IT are shown to expand and diversify their activities in several different ways, leading to changes in the structure of the industry. In particular we can foresee a greater support for market-driven trends towards design and build and multidisciplinary practice by the evolutionary application of BPR concepts.

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