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Processes, maps and protocols: understanding the shape of the construction process

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Process mapping and benchmarking are becoming widely recognized as important management tools for understanding how value is delivered for customers, and their use in the construction industry is growing rapidly. Influenced by research on design project management, and the requirements of developing inter-firm IT systems, this work has focused renewed attention on the role of process protocols. The aim of this paper is to explore empirically the use of process maps and protocols within one retail client with a large programme of retail development projects.

Keywords: Process mapping, process protocol, benchmarking, key performance indicators, retail clients

Introduction

Process mapping and benchmarking are becoming widely recognized as important management tools for understanding how value is delivered for customers, and their use in the construction industry is growing rapidly. The aim of this paper, based on research conducted in collaboration with a major UK retailer and funded by the Engineering and Physical Science Research Council's Construction as a Manufacturing Process sector programme of the Innovative Manufacturing Initiative (Award No. IMI/C/02/009), is to explore the use of maps and protocols for the management of the process of retail store development. Four projects, two in France and two in the UK, were mapped and benchmarked at the total project level using standard process mapping techniques and the UK Construction Best Practice Programme's (CBPP) key performance indicators (KPI).

The first section explores the principles of process mapping, and develops the approach to process mapping and benchmarking techniques used in the research. The retailer's corporate process protocol for store development is then introduced before the process maps of the four case projects are analysed. In conclusion, it will be argued that the retailer has great difficulty in following its own process protocol due to the differences between each project, and that this places significant limitations on the viability of a generic process protocol.

The principles of process mapping

Process mapping is recognized as an important management tool for understanding how value is delivered for customers. Business processes are the flows of information and materials that are embodied in the product the customer buys, and mapping those processes identifies how the organization meets its customer's requirements (Winch, 1994). Process maps can be broadly distinguished into two types: true *maps* of what actually happens in the organization, and *protocols* of what ought to happen. The first is descriptive

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and the second is normative. The relationship between maps and protocols is the subject of business process redesign (BPR).

Basically there are two approaches to process mapping. The first derives from IT implementation related systems engineering and focuses upon the information flows themselves (the integration definition for functional modelling (IDEF0) methodology is the best known example) and might be called the engineering approach. IDEF was developed to support the diffusion of an integrated computer-aided manufacturing system for US Airforce suppliers (Hunt, 1996). While valuable for such purposes, the engineering approach tends to be over-detailed for use by non-specialist managers and, perhaps more importantly, tends to ignore the organizational context which structures the flows of information and materials being mapped. Indeed, IDEF0 was deliberately specified to exclude such organizational issues. Moreover, such system-orientated approaches do not allow value adding and non-value-adding activities to be distinguished (Kartam *et al.*, 1997).

The second approach, which might be called the business approach, focuses on actual flows of information within an organization between the different actors involved, mapping what Rummler and Brache (1995) call 'the white space on the organization chart'. This is much more of a management tool: it is less demanding in terms of the resources required; simple maps quickly allow identification of dams and backwaters in flows; and managers can quickly develop smoother and more direct information and materials flows for the processes mapped. The developers of the process protocol (Kagioglou *et al.*, 2000) found that their industrial collaborators preferred to focus on the overall principles of the process, rather than the details at the level of the IDEF description. Advocates of BPR might wish to argue that mapping how information flows between established actors would lead to conservatism in process redesign. This may well be true, but unless the process of change in a BPR project starts from a clear understanding of the current situation, and why it has developed in that way, it is almost certain to fail.

For the business approach typically a two-dimensional map is developed, compared with the one-dimensional context-free maps preferred in the engineering approach. Two-dimensional maps usually have a dimension of sequence or time along the horizontal axis, and the actors or functions responsible for each sub-process (task) on the vertical access. The flow of information and materials through sub-processes is then represented in the body of the map. In order to ensure the readability of the maps, typically they are layered and hyperlinked. Although more detailed maps were also developed as part of our research, the argument here is based on our *total project* process maps. We selected Corel Flow 3™ as a simple and effective mapping tool. However, having used it in practice, we would not recommend it to others due to a number of programming glitches. For our current work we have selected MS Visio 2000™.

Our research objectives required that the four total project maps be easily comparable. Therefore we needed to ensure that, in our comparative analysis, differences in the 'shape' of the maps were not simply an artefact of the way that the map had been drawn, and we decided to standardize our maps on both the horizontal and vertical dimensions. The vertical dimension is simply a grouping of types of actor in any project coalition, as identified in Table 1. Grouping was necessary for the total project maps because to have identified each actor separately (20–30 on a typical project) would have made the map too complex. These groupings were then unpacked in lower level maps.

For the horizontal dimension, we were able to review a number of existing protocols specifying the phases of a construction project (Carr and Winch, 1998), among the best known of which are the RIBA Plan of Work in the UK, and the elements of the Code des Marchés Publics in France. Following this review, and drawing upon earlier work by Le Groupe Bagnolet (e.g. Syben, 2000) a 10-phase dimension was developed which gave adequate discrimination in the phases of the process without overburdening the map. These phases are not strict sequences and, as can be seen from the maps, there is considerable overlapping of tasks between phases. Table 2 identifies the standardized phases of a construction project used in our research. Each of the phases also has an output, delivery of which determines the end of the phase.

The maps contain two types of process: sub-processes such as 'cost planning' (marked by rectangles), and events such as 'start on site' (marked by diamonds). The latter are, at the level of the total project map, instantaneous, while the former have a meaningfully measurable duration. Both can be

Table 1 Principal actor groupings for total project maps

Grouping	Typical members
Client	Client; client's landlord;
Consultants	Architects, engineers, principal quantity surveyors
Regulatory	Building control; development control authorities
Contractor	Principal contractor
Trade Contractor	Trade contractors

Table 2 The standardized project phases

Phase	Description
Define need	Defining the business need for the built product in terms of the business strategy. *Output : business case*
Establish viability	Establishing the technical and financial viability of the proposed built product. *Output : decision to build*
Conception	Working through alternative locations/configurations for the built product. *Output : choice of location and configuration*
Scheme design	Defining the built product. *Output : complete definition of the building*
Detailed design	Working through the detail of the design, and producing the required working drawings. *Output : complete description of the built product*
Production planning	Planning the execution of the design on site. *Output : programme and budget*
Main trades	Executing the structure. *Output : structure*
Finishing trades	Fitting out the structure ready for use. *Output : completed product*
Commissioning	Ensuring that all systems are integrated and capable. *Output : product ready for use*
Facility management	Managing the built product in use. *Output : realization of the business case*

explored in deeper layers of the map if so desired, where the events can also become measurable processes. The map is gridironed to ensure comparability of the 'shape', and the grid squares are coded to facilitate hyperlinking to deeper layers of the map. Horizontal lines within the map indicate flows of information and materials between sub-processes. Vertical lines on the grid lines indicate flows from one actor to another, while dashed vertical lines between grid lines indicate joint activity between the actors connected. (This rather inelegant presentation is driven by the constraints of reproduction in black and white. Colour and shading were used in the original maps.)

Four projects were selected for study located at Milton Keynes, Derby, Versailles and Marseille. These projects were chosen because they were current and because they displayed a number of similarities in terms of size and complexity, yet were different in the choice of procurement routes. The majority of the data were collected through interviews during 1997 and 1998 with the representatives of the project coalition members, including members of the client's store development group, the project consultants and principal contractors. Drawings, minutes, reports and other documents were provided on all four projects. These data enabled us to develop the project narratives, process maps, and organigrammes which were then validated by the collaborating informants.

Data were also collected which allowed the performance of the projects to be measured in the manner of the KPIs developed by the CBPP. In terms of the project stages specified for the KPIs (CBPP, 1999), A is 'commitment to invest', B is 'commit to construct' and C is 'available for use'. In terms of the retail client's protocol, these events were interpreted as capital expenditure committee (CEC), start on site, and handover, respectively, with the exception of Versailles, when it is contractor appointment. Data on C are not available for Versailles because the project was abandoned after problems with estates negotiations. CEC is probably later in the project cycle than the KPI definition of 'commitment to invest', because conceptual design comes after that stage. However, this is the point at which this client's board makes its investment decision. These events are marked by diamonds on the lowest horizontal axis of the process maps.

The store development protocol

Within the client, the management of its capital programme is the responsibility of the store development group (SDG). Although SDG policies have evolved over the years, the fundamental guiding principles have remained firm. The client is first and foremost a retail business. Store development is no more than a vehicle for the company's core business. The building is not seen as an end in itself; every element in the store is there to enhance the retail operations by attracting customers to buy.

By 1997, the SDG had a well established and proven method of working, defined in the 'store development group : operational guide to developments'. All developments were managed by a project core team, headed by a project manager responsible for all projects within his specified division. Under this system, a project manager could be responsible for a number of projects within his division at any one time, possibly supported

by an assistant project manager depending on the work load. The project manager liaised with members of the SDG and supporting functional departments elsewhere in the business, such as corporate design, and external consultants during the project development stage. It is notable that while the designated store manager was normally part of the project core team, there was no representation from the client's store operations functions at a more strategic level. In essence, the mainstream retail operations of the business were separated from the development of its retail outlets.

The second key characteristic of the client's development process was the establishment of pre-defined gates (Cooper, 1993) when key decisions relating to the project are made, as shown in the process protocol presented in Figure 1. This protocol was developed in the standardized format described above from SDG documentation and interviews, and then validated with our informants. These four gates were the three project board reviews and, lastly, the CEC. Both the project board and the CEC were standing committees, not project-based review meetings. The project board met on a fortnightly basis, chaired by the head of SDG. Each project typically moved through three boards to provide an initial review, a detailed review, and a CEC review in which options for the CEC were assessed. These acted as soft gates, and it was through these boards that the operational and merchandising functions had their principal opportunities for input to project development. The CEC met monthly, its members being main board directors, including those responsible for the merchandise divisions, chaired by the deputy chairman. This was the principal hard decision gate in the process when the decision to proceed or not was taken. Subsequent to the CEC, the project moved into implementation mode, and the operational functions no longer had a formal influence over the design, but were expected to take ownership for the delivered store through the participation of the designated store manager in the project core team. As stressed in the 'guide', 'stores can have a significant influence between project boards 1 and 2, during the detail brief. Once a scheme has reached CEC it is frozen and can no longer be changed.' Subsequent to this point changes had to go through change control, managed through the raising of a variation order-request form (VORF).

The four case study projects

Table 3 gives the performance of the projects in terms of KPIs, while Table 4 provides an overview of the projects studied. The figures in Appendix A are the four total project process maps. It can be seen that project performance is generally good in terms of predictability, with three of the projects delivering on the planned programme for the B to C phase; indeed Marseille was delivered two weeks early. Only Derby significantly overran the budget sanctioned at CEC, and Derby was delivered in by far the shortest time, with the saving coming between CEC and start on site. Also clear is the serious impact that procedures for regulatory approval for expansions to commercial property can have for moving from CEC to start on site, particularly in France. However, Appendix A also shows that the stern words of the 'guide' are not heeded, and major changes take place between CEC and start on site and that one project (Versailles) was abandoned after contractor appointment. This section will briefly review the dynamics of these post-CEC changes.

Milton Keynes

Although the design and build contractor was appointed in July 1997 and the cost plan agreed at £5.5m with a 30 week programme and the pre-start meeting was held on 29 September 1997, delays in obtaining building permits and landlord's consent meant the contractor did not start on site until 2 February 1998. The main problem here was sale of the whole shopping centre to a new landlord coinciding with the start on site of this project, and consent had to be obtained again from the new owner. Delays in obtaining this consent meant that the project manager was faced with the choice of determining existing contracts, or negotiating with them to cover their additional costs while consent was obtained. A VORF was obtained to cover the increased costs of the principal contractor and nominated trade contractors due to the deferment of start on site. The latter, for instance, were obliged to put into storage equipment that had been ordered for the project. These factors, together with problems over the drawings for the steelwork, raised the outturn cost to £7.5m.

Derby

The design was based upon a 'non-finessed survey' of approximately three hours to assess general building quality, presence of dangerous materials and the like as part of a major acquisition of properties from a former competitor in July 1997. The design team was appointed in September 1997. Their brief was to assemble a proposal for the CEC on 7 November 1997, much less than the standard 22 weeks specified in the store development guide. The client supplied a matrix costing and a high level brief showing the level of specification for a 'first division' city-centre store. This

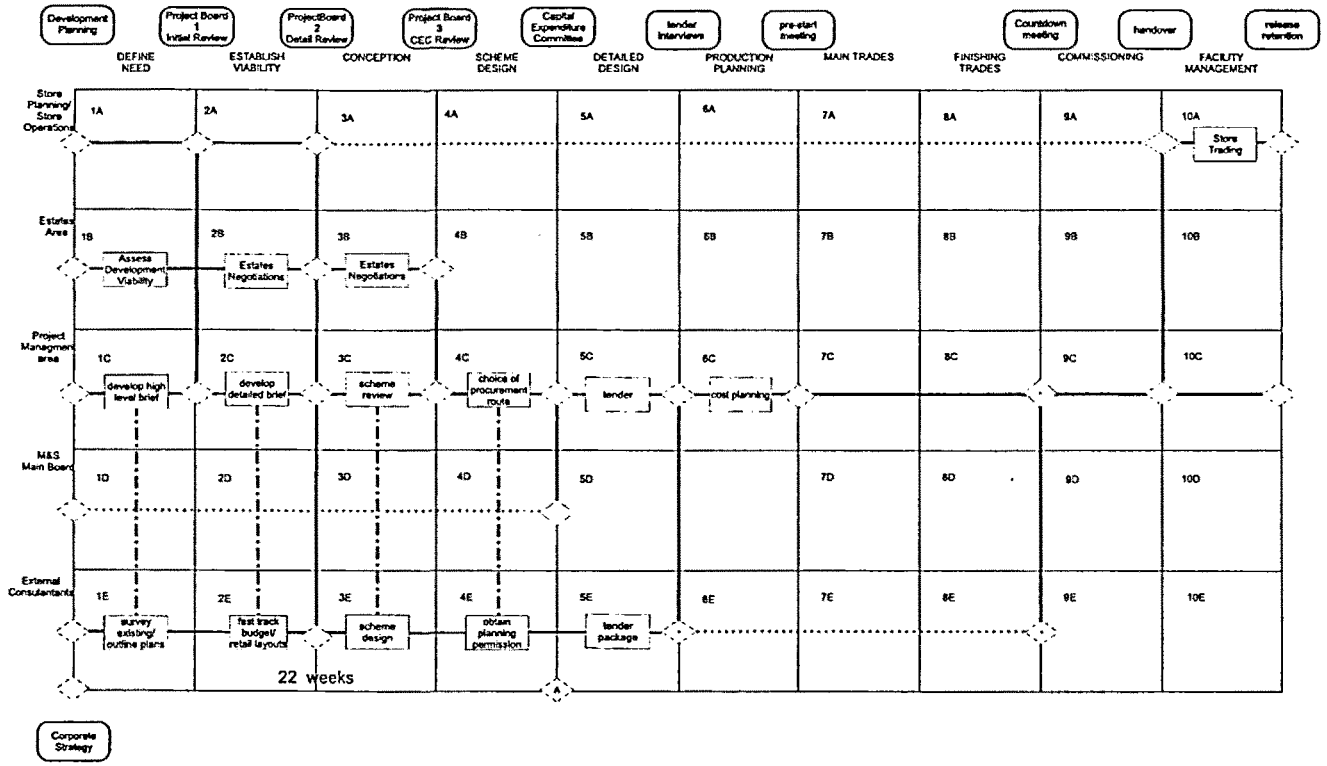

Figure 1 Store development process protocol source: interview 27/05/1998

scheme proposal was presented to the CEC on time, and budget approval given on 13 November. The construction manager was formally appointed on 28 November 1997, having been invited to the design team meeting of 20 November on a fixed fee of 4%. It quickly became clear that the project was going to suffer major cost overruns amounting to £1.1m against a contingency sum in the budget of £50k. The main items identified as driving costs were additional structural works, the staff quarters, and mechanical and electrical services. A value engineering meeting was held with all parties including store management present to identify possible costs savings. The project was delivered on time, but with a substantial cost increase against the CEC sanction.

Versailles : Parly II

The project involved an extension to an existing store, currently located in two unconnected units on the first floor of the Parly II shopping centre. In brief, this involved the transfer of one of the units from its current situation to the floor directly above the other, with creation of vertical access between both floors. The job also involved the extension of the store by demolition of a number of smaller shop units not tenanted by the client and their relocation to new premises in the mall as agreed with the centre owners. After a fast-track estimation, the project achieved CEC approval in November 1996. The management contractor was appointed during the process of seeking planning permission at the client's risk. Once received, the key date in the entire project was when the tenants of the

Table 3 Project performance (time in weeks)

	Derby		Milton Keynes		Versailles		Marseille	
	Actual time	Cost change	Actual time	Cost change	Actual time	Cost change	Actual time	Cost change
A to B	13	−1%	40	−25.5%	70		133	−11%
B to C	35	19%	30	35%	47[a]	n/a	26 (−2)	− 3.1%
Overall	48	19.1%	70	2%	117[a]	n/a	159	−13.7%

[a]Planned (interview 11/2/98).

Table 4 Project performance data and costs

	Derby	Milton Keynes	Versailles (cost in FF)	Marseille (cost in FF)
CEC approved construction budget	5 277 900	7 471 000	36 174 100	36 791 100
Contract sum	5 282 656	5 544 232	Job on hold.	32 758 500
Out-turn cost	6 286 300	7 486 400	Job on hold.	31 734 400
Programme, date of:				
CEC	7/11/97	1/5/97	1/11/96	1/10/95
Planned programme (weeks)	35	30	47	28
Contractor appointment	28/11/97	07/01/97	12/01/97	22/04/98
Start on site	02/02/98	02/02/98	Job on hold.	01/06/98
Building handover	28/09/98	30/08/98	Job on hold.	20/11/98
Release of retention	28/09/99	30/08/99	Job on hold.	21/11/99
Form of contract				
Contract form	Proprietary design & construct Version 2 May 1998	Proprietary design & construct Version 2 May 1998	*Assistance au Maître d'Ouvrage* standard form	*Entreprise générale* standard form
Who are consultants contracted to?	Employed by client for initial work. Novated to contractor at date of contract commencement	Employed by client for initial work. Novated to contractor at date of contract commencement	All to client	All to client
Level of design info at:				
CEC	Drawings at 1:100 scale. Fast track development Development-Spec level not finalized	Drawings at 1:200 scale. Milton Keynes project to be similar to original fitout specification (1995)	Feasibility drawings at 1:200 scale	Feasibility drawings at 1:200 scale
Tender 1	As CEC with revisions to layouts to facilitate tender invitation	Drawings at 1:100 scale. Brief specifications	Full working drawings at 1:100, 1:50, 1:20 & 1:5 scale Plus detailed specifications	Full working drawings at 1:100, 1:50, 1:20 & 1:5 scale Plus detailed specifications
Tender 2	Not applicable	Full design with 1:100, 1:50, 1:20 & 1:5 drawings together with fully detailed project specifications	Job on hold	Not applicable
Start on site	As CEC. Progressive design work to facilitate the issue of BoQs for most packages. Final BoQs issued in April 1998. Design continued later	Full design with 1:100, 1:50, 1:20 & 1:5 drawings together with fully detailed project specifications	Full working drawings at 1:100, 1:50, 1:20 & 1:5 scale plus detailed specifications	Full working drawings at 1:100, 1:50, 1:20 & 1:5 scale plus detailed specifications

smaller units were going to move. This was in the hands of the owners of the shopping centre. By July 1998 these issues remained to be settled: the operators of the smaller units had not moved and therefore were obstructing the works. In the end, the project was aborted as the centre owner could not force the other units to move.

Marseille : Grand Littoral

The works here involved the fitting out of the store in the new extension to the Grand Littoral shopping centre. Shortly after the works had commenced on site, the client's senior store operations executives visited Grand Littoral, and noted that the rest of the centre was not trading as well as had been expected. The operations executives decided to downgrade the footage of the store under development by about half. It was pointed out by the general contractor that this late design change would save very little money, but the operations staff were insistent that the store needed to be much smaller to allow the right intensity of trading under the reduced expected footfall. Therefore, approximately half the retail space provided under the contract was to be left fallow. The project was delivered two weeks early, and with cost savings on the tender price, but it should be borne in mind that there was a substantial reduction in scope and requirements.

Overview of project performance

These four projects had much in common:

- the client and the client's project management team, SDG, were common;
- the project missions i.e. the fit-out of retail spaces to a very well developed and standardized client brief and tight time constraints, were identical;
- the client's process protocol applied to all; and
- the client was enormously experienced and sophisticated in procuring buildings to support its retail operations, with a reputation for innovative approaches to supply chain management.

There were some differences between the projects:

- existing store operations had to be maintained at Milton Keynes and Versailles, while the other two were new outlets;
- Marseille was new-build, while the other three were refurbishments and extensions; and
- time pressures on Derby were perceived to be particularly tight.

In terms of performance, the most remarkable finding is that on three of the four projects, client-side initiatives were the largest source of changes *after* contractor appointment, despite the hard gate at CEC. In all three of these cases, the reasons were beyond the immediate control of the SDG:

- at Versailles the landlord of Parly II could not deliver on its commitment to move two small units;
- at Milton Keynes, the client's landlord decided to sell the centre; and
- At Marseille, Grand Littoral as a whole was trading below expectations.

The only project not to suffer such external shocks was Derby, which was also the only one to witness major budget overruns between CEC and handover (A to C).

There would appear to be one central reason for these problems – the programme. In retail store development, time is of the essence. It is notable that two of the three completed projects witnessed major budget increases during their construction programme (B to C), but all were handed over at or before time, suggesting the primacy of programme over budget in project management priorities. In the earlier phases, deliberate risks were taken to reduce 'programme' in three cases: at Derby the design development was based on very limited survey work; and at Milton Keynes and Versailles the contractor was appointed prior to the receipt of clearance from the landlords to go ahead, and before full planning permission was granted.

In addition to the nature of the project mission, and the distorting effects of particular external shocks, the choice of procurement route has a major impact on the shape of the project process. The continual striving to find the most appropriate project organization for the particular requirements of each project meant that different procurement routes were chosen for each project:

- Milton Keynes followed the usual UK practice of this client in choosing design and build with novated designers;
- the very tight programme led to a switch at Derby to construction management;
- Versailles followed this client's usual French practice of *assistance au maître d'ouvrage* (AMO – a French form of construction management); and
- the opportunity for a new-build project led to a switch to *entreprise générale* (general contracting) in Marseille.

It should be noted that contractors do more design work under a French general contract than they do under a British design and build contract. The latter typically includes only working drawings, while the

French contractor usually does all structural design. See Winch and Campagnac (1995) for an analysis.

Both construction management for Derby and general contracting for Marseille were considered innovations by the SDG in the sense that they were changes to their established country-specific practices to take advantage of new opportunities. While clearly some of these differences in choice of procurement route are the result of differences in the French and British contracting systems (Winch (2000) and Campagnac (2000) provide overviews of these), differences within each country suggest other forces are at work. The main point is that choice of procurement route is the outcome of an appraisal of the particular needs of specific projects. As clients strive for best value in their investment in built products, they appraise in detail the particular characteristics of each project, even when the projects are all very closely related to each other, and are managed within a common client process protocol. It is the project mission at this detailed level which shapes the project process.

In this continual appraisal of their portfolio of projects clients shape them in different ways according to the perceived risks that they face on each. This retail client has traditionally retained risks by using management forms of contracts. As risks reduced in the UK market due to the switch away from refurbishment of the existing stock to out-of-town new-build development during the 1980s, the client started to transfer risks to contractors, as we saw at Milton Keynes. However, the recent shift back to city-centre development and, hence, refurbishment has encouraged the client to take greater risks in order to get the best deal, as seen in Derby. Interestingly, the reason for the predominance of AMO in France was that the client was less sure of its relationship to the French industry, and therefore it preferred to retain risk through using a British construction manager as in Versailles, rather than transfer the risk by contracting directly with French firms. The apparently low risk new-build fit-out in Marseille gave it an opportunity to switch to a general contract made directly with a French firm. However, at both Milton Keynes and Marseille we saw that factors beyond the client's direct control meant that it could not get the best from design and build approaches, and that it was hampered by the inflexibility implicit in such risk transfer.

Processes, maps, and protocols

There has been considerable interest of late in developing a generic process protocol (http://pp2.dct.salford.ac.uk/) for the UK construction industry. According to its foreword, the 'process protocol' is: 'a common set of definitions, documentation and procedures that will provide the basics to allow the wide range of organizations involved in a construction project to work together seamlessly.... The process protocol in its generic form allows objective comparison of projects, providing the basis for both company and industry knowledge base development' (Kagioglou *et al.*, 1998, p. 1:7). The ambition of this initiative is to provide an agreed set of processes and procedures to which the UK industry can work, thereby standardizing deliverables and facilitating the implementation of IT. It is inspired by a number of recent developments in management thinking, including:

- BPR as a means of realizing the potential of IT to radically transform business and generate improvement (Scott Morton (1991) and Davenport (1993) provide valuable reviews);
- work on new product development processes, which emphasizes the importance of standardized processes and stage/gates or screens in effective new product development such as that of Cooper (1993) and Wheelwright and Clark (1992); and
- the ideas of process management inherent in the concept of lean production, as articulated by Womack and Jones (e.g. 1995) and others.

The process protocol initiative raises a number of important issues, not all of which can be discussed here: one early commentary is offered in Carr and Winch (1998). Our attention will be focused on the implications of our work on process mapping with one retail client for the process protocol initiative. These are:

- despite very closely matched projects in terms of client, project mission, and the existence of the client's own in-house protocol, there was considerable variation in the shape of the processes for the four projects mapped;
- despite the insistence on scheme freeze after CEC, significant client-initiated changes were made to the project after contractor appointment;
- these differences and changes often were beyond the ability of the client in the form of the SDG to control directly; and
- the strategic importance of 'programme' in the project mission encouraged the making of entirely appropriate trade-offs that generated cost increases.

The client for the four construction projects, which were very similar in mission, found great difficulty in keeping to its own process control. This suggests that the opportunity for a single client to adopt the much

more detailed approach of the process protocol is rather limited. However, the ambitions of the process protocol initiative would appear to be wider than that, for it offers: 'a new process paradigm, which can be managed and reviewed across the breadth and depth of the industry and which focuses on changing and systematizing the strategic management of the potentially common management processes in construction while accommodating the fragmentary production idiosyncrasies' (Kaglioglou *et al.*, 2000, p. 143). This suggests that its ambition is, in addition to a project-specific common approach, to offer a substitute for the existing generic protocol currently used in the (UK building) industry: the RIBA Plan of Work. However, the experience with the RIBA Plan of Work over the 35 years since its first publication in 1964 is not encouraging. 'Its intention was to provide a model procedure for the methodological working of the design team' (RIBA, 1973, p. 347). Yet, despite a stern warning at the end of stage D to the effect that 'the brief should not be modified after this point' and an even more stern one at the end of stage E to the effect that 'any further change in size location shape or cost after this time will result in abortive work', clients and others have routinely changed their minds about what they want. It is not at all clear how the process protocol would alter this situation.

There is also a business reason why the process protocol is likely to be inappropriate at levels of the industry. The whole incentive for companies to improve and redesign their business processes is to be more competitive; this is the basic tenet of the process improvement literature. The greater satisfaction of clients and customers is only the means to the end of beating the competition and thereby generating higher shareholder value. In industries like construction, where firms do not possess strategic assets such as sunk costs, locational advantages, or patents, nor where they can compete through cost leadership obtained by capital investment, process capabilities are all they can offer clients: the ability to design better structures; the ability to better manage supply chains; and the ability to motivate skilled labour. If these processes become common between firms through a generic process protocol, then their ability to compete with each other is further diminished, leading to even lower levels of profitability. Every construction firm, to be successful, needs to offer clients a *different* process from its competitors. This is what is behind the success of early movers with partnering, which currently are generating higher profits than their less innovative competitors.

More broadly, our conclusions from this research are that a generic process protocol for the entire construction industry at a level of detail useful enough to provide the basis for 'the standardization of deliverables and roles' (Kagioglou *et al.*, 2000, p. 151) is probably unrealizable. As Hammer and Stanton (1999) argue, process standardization is very difficult to achieve where customers' needs are diverse, even *within* a single company. In an industry like construction, which serves relatively proactive clients, rather than relatively reactive customers, the goal of process standardization is likely to be even more elusive.

None of these arguments gainsays the potential advantages from process mapping and developing process protocols in the appropriate context. That context, we propose, is that of a specific coalition of firms organized into a supply chain by either a client or, probably more frequently, a principal contractor. Thus a process protocol would act as the 'articles of agreement' of a partnered supply chain which would then use it as the baseline for reconfiguring the shape of the project process to meet the challenges of a specific project mission. This is exactly the intention behind the development of IDEF0 as the 'architecture of manufacturing' for the ICAM initiative: to provide 'a language for this new architecture' (Hunt, 1996, p. 98), in the context of the deployment of AGILE manufacturing concepts (Kidd, 1994). IDEF was developed to meet the needs of a single client, the US Airforce. In a similar manner, the development of the process protocol was led originally by a single client, BAA plc. From this perspective, if these initiatives were to be scaled up to the industry level, the outcome would be the development of a number of competing process protocols as principal contractors competed to offer distinctive supply chain configurations which provided different price/performance trade-offs for clients. Such protocols would then form the basis for the development of proprietary IT-based project information management systems, and be 'shaped' on a negotiated basis to meet particular project missions.

Any national construction industry needs a common language for discussing and planning its processes. The RIBA Plan of Work has played a vital role in providing this language in the UK for many years. However, its assumption of the architect as the leader of the project coalition and focus on design limits its use as the shape of project processes has evolved since the 1960s. The process protocol initiative will have performed a valuable role if it can authoritatively replace this language with a newer, more appropriate one to meet the challenges presently facing the UK construction industry. Only time will tell if it can garner the wide support that this will require. However, a language is not a protocol. On the basis of the evidence from one retail client managing four very similar projects reported here, it appears unlikely that it will be able to achieve the aim of providing a generic protocol for the construction process.

Conclusions

The fundamental insight that building is a process is by no means new (see Turin, 1967) but a more widely shared process perspective is gaining ground (Winch, 2002). In this research, we have applied standard business process mapping methods to the construction project process. Our focus has been on what actually happens on projects, rather than what ought to happen. We believe that doing this is very important for two reasons. First, unless current processes are fully understood, then it is difficult to generate a route map from where we are to where we might want to be in the future. Second, such process maps are vital for understanding how certain levels of performance, as measured by output benchmarks, are achieved. We have criticized the development of the generic process protocol on the grounds of both historical experience and its ignorance of the realities of process-based competition. If our argument that the successful implementation of process mapping in the construction industry would lead to not one national generic process protocol but a number of competing protocols that charter partnered supply chains (quasi-firms in economic language) is sustainable, then a number of issues can be identified as future research requirements.

The work of Cooper on new product development has identified the importance of gated review processes. He argues that these are the points where the project team converges and all the new information is brought together (Cooper, 1993, chap. 7). The gates in place at the retailer studied were standing reviews, not project-based. Work by Winch *et al.* (1998) on the successful Glaxo project has shown the importance of project-based review gates on construction projects. Much further work is required to understand the most effective way to manage such project reviews, and to answer confidently the who, what, when questions:

- who should be present at the review to sign off progress and to authorize the project to move to the next phase?
- what information is required for that decision to be made?
- when in the project life-cycle should the reviews take place as hard or soft gates?

The mapping of project information flows has to date ignored an important aspect: what might be called the 'resolution' of the flow. Taking the analogy from visual display units, it is the amount of information (pixel count) required to communicate a defined item of information, such as an elevation. International comparative work by Flanagan *et al.* (1986) and Winch and Campagnac (1995) has shown that, for a comparable project mission, much more information flows on a UK project than a US or French one. In other words, more drawings are generated and passed from designers to constructors, and the resolution is higher, generating additional cost. It is not clear why this should be, although it appears to be related to contractual liabilities, but it is now firmly embedded in industry practice. Research is required into establishing good practice in the resolution of project processes, so that resources are not wasted in generating, transmitting, and interpreting unnecessary information, while retaining full definition of the information flows that are required.

Much greater attention also needs to be given to the governance of the process. Processes, be they flows of information or materials, essentially are sequences of transactions through time (Winch, 2002). Processes do not, therefore, flow in free space, but within and between firms which have contractual relations with each other. Thus the governance modes selected for these transactions will profoundly shape the project process. As we saw on the different projects reviewed above, the perceived risks associated with each process shaped that process in different ways. A process perspective needs to include an understanding of the ways in which they are shaped by the perceived risks associated with them.

It follows from the above arguments that the construction industry needs not a generic process protocol, but a widely accepted *methodology* for creating maps and protocols which can provide the baselines for shaping project-specific processes, and communicating to clients the merits of competing protocols. One candidate for this is IDEF0, but its lack of contextualization and its rigorous, detailed development procedure may well inhibit its widespread acceptance in the construction industry. Another is the use of enactable models that allow walkthroughs (Abeysinghe and Urand, 1999), but these are in an early stage of development. In our judgement, a business approach to process mapping as articulated by Rummler and Brache (1995) would be more appropriate to meet the contemporary needs of managing construction projects than an engineering one. It is very much to be hoped that the process protocol initiative can develop and diffuse such a business approach, rather than aim to be generic.

There is, we argue, much potential for the development of the art of process mapping and design of process protocols in construction, but it should never be forgotten that the process is merely a means to an end: the built product that the client needs to house its own business processes. The cautionary tale cited by Davenport (1993, Appendix B) is worth reiterating. The CEO who had championed the redesign of Florida Power and Light into a 'process-focused' company was

relieved of his duties, despite that fact that the company was the only US company at that time to have been awarded the prestigious Deming Award. His replacement stated that the 'undue emphasis' on process had generated bureaucracy and removed from employees the personal responsibility for meeting customer needs that is the hallmark of good business.

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Appendix A

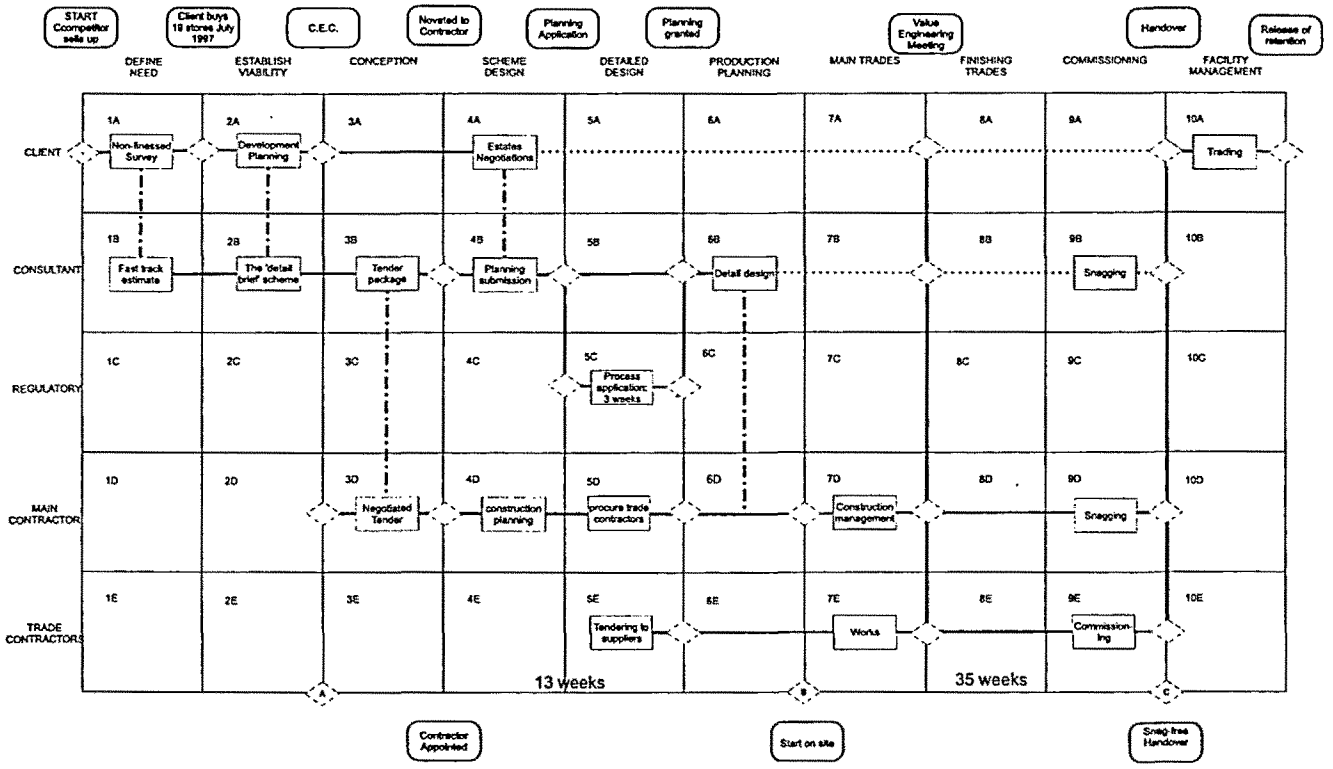

Figure A 1 Derby total project process

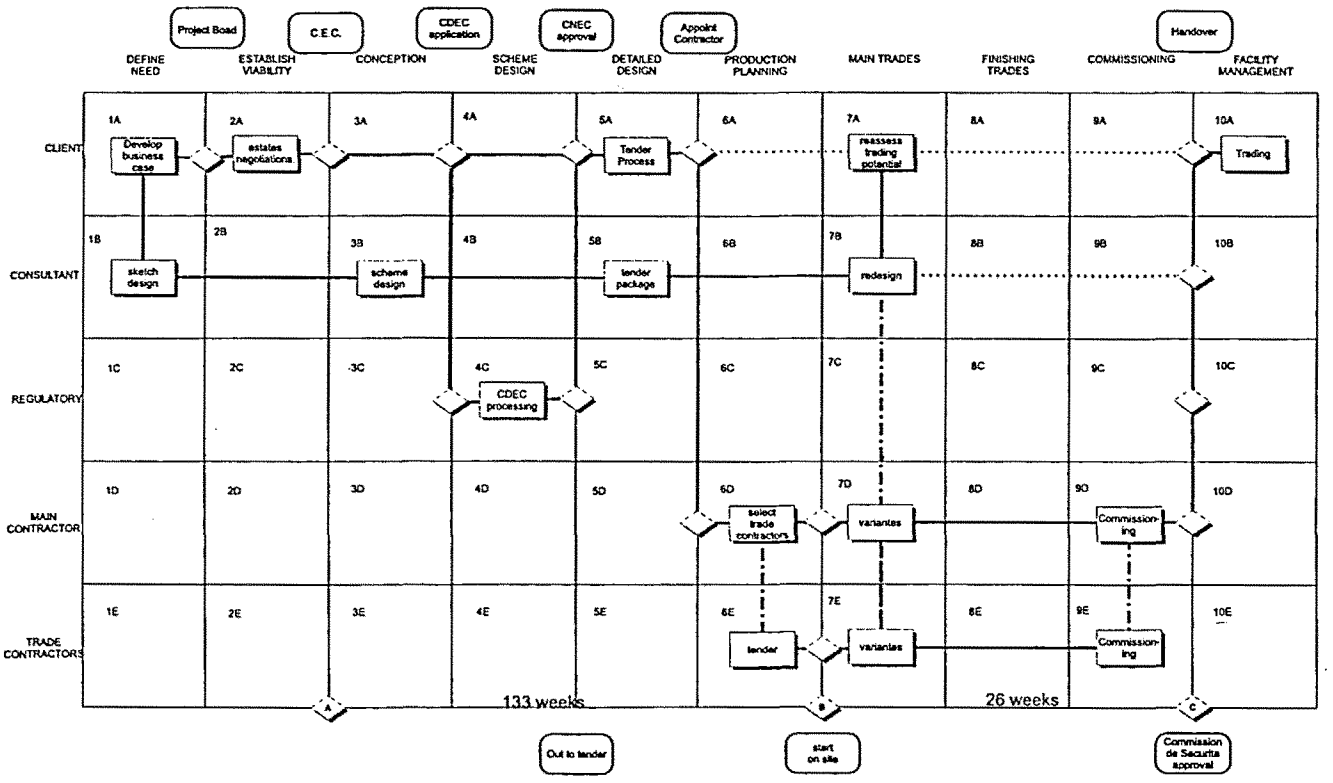

Figure A 2 Milton Keynes total project process

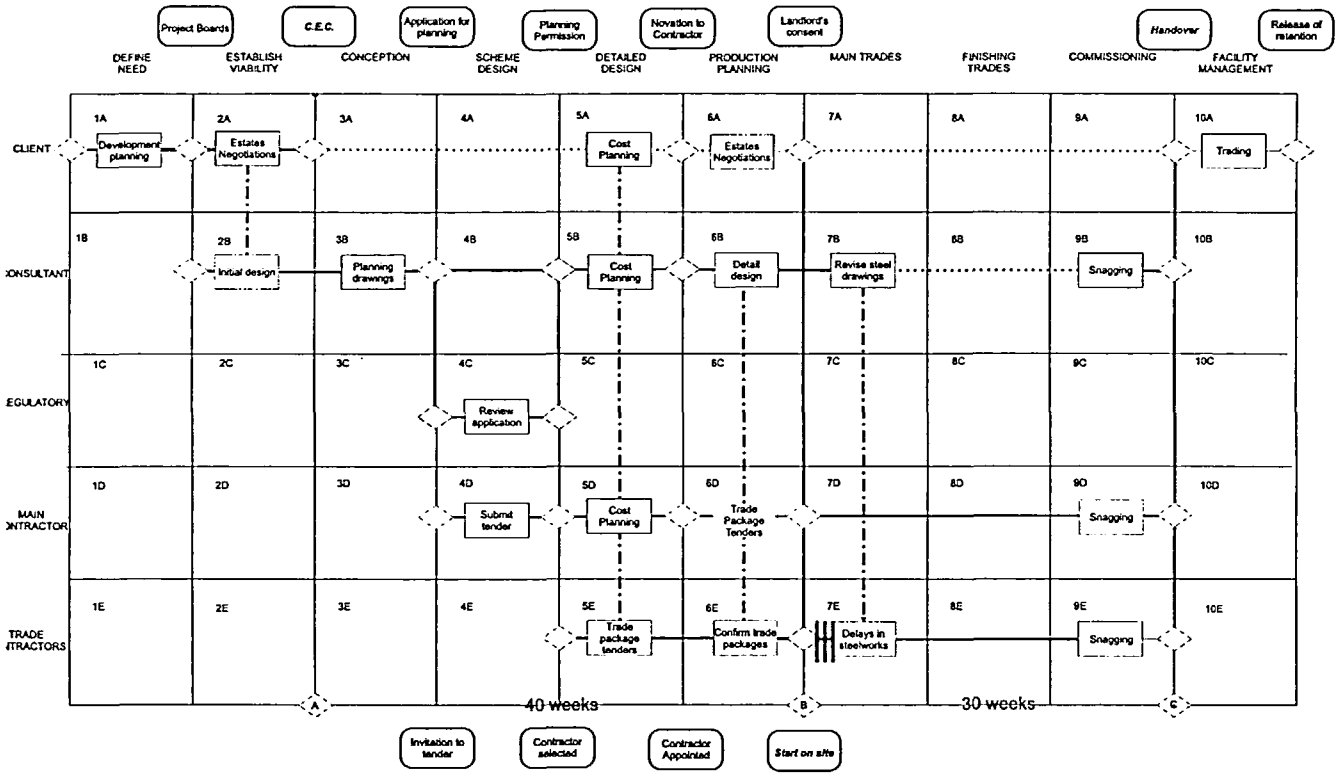

Figure A 3 Grand Littoral total project process

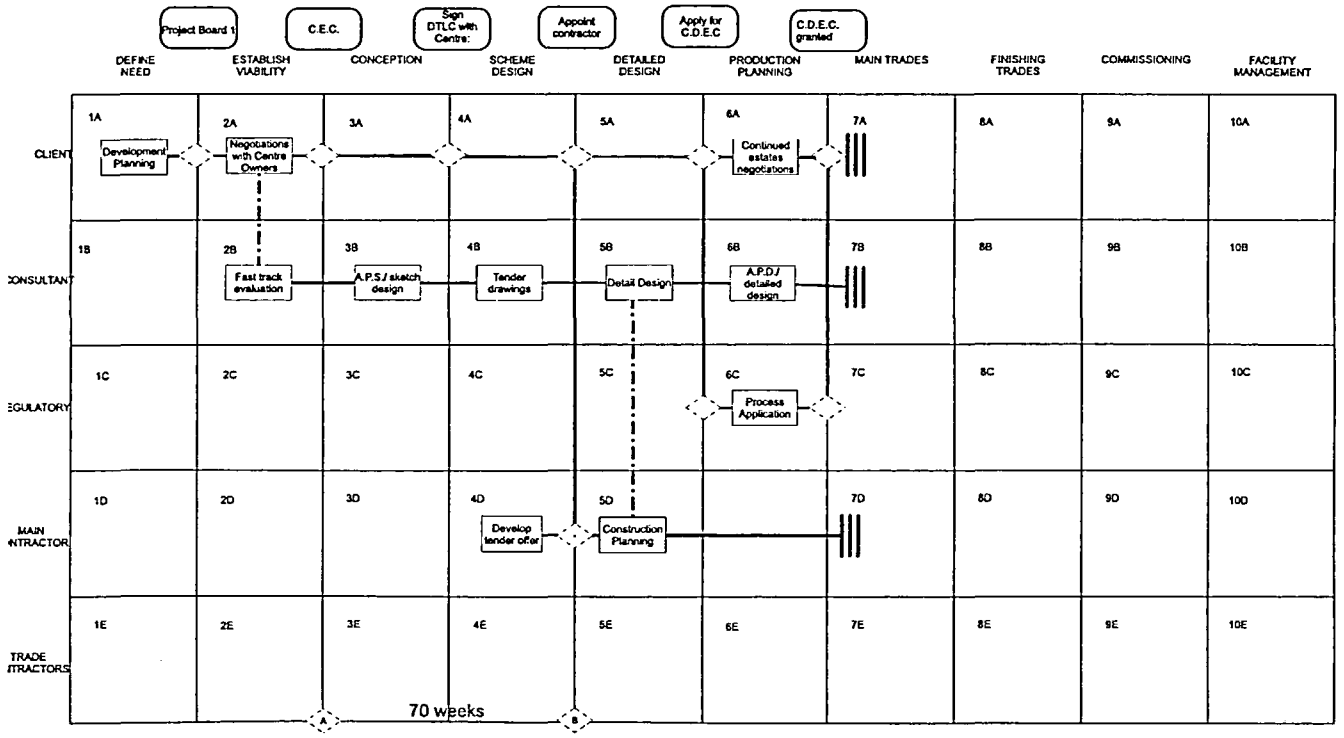

Figure A 4 Parly II total project process