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Innovativeness in British and French construction: the evidence from Transmanche-Link

GRAHAM M. WINCH

Bartlett School of Graduate Studies, University College London, Philips House, Gower Street, London WC1E 6BT, UK

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This paper addresses the ‘innovativeness’ (the extent to which the design of the organization facilitates or inhibits innovation) of French and British project organizations. Following a review of the literature on organization design and innovativeness, data from a comparative organizational assessment of the British and French approaches to managing the Channel Tunnel construction project by Transmanche-Link are presented. These show that the British approach could well have less capacity for innovation than the French. The available evidence on the relative levels of innovation on the two sides of the Channel Tunnel are reviewed, showing that the predicted effects are found.

Keywords: French construction, British construction, Channel Tunnel, major projects, construction innovation

En ce qui concerne la relation entre la gestion de projet et l’innovation technique et organisationnelle, l’exemple concernant le percement du tunnel sous la Manche est très instructif. De grandes différences existent entre les méthodes anglo-saxonnes et françaises. Les méthodes anglo-saxonnes sont beaucoup plus formalistes, procédurières, et privilégient effectivement en cas de conflits les solutions juridiques. Les démarches françaises tendent à faciliter l’innovation et l’adaptation, surtout de la part des équipes de réalisation et des directions de travaux. (Colombard-Prout, 1993, p 113)¹

Introduction

One of the principal themes in the management of innovation is that of the ‘innovativeness’ of the organization—the extent to which the design of the organization facilitates or inhibits innovation. Clearly the Innovation Director of GTM Construction believes that the French approach to project management on the Channel Tunnel favoured process innovation compared with the British. Further information on how GTM Construction facilitates innovation and learning

is provided in Construction Productivity Network Report No. S196 of the EPSRC funded seminar on ‘Human Resources for Construction Innovation’. Survey evidence is presented in the present paper that explores that contention. Following a review of the literature on organization design and innovativeness, data from an organizational assessment of the British and French approaches to managing the Channel Tunnel project are presented which show that the British approach could well have less capacity for innovation than the French. The available evidence on the relative levels of innovation on the two sides of the Channel Tunnel is then reviewed, before some conclusions are drawn.

Innovativeness and innovation

One of the most strongly established themes in organization and management is that of the capacity of organizations for innovation – while the terms may have changed over the years, the principle has not. The proposition is that some organizational forms, while perfectly appropriate for stable states, actually inhibit

the innovation required for competing in changing conditions. This proposition is found in the work of Burns and Stalker (1994) from the late 1950s; Kanter (1984) from the late 1970s; and Eisenhardt and her colleagues (Eisenhardt and Tabrizi, 1995; Brown and Eisenhardt, 1997) from the early 1990s. Let us take them seriatim.

The work of Burns and Stalker was first published in 1961, and represents one of the cornerstones of the argument that organization designs should be appropriate for the mission they are intended to achieve. On the basis of comparisons between the more innovative English electronics companies and less innovative Scottish electronics companies, they distinguished the *mechanistic* and *organic* organization designs (summarized in Table 1) not as a dichotomy but as a polarity within which organizations could find their appropriate designs. While a pure mechanistic form was appropriate for a completely stable environment, the pure organic form was appropriate for rapidly changing environments, such as electronics, where continual innovation was required for competitive success.

Kanter's research expanded this theme by studying 10 US firms in manufacturing and services, where she distinguished between the *segmentalist* organizations found in car manufacturing, refining, insurance, and telecommunications services and *integrative* organizations found in electronics. The main differences between these two are summarized in Table 2. As Kanter stresses, again it is a question of appropriate

organization design, and the argument is not that there is no innovation in segmentalist organizations but that such activity is very slow when compared with integrative organizations, so that in fast-moving environments such as electronics segmentalist organizations simply cannot keep up.

Eisenhardt and her colleagues followed their predecessors in using the electronics industry as a benchmark for innovativeness while focusing more precisely on the organization of product development projects. Quantitative research sampling 36 of the top global electronics companies (Eisenhardt and Tabrizi, 1995) addressed project organization, while grounded research in 6 leading US companies (Brown and Eisenhardt, 1997) focused more on project managers. They distinguished between two different strategies for project organization, the *compression strategy* and the *experiential strategy*, concluding that the latter was faster and more creative than the former. Table 3 summarizes the differences between the two.

Perhaps the most interesting aspect of this work is that the compression strategy would be considered by many in construction project management as good practice, yet it is found here to be less effective at innovation than the experiential strategy. Further analysis moderates this view: in the relatively slow moving markets of mainframe and minicomputers, the compression strategy is found to be appropriate; it is in the leading edge of personal computers and software that it is found to be wanting. The grounded approach in the later research broadly supports this

Table 1 Mechanistic and organic organizational forms^a

Mechanistic organization	Organic organization
Tasks broken into specialisms	Jobs not formally defined
Tasks undertaken in isolation	Tasks undertaken in context of whole
Precise definition of functional roles	Jobs defined in interaction
Management interaction vertical	Horizontal interaction
Work governed by instructions from above	Jobs performed in light of knowledge of whole
Complex hierarchy with omniscient apex	No presumption of omniscience at apex
Simple control systems	Coordination through shared culture
Work handed from function to function	Work with few distinguishable stages

^aSource: Burns and Stalker (1994, chap. 1, see also chap. 6).

Table 2 Segmentalist and integrative organizational forms^a

Segmentalist organizations	Integrative organizations
Organization divided into departments and levels	Broad job charters and ambiguous, non-routine assignments
Information a secret rather than circulating commodity	Intersecting job territories oblige information sharing
Hierarchy holds the organization together	A culture of pride develops self-confidence
Vertical relationships dominate interaction	Teamworking dominates interaction
Pre-existing routines for action	Local autonomy for action
Measurement to guard against deviations	Motivation to succeed

^aSource: Kanter (1984, chaps 3, 5).

Table 3 Compression and experiential strategies^a

Compression strategy	Experiential strategy
Spend more time in pre-planning	Increased design iterations
Greater supplier involvement in the process	More test cycles
Greater use of CAD	Frequent project milestones
Overlap of project stages	Heavyweight project management
Multifunctional teams	
Reward meeting project schedules	

^aSource: Eisenhardt and Tabrizi (1995).

quantitative analysis; most notably, the case company that defined ‘project management’ as one of its core areas of competence was found to be one of the least effective innovators. The basic problem is that the compression strategy requires careful definition and pre-planning, whereas in a truly dynamic environment greater responsiveness to the market is required which utilizes ‘low-cost probes’ into the future and intensive feedback, rather than trying to identify all the risks and contingencies early in the project. More generally, the contribution of traditional project management tools to effective project delivery has been much in question recently; see Morris (1994) and Winch (2000) for reviews of the issues.

Three very different research projects over nearly 40 years have reached much the same conclusions: organizations that are relatively programmed and planned have more difficulties in innovating; those that are not have fewer. They are not entirely in agreement – one of the areas of difference (particularly between Kanter and Eisenhardt) is the role of teamworking; as will be seen, this is also a difficulty in analysing the results of the Channel Tunnel survey. On the basis of this research, and a number of complementary studies, the following propositions can be offered which can be tested using the data from our research.

Relatively *uninnovative* project organizations will feature

1. tall hierarchy
2. clear divisions of labour and precise definitions of roles
3. reliance upon procedures for the co-ordination of work
4. low commitment to work and colleagues

Relatively *innovative* project organizations will feature

1. flat organization
2. ambiguous and overlapping role responsibilities

3. reliance upon strong project leaders for coordination of work
4. high commitment to work and colleagues

The next section explores these propositions in the context of the Channel Tunnel project.

Innovation and project organization in Britain and France

The data in this section are taken mainly from a self-completed questionnaire distributed to all managers working for TML in September 1993 during the commissioning phase of the project, the results of which are summarized in Table 4. Full details of the survey results can be found in Winch *et al.* (1997) and Winch *et al.* (2000), while a case study (Winch, 1996) provides contextual information; the presentation here will be restricted to the data bearing on the propositions above.² The data are mainly either differences of means between the British and French cohorts on a principal components analysis of the questionnaire, or responses to the open-ended questions. Details of the methodology deployed can be found in the Appendix. Table 4 reports the summary results of the survey, which are discussed in detail in the following sections. Complementary data are drawn from a case study of another Anglo-French joint venture, the second Severn bridge, built by a GTM Europe/Laing Construction joint consortium (Campagnac, 1996).

Proposition 1: the nature of hierarchy

The overall organization design of TML at March 1993 is shown in Figure 1. No later chart is available, but we were assured (interview 12/3/96) that the same structure existed at the time of the fieldwork six months later, albeit considerably reduced in overall number of staff. Essentially it is an administrative adhocracy (Mintzberg, 1979. Chap. 21). This organization structure was common to both the French and British parts of TML; therefore our data on hierarchy are differing perceptions of how the common hierarchy is experienced by the respondents.

Table 4 French and British management organization and behaviour compared^a

	French	British
Work organization	<i>fonceur</i>	procedural
Group behaviour	competitive	collegial
Job involvement	distanced	involved
Interpersonal relations	individualistic	supportive
Stress	high	low

^aSource: Winch *et al.* (2000).

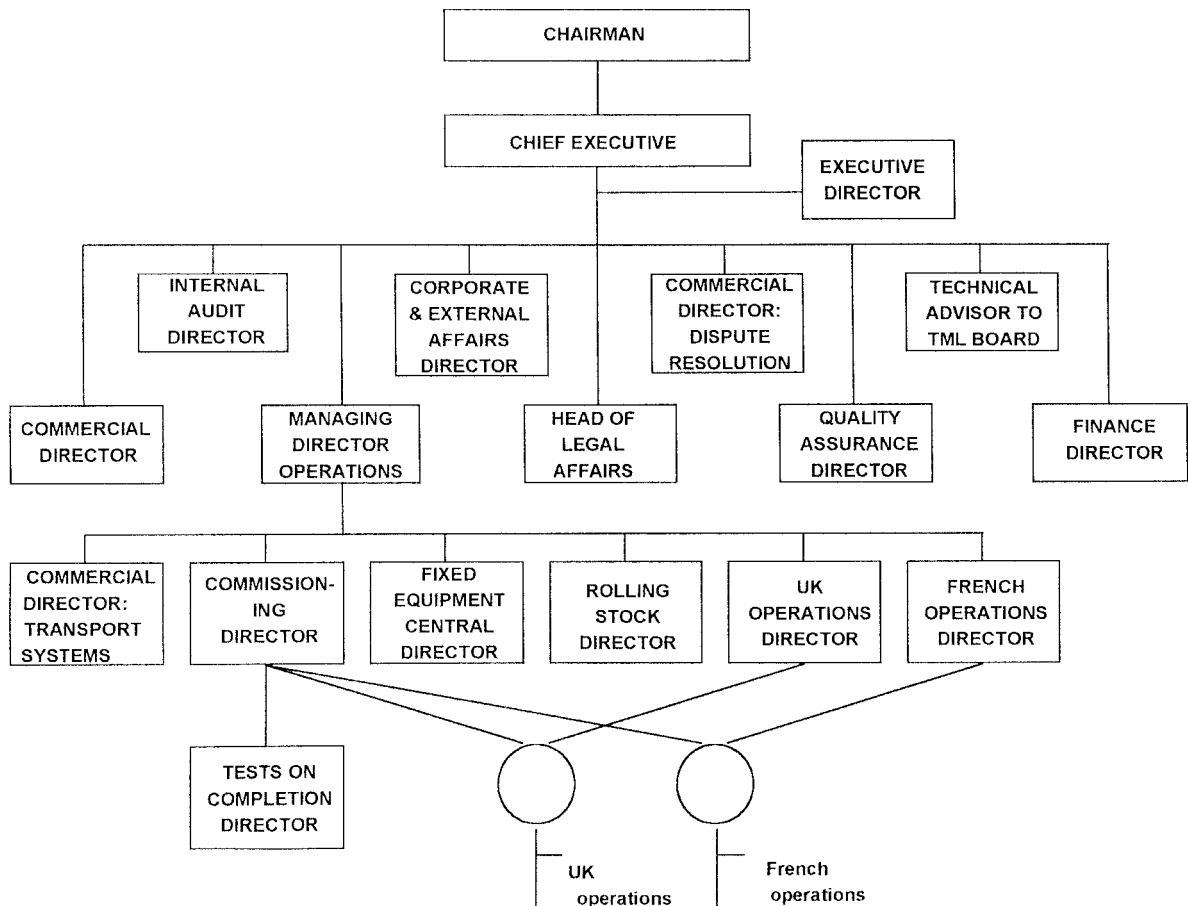


Figure 1 TML organization, 1993

Source: interviews

Two components extracted both identified the influence of particular actors in decision making at the unit level. The first component, member influence, grouped the individual unit members alone, and unit members together with the unit manager; while the second, manager influence, grouped the unit manager alone and people outside the unit. As might be expected within a common organizational structure, there were no significant differences on these two components between the British and the French ($p = 0.59$ and 0.87 , respectively). A further analysis of the results identified that, as might be expected, the unit manager was seen as the most influential actor, while the individual unit members were seen as the least. A χ^2 test on a question derived from the value survey module (Hofstede, 1980) part of the questionnaire on perceived style of the respondent's manager showed that managers similarly tended towards the autocratic rather than the participative end of the spectrum of management style on both sides of the Channel ($p = 0.99$ $df = 4$).

The picture that we have of hierarchy within departments at TML is that they are fairly similar in

terms of who has the most influence over decisions. There are no significant differences, then, in hierarchy between the British and French within what is, as can be seen from Figure 1, a relatively flat common organization structure.

Proposition 2: the definition of roles

Although there do not appear to be any differences in the nature of the hierarchy itself between the British and French, the definition of roles within the hierarchy does vary significantly. One British response identifies a difference that others have noted: 'The British managers tend to be 'pigeon-holed' in a particular discipline, whereas the French tend to be more multi-disciplined. The French tend to need a hierarchical structure within which to work efficiently, whereas the British tend to be more flexible' (GB 16).

Campagnac, too, found that the French organization is one where authority is centralized and passes vertically in a single hierarchy, while the British is more decentralized, with authority being diffused horizontally and passing upwards in multiple hierarchies. As

one of her informants put it (Campagnac, 1996, p.24): 'Les Anglais ont aussi une hiérarchie mais par fonctions. On y voit rarement des décisions imposées. Pour prendre une décision dans le système anglais, il faut le consensus auprès des représentants de chaque profession.'³

The problems of role specialization and fragmentation were behind the major problems in the management of the British tunnelling effort in the earlier phases. As one American construction manager put it (cited in Fetherston, 1997, p. 297): 'The job wasn't organized right . . . We had a plant department that was independent of the production people, a railway that was running independent of the tunnel drive. There were little kingdoms all over the place'.

There is evidence here that there is a more precise definition of roles, most notably around the many different construction professions, each covering a relatively small set of areas of competence. By contrast, French engineers have a larger set of areas of competence, with broader responsibilities. This point is illustrated by the senior British informant who, in response to a question regarding cultural differences on the project, replied that the only cultural difference was that 'the French never really could understand what a quantity surveyor did that an engineer could not do' (interview 5/9/95). This evidence cannot be pushed too far – the variable which explored the ability of people to rotate between jobs, a measure of specialization – did not load on any other variable, and displayed no significant difference between the two groups ($p = 0.85$); however, it does suggest that the allocation of roles within the hierarchy in Britain is more precise and segmented than it is in France.

By contrast, there is evidence that the British have a stronger team orientation at work. As one British respondent put it: 'The French are much more independent, and less prepared to compromise than the British, or to fit in with other's schemes' (GB 59). One of Campagnac's British informants reported greater teamworking amongst the British, arguing that (Campagnac, 1996, p. 24): 'Comparatively with GTM, Laing is more "team oriented". French are more hierarchical. We are more prepared for brainstorming than our french colleagues'.

These qualitative responses are supported by the very significant differences on the unit cohesion component, where the French scored more highly than the British, implying low unit cohesion amongst the former ($p = 0.00$). The French competed with each other very significantly more and tried to get ahead of each other more, while also showing a greater tendency to encourage excellence from each other. Two questions asking whether unit members ganged up on each other to control work effort also loaded on this

factor, but with very low means (below 1.58) and no significant difference. On this basis, we concluded that the French were much more *competitive* at work, and the British more *collegial*.

Proposition 3: the control of work

So far as the control of work is concerned, three principal components were identified. The first component identified work autonomy by exploring how much authority the respondent had in making decisions about work tasks, and indicated that the French were very significantly more autonomous ($p = 0.01$). In terms of authority setting quotas on how much work was to be completed the French had significantly greater autonomy, and a tendency to more autonomy in making decisions about the tasks to be performed day to day. In decisions about handling work exceptions, establishing procedures, and control over work pace, the French scored more highly, but not significantly.

Next, a work coordination component was identified, showing the British as very significantly more procedurally orientated than the French ($p = 0.00$). The difference of means on three questions exploring whether procedures specified major tasks, their number, and what percentage of time was spent on tasks with written procedures were all very significant, while a fourth, investigating how often feedback on work performed was received from colleagues, also loaded on this factor, but with the British showing a very significant propensity to do this compared with the French. Thus British managers relied upon much greater coordination through both procedures and mutual adjustment than the French.

The third component extracted also indicated very significant differences between the British and the French—this was the work control component ($p = 0.00$). The extent to which written procedures were followed, how far in advance the respondent knew about the work to be done, and the extent to which the supervisor held the respondent personally responsible all loaded on this factor. Both groups displayed very high (mean 4.04) levels of personal accountability for their work, and both followed consistently the written procedures that they had, while there was a tendency for the French to know about their work more in advance. Thus there are some indications that the French have more control over their work, but this is not well supported by the loading of the manifest variables, and is in a context of high levels of personal accountability for both groups where both follow what procedures there are.

Although this was not universal, generally the British respondents held the view that they had a more

systematic and disciplined approach to work than the French. As one British informant put it: 'I may be biased but in general terms my impressions are that the British systems have been far more professional and efficient than our French counterparts' (GB 30). However, this was not always seen as an advantage. Another British respondent, who also had worked with the French on the Tornado military aircraft joint venture, argued that: 'On a day to day basis the British seem entrenched in rules and regulations to the point of major delays in headway. The French appear to have a much more relaxed approach' (GB 80). He was echoed by a number of other British informants regarding what they saw as the more relaxed approach of the French. None of the French respondents commented upon this greater reliance on systems and procedures by the British, although one of the thirteen French respondents working in Folkestone, and therefore excluded from the quantitative analysis, did argue that: 'L'anglais est plus analytique et moins pragmatique que le Français . . . Le Français va plus vite à la synthèse mais sans toujours analyser complètement le problème' (F 233).⁴

Campagnac also found that the British relied much more upon procedures than the French, while the French relied much more upon personal responsibility. As one informant told her (Campagnac, 1996, p. 24):⁵ 'En France, on a l'habitude de se reposer sur des individus à qui l'on confie des responsabilités très poussées. Ici, les gens se basent davantage sur le système plutôt que sur les individus. Les responsabilités sont plus éparpillées, plus divisées qu'ailleurs.'

So, coupled with their lower autonomy, the British can confidently be described as more *procedural* than their French counterparts. In strong contrast, the French were more *fonceur* (action-orientated) than their British colleagues. The apparent contradiction of the British reliance on both procedures and mutual adjustment for the coordination of work might be explained by the necessity for mutual interaction in those cases where procedures do not provide the answers to work coordination problems. The more individually competitive French, on the other hand, make work coordination decisions not already prescribed by procedures on an individual basis.

Proposition 4: commitment to work

The survey explored commitment to work extensively, and the variables loading on the principal components all asked respondents to report upon how they felt about various aspects of their work from what motivated them to how stressed they were. The first component extracted was a job satisfaction component correlating satisfaction with the job and career

progress, and level of personal responsibility – a question on frequency of thinking of quitting the job loaded negatively. While the British had a tendency to express greater satisfaction with their career progress, there was no overall significant difference on this component or any of the loading variables ($p = 0.65$).

The next two components identified aspects of extrinsic motivation. The first explored *instrumental motivation*—there was no significant difference between the two groups on the extent to which they were motivated by higher pay, bigger bonuses, or the promise of promotion ($p = 0.63$). All three were important (average mean 3.5) to both groups. However, there was a very significant difference when it came to the third component, which identified the extent to which respondents were motivated by encouragement from others on their performance: the feedback motivation component. Here praise from both colleagues and superiors made a very significant difference to the motivation of the British compared with the French, whereas there was no difference in the effect of a promise of job security. A question on whether it was hard to care about the work also loaded on this factor, but with a very low mean (1.66). However, it should be noted that an instrumental orientation was a stronger motivator for both groups than these more interpersonal motivators, where the average mean was 3.1.

Only two variables loaded on the fourth component, but it identifies an interesting and very significant difference between the British and French managers ($p = 0.00$). We called this the job involvement component, and consisted of expressed unhappiness when performing poorly on the job correlating negatively with the extent to which feelings were affected by poor performance on the job. In both cases the differences in scores are very significant, with the British being both more affected by job performance and, probably as a result, more upset when they perform poorly.

An interesting aspect of responses to the open-ended questions on their counterparts' working styles is that the few who mentioned this mainly saw the other as being more relaxed at work. One Frenchman reported: 'travail plus calme avec les Anglais, plus actif avec les Français, mais tout aussi intéressant' (F 177).⁶ On the other hand, a British respondent believed that: 'French people tend to be easier going, more relaxed in attitude' (GB 14).

From our research, the data on job involvement suggest strongly that the British are much more *involved* both in their work and with their colleagues, compared with the more *distanced* French. Similarly the data on feedback motivation suggest that the British are more *supportive* than their *individualistic* French counterparts, working as a team to solve problems that

could not be laid down in procedures, while the French shouldered responsibility for decisions alone, being less willing to rely upon procedures. These findings that the British are supportive and involved tends to endorse the conclusions from the data on the unit level that the British display more collegial group behaviour.

Innovativeness in French and British project organization

The evidence here is mixed but, on balance, it supports the contention that the project organization of the French is more likely to facilitate innovation than that of the British. Much of the organization structure was common, and the principal components identifying who was responsible for decision-making showed no significant difference. However, there were important differences in the allocation of roles within that hierarchy. Whereas the French had a unitary hierarchy with multiskilled managers, the British had a multiple hierarchy composed of the different, more narrowly defined skills. Stewart and her colleagues (Stewart *et al.*, 1994, chap. 4), in their comparative study of a British and a German construction firm, argue that the greater integration of the organization structure in the German firm compared with specialization in the British meant that coordination was easier, and meetings fewer.

A notable feature of comparative data is the much stronger sense of collegiality and teamworking amongst the British, but it is not at all clear whether this generates greater innovativeness. Kanter argues it does, while Eisenhardt and Tabrizi suggest that it does not. The data here suggest why multidisciplinary teamworking may not facilitate innovation—teamworking can be a response to the problems created by greater fragmentation in role allocation and over-reliance on procedures to control work. Arguably, the British emphasized teamworking because they had greater needs for mutual adjustment between functions, in order to compensate for weaknesses generated by overspecialization and the inevitable limitations of formal procedures in a dynamic work environment.

So far as work control is concerned, it is clear that the British managers rely more upon procedures, while their French counterparts have more autonomy in their work. The clearest conclusions from this research support what Schramm-Nielsen (1991) has called a 'personocracy', with strong leadership from *fonceur* managers who possess a greater range of skills. This, it might be suggested, gives French managers greater freedom to innovate. By contrast, the British managers work in a context which is closer to a bureaucracy, where systems and procedures combined with

teamworking enable coordination between more clearly and narrowly defined sets of skills. The evidence from the research reviewed above is that this situation is more likely to inhibit innovation

Clearly the British are more involved and committed to both their colleagues and their work. The work experience is more intense, with a less clear boundary between work and home, and greater levels of feedback and support. In contrast, the French place more distance between work and home, and tend to be more in competition and less supportive of each other. The more interactive British approach helps to develop a collegial atmosphere in which teamworking thrives, and might be expected to facilitate innovative activity, but it has to overcome the more segmented and procedural organization and control of work.

One factor that might be expected to affect innovation is levels of education. The quantitative data found no significant differences in levels of education if level of attainment, rather than years of education, is taken as the measure – this is preferred due to structural differences in the education systems of the two countries. However, clearly the French director responsible for commissioning the transportation system felt that there were differences in skill levels. He argued that, 'if French engineers score 100, then 110 British engineers were required to do the same job, but at only 80% to 85% of the cost' (interview 12/3/96). Merely counting levels of education may be inadequate, when there appears to be a fundamental difference in the knowledge-base of British and French engineers (Campagnac and Winch, 1997): French engineers have a bias towards theoretically acquired knowledge, while their English counterparts have a more empirical bias. Fetherston (1997, p. 6) puts the point more bluntly: while the British engineers earned their position through an 'intimate knowledge paid for in sweat', the French were technocrats, 'trained to lead as well as build'.

Levels of innovation in France and the UK

The conclusion from the data analysis is that, on balance, the French approach to project organization is more likely to facilitate innovation than the British, but what evidence is there of higher levels of innovation on the other side of the Channel? Our focus here is on performance improvement innovations, the type that will have to be made if the key performance indicator targets (Construction Task Force, 1998) are to be met. This is the thrust also of Colombard-Prout's argument—the capacity of the French to make incremental innovations which cumulatively enhance performance.

The Channel Tunnel project made a large number of product enhancing innovations which are impressive in both range and scale (see Byrd, 1992; Fetherston, 1997; Harris *et al.*, 1996; ICE, 1992, 1994; Kirkland, 1995, for the evidence presented here). Yet, due to the integrated nature of the completed facility, these were almost entirely common to both sides of the Channel. Our interest here is whether more innovations in how to achieve these product enhancements were made on one side than the other. A large number of the differences in the choice of technology by the British and the French can be accounted for by geological and topological differences on the two sides of the Channel. For instance

1. The French operated much more sophisticated closed face tunnel boring machines (TBM) compared with the British open face types, but this can be explained by known differences in the geology of the two sides of the Channel, rather than differences in innovativeness.
2. The lining assembly system was more sophisticated on the French side, but again this is due largely to differences in performance required to deal with known geological conditions. Additional hand-fitting was required on the British side due to the unexpected overbreak spoiling the planned circularity of the tunnel bores.
3. The British adopted the new Austrian tunnelling method (NATM) for their cross-over, access adits, and part of the landward tunnel drives; the French adopted a more conservative North American method on the grounds of less favourable geological conditions. Exactly why the French rejected NATM is unclear from the documentation available (compare Harris *et al.*, 1996, p. 359 and ICE, 1994, p. 69); however, the opportunity for the British to learn how to use the technique on the early No. 2 adit before the larger challenge of the crossovers was tackled appears to have played an important role in convincing Eurotunnel and its consultants of the merits of the method. Thus it would appear that differences in geology and the British opportunity to try out NATM on access adits early in the programme meant that the choice of NATM for the cross-over would have represented a higher risk for the French.
4. Lemoine (1994, p. 128) argues that the British productivity levels were lower due to lower levels of investment in plant. However, he cites only differences in total numbers employed at particular points in time. This is not an adequate basis for a productivity comparison, as

it could be explained simply by differences in the phasing of the project. We are not aware of any publicly available figures on man-hours expended, which is the only sound basis for a productivity comparison. Moreover, differences in numbers of employees can, at least partially, be explained by the facts that: the British tunnelled 36% further than the French, requiring a much greater effort in spoil removal and lining production and placement; they had constrained access via a complex system of adits under Shakespeare Cliff compared to the very large access shaft at Sangatte; and they were obliged to deploy additional labour in lining placement due to unexpected problems with overbreak.

However, three differences in choice of technique between the British and French which cannot be explained by external factors can be identified.

1. The tunnel construction transportation system was controlled manually on the British side using a magnetic location board and communication with the drivers by radio. The French system was controlled from a computerized control room with a screen location display and communication with the drivers by a full signalling system. The system also had the capability to be programmed to work automatically. However, the system had problems operating under the harsh tunnel conditions.
2. The French segment factory used an automated system for the manufacture of reinforcement cages, while the British ones were hand-welded. An automated handling system was used also to stock completed segments on the French side. Although the French system was described as 'fantastic' by one British project director, the automated handling system proved to be unreliable, and inflexible, and very sensitive to errors, causing fabrication to stop at times. The reject rate of segments on the British side was 0.6%, compared with 1.7% on the French.
3. The cross-passages between the three main tunnels were cut using manually handled air-spades on the British side and small excavating machines on the French, the use of which on the British side had been abandoned as 'just a mistake'.

It does appear as if the French were more ready to make process improving innovations than their British counterparts, particularly through the use of automated systems. However, these innovations did

not always work as well as expected, which might provide some justification for the less innovative British approaches. More broadly, the difference between the French and British tunnelling operations was that the latter 'worked under factory conditions', to quote a senior (American) construction manager (Fetherston, 1997, p. 293). Additionally, the French developed systems suitable for use by the completely inexperienced workers of the Pas de Calais, but the British imported skilled tunnellers from all over the UK and Ireland and kept to more traditional approaches. The commitment to using the project as a job creation exercise for locals meant that the French were obliged to innovate and train in order to do the work, while the British simply relied on buying in the skills required for traditional technologies – 'the British tunneller was the sum of his experiences: the French tunneller was the graduate of a special course of instruction' (Fetherston, 1997, p. 293). Campagnac (1996) also remarked on the reliance upon traditional craft skills on the Severn Bridge project, and the difficulties of adapting those skills to the advanced French hydraulic shuttering systems used for bridge segment manufacture.

While more indicative than conclusive, the evidence here is that there was a greater level of innovation and sophistication in the organization of work on the French side of the Channel compared with the British. Some of the process innovations can be explained by geological factors, but most cannot be so explained. In a number of different areas, the French chose to invest in higher technology to achieve greater productivity. While these systems did not always work as well as expected, they did push the technological frontiers and showed determination to move from the mucky boots tradition of construction that the British seemed to revel in. In the opinion of one American construction manager working on the British side, the French operation 'was boring ... There was none of this running around ... It was like being on a ship' (cited by Fetherston, 1997, p. 293). It would appear that the 'crisis type of personality' which the Tavistock Institute (1966, p. 50) found to be predominant in the industry with its 'inappropriate use of mechanistic management tools' is culturally specific to British construction.

Conclusions

The available evidence does suggest that GTM's Innovation Director has a point – so far as project execution methods are concerned, there is evidence that where independent technical choices could be made, the French were more innovative. Thus the contention

here is that the greater commitment to trying out new ideas on the French side of the Channel Tunnel can be explained largely by differences in organizational form. Action-orientated managers, with a technocratic ethos acting within a unitary hierarchy had greater opportunity to innovate, and used this to design systems suitable for use by specifically trained workers with no previous experience. British managers, despite strong commitment to their work and colleagues, and effective teamworking, were hampered in their innovation attempts by procedures and narrow role specifications, and tended to fall back upon what they knew and the traditional skills of their experienced tunnellers. Much more research is required before we can be confident that these differences in organizational form do lead to different rates of process improving innovation in the two countries, but it does suggest that the procedural and collegial orientation of the British is inhibiting innovation.

Appendix: Research methodology

The basic methodology deployed is that of organizational assessment (OA) (Van de Ven and Ferry, 1980), which proposes the collection of quantitative data in the context of a qualitative knowledge of the organization under study. The OA unit member instrument was used as the basis of the means by which the data presented here were collected. Questions were phrased so as to ask respondents to report on their own personal experience. Hofstede's (1980) value survey module was also implemented, with the aim of understanding the relationship between national culture and managerial behaviour in construction, and the initial results of this work are presented by Winch and his colleagues elsewhere (Winch *et al.*, 1997). After a period of qualitative research within TML, the data were collected by a self-completion questionnaire distributed in the mother tongue to all members of TML staff at first-line supervision level and above, through company channels, in September 1993 during the commissioning stage of the construction. With few exceptions, which were excluded from the analysis, the respondents were French nationals working in the French offices of TML at Sangatte, and British nationals working in the British offices at Folkestone. The latter included head office functions and therefore was larger in size and also the workplace of a small number of French. A response rate of 31% on the French side and 42% on the British yielded 52 usable French cases and 153 usable British ones. Data analysis essentially consisted of the search for significant differences between the responses of the two groups to the common questionnaire variables.

On the basis of the structure of the original OA, the organizational and behavioural variables were explored at three different levels of TML organization: group behaviour at the unit level; work organization at the task level; and feelings at the individual level. The analysis is based around the results of principal component analysis of the entire data set grouped *a priori* into these three levels. *t*-tests were then applied to both the component scores and the manifest variables to identify significant (at the 5% level), and very significant (at the 1% level) differences between the variable means of the British and French subsets. Where significance is only at the 10% level, the relationships were described as a tendency. Unless otherwise indicated, the data are taken from responses on 5-point ordinal scales, scored 1 low and 5 high.

In order to avoid the problem of the British respondents dominating the extraction of principal components, the French respondents were entered into the process three times, giving a nearly equal number of French and British cases in the calculations. This obviously increases the chances of making a type I error in rejecting the null hypothesis that there is no difference between the British and the French respondents' scores on the principal components. The summary of the results in Table 4 presents *only* those principal components where very significant differences in the scores on the latent variables are, in our opinion, fully supported by differences in the means of the loading manifest variables. A full presentation of the principal components identified and their interpretation, together with a table of the variables and their mean values is provided in Winch *et al.* (2000).

The quantitative data were supported by qualitative data in three ways. First, a detailed case study (Winch, 1996) of the construction of the Channel Tunnel, largely from documentary sources, was prepared so that the social context within which the respondents responded to the questions was known. Second, interviews with TML and Eurotunnel managers were conducted during the course of the research, to tailor the questionnaire to the social context of TML, and to provide contextual information for its analysis. Third, responses to an open-ended question in the TML survey instrument were invited in order to encourage respondents to offer their own perceptions of their experience working with their British and French counterparts. The English text of the open-ended question from which we have drawn our respondent quotations is as follows.

Q39 'The Channel Tunnel is a Franco-British joint venture. What are your reflections on your experience of this as an example of binational cooperation? Have you noticed differences in the French and British approaches? Have you

encountered any problems? Is there anything which could be improved?'

Endnotes

- 1 The Channel Tunnel provides a very instructive example of the relationships between project management and technical and organizational innovation. There are large differences between the Anglo-Saxon and French methods. Anglo-Saxon methods are much more regulated, procedural and more likely to have recourse to the law in cases of conflict. The French attitude tends rather to encourage innovation and flexibility, especially on the part of construction teams and managers.
- 2 The empirical research reported here was financed by The Leverhulme Trust (Award No. F.134BE) and conducted in collaboration with Carla Millar and Naomi Clifton.
- 3 The English also have a hierarchy, but by function. One rarely sees decisions imposed. To take a decision in the English system, it is necessary to have a consensus of the representatives of each profession.
- 4 The Englishman is more analytical and less pragmatic than the Frenchman. The Frenchman goes more quickly for the synthesis, but without always completely analysing the problem.
- 5 In France one is used to giving to individuals considerable responsibility. Here, people rely more upon the system than individuals. Responsibilities are more dispersed, more divided than elsewhere.
- 6 Work is more calm with the English, more active with the French, but also more attractive.

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