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IMPLEMENTING AN OFFSITE CONSTRUCTION STRATEGY: A UK CONTRACTING ORGANISATION CASE STUDY

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Many United Kingdom (UK) contractors only consider offering offsite solutions on a bespoke project-by-project basis, with very few having immediate plans for integrating fully offsite manufacturing as part of their core business strategy. Limited literature exists regarding how a major UK contractor could achieve such a strategic offsite capability, as this capability is usually referred to as an out-sourced, sub-contracted activity. The concept of a major contractor providing its own capability and completing large scale infrastructure projects using offsite construction (OSC) methods is not common in the UK, although the concept is less rare in certain other countries, such as Australia. The aim of this paper is to determine the benefits that OSC can offer for UK contractors and to investigate how an offsite strategy can be implemented in practice. Semi-structured interviews were conducted with a major UK contractor, transcribed, and thematically analysed to determine how effectively the offsite strategy and methods were being implemented at different levels within the contractor's operations. The potential attractiveness and future of offsite for major UK contractors is discussed. The paper concludes with three recommendations for contractors considering the development of offsite capability. First, commitment from senior leadership at a strategic level, second, clear communication to all level through the firm and third, investment in innovation.

Keywords: Case Study, Contractors, Infrastructure, Offsite, Prefabrication, Strategy

INTRODUCTION

Significant research into the drivers and barriers to OSC has been undertaken (Nadim and Goulding, 2010; McKay, 2010; Blismas et al., 2005; Gibb, 2001; Goodier and Gibb, 2005a; Goodier and Gibb, 2007). Attempts to establish similarities in approach between construction and manufacturing companies have been made, and it has been commonly suggested that OSC should utilise manufacturing techniques similar to those used in automotive manufacturing (Egan, 1998; Crane et al., 2002; Constructing Excellence, 2009). Currently, the UK Government is looking into offsite as an option for cheaper, more affordable housing (Miles and Whitehouse, 2013). There is also significant knowledge regarding the principles behind manufacturing and offsite (Gann, 1996; Pan and Arif, 2011; Gann, 2010). There is little literature, however, on how a major construction contractor could begin to achieve its own in-house offsite capability, other than simply taking advantage of a project-specific opportunity. The process is usually referred to as an out-sourced, sub-contracted activity (Yorkon, 2013). The idea of a major contractor providing its own capability while completing large scale infrastructure projects for clients using OSC is rarely discussed. "The

question remains, what construction companies have to be mindful of, when going for manufactured construction?" (Pan and Arif, 2011). The aim of the research is to identify key measures that will enable a contractor to successfully obtain an offsite capability.

Manufacture and Construction

The performance of the UK construction industry has been frequently debated, with the industry's perceived poor performance commonly cited (Latham, 1994; Egan, 1998; Crane et al., 2002; Constructing Excellence, 2009). Specifically, the efficiency of construction activities is frequently questioned, particularly by Egan (1998), who thought that "within five years, the construction industry should deliver its products to its customers in the same way as the best consumer-led manufacturing and service industries. To achieve the dramatic increases in efficiency and quality that are both possible and necessary we must all rethink construction". These reports have increased the profile of offsite and encouraged debate (Pan and Arif, 2011; Constructing Excellence, 2009).

OSC could be described as a manufacturing process used within construction by virtue of its production process, prior to transportation and installation. Business leaders in manufacturing are often cited as championing standardisation and mass production (Pan and Arif, 2011). Increased standardisation of components in buildings can result in fewer defects, higher quality and a more reliable rate of production depended on less fluctuation in construction programmes of projects (Egan, 1998; Gibb and Isack, 2003). As a result of Henry Ford's vision, mass production became "almost synonymous to manufacture" (Crowley, 1998). Pan and Arif (2011) claim that customised production could not offer benefits, such as economies of scale, that mass production provided. However, it is recognised that mass production is not necessarily an aim for all OSC products, particularly with infrastructure projects which are often "prototype" projects - one-off construction of a particular size, span, skew or other trait.

Egan (1998) based his recommendations for improvement on the techniques of automotive manufacturers. This raised the question of whether the construction industry could adopt a similar approach. In the automotive industry, "products" cover a wide range of vehicle sizes and types. All production is undertaken in controlled environments and the basic "model" is standardised with only matters of detail being varied. Strategic plans for manufacture are made across cycles of several years. Planning considers the whole life-cycle of many of the lines launched within this period. Automotive manufacturers aim to predict the expected sales of prospective product releases before planning for production capability and resourcing (Fleischmann et al., 2006). Buildings however, have a longer life-cycle than cars and higher unit production costs. This makes sales planning over such lengthy periods challenging. In construction the "product" provided is significantly different with regards to output (Gann, 1996; Pan and Arif, 2011). When compared to many other manufactured "products", housing and buildings have complex components and are of a much larger scale, and with greater expected durability (Pan and Arif, 2011). Pan and Arif (2011) discuss "the logic of mutual learning between construction and manufacturing is perceived to, and should, be embedded in the many attempts to address their relations".

BACKGROUND

The UK OSC market

Various attempts have been made to quantify the UK OSC market (Goodier and Gibb, 2005b; Goodier and Gibb, 2007). The size of the UK "offsite fabrication" market was estimated to be worth £800.9m in 2002 (Samuelsson et al., 2003), which is 1.7% of new construction (£47.137bn in 2002). Goodier and Gibb (2007) estimated the total value of the OSC market in the UK in 2004 to be £2.2bn, with the total value of the UK construction sector being £106.8bn. The proportion of the UK offsite market was therefore 2.1% and was predicted to reach approximately £4bn by 2009. BuildOffsite predicted a market of £6bn by 2009 (Goodier and Gibb, 2007). Taylor (2010) obtained financial accounts for 245 companies operating within the UK OSC sector. From the market's turnovers and profits, he estimated that the value of the OSC would contribute between 6% and 7% of construction output and the value predicted for 2013 was £4.8bn (Taylor, 2010). This 2013 prediction considered the recession of 2008-09 whereas Goodier and Gibb's (2007) did not. Nadim and Goulding (2010) explained that the majority of growth would be in new buildings rather than refurbishment work and that the UK was ready to "embrace offsite production". At that time, two thirds of respondents felt the UK was ready for such an uptake.

Historically, in the UK profitability for contractors has been low, with large turnovers required to generate significant economic stability. The Government's Department for Business and Innovation and Skills (2011) provided data on Key Performance Indicators (KPI's) across the whole construction industry which demonstrated further evidence of this decline in profitability. These statistics supported by the Construction Excellence report (2009) emphasise that the construction industry getting by without much innovation before the recession. The industry's productivity was clearly dropping, whilst profits were rising and staying high. Only once profits began dropping, productivity within the industry began to increase dramatically. This was an economically unstable practice and required "significant improvement" (Constructing Excellence, 2009).

Research and Development (R&D) in the UK construction industry

R&D in the construction industry has been frequently debated (Hampson and Brandon, 2004). The amount of money spent on R&D in the UK construction industry is insufficient to lead to performance improvements (Dulaimi et al., 2002). Sir John Fairclough's 2002 report concluded that a "modern, efficient, high quality construction industry" would benefit society. In order to achieve this, he recommended innovation driven by R&D activities (Fairclough, 2002; Kulatunga et al., 2007 and 2009). Macmillan (2002) also argued that R&D activities were important in improving the performance of the UK construction industry. R&D has been credited with the ability to influence and encourage best practice within the industry (Barrett, 2007). As with any exploratory activity however, there are risks attached to undertaking R&D activities (Van Rooij, 2008; Mitchell and Hamilton, 2007). Kulatunga et al. (2009) discuss that R&D activities may not always deliver obvious benefits or generate large profits, but there is a possibility that construction organisations could benefit in the long run by considering less obvious innovations and changes. They argue that effective management to minimise the risks of R&D was required in industry, as opposed to "rejecting R&D altogether".

The need for more R&D, innovation and OSC is discussed by the literature, however innovation is risky, and offsite requires investment in manufacturing. Hence, if a major contractor chooses to invest, aside of the technical difficulties, it is critical to methodically review the company's culture aiming to embrace OSC within its normal business processes.

RESEARCH METHOD

Qualitative case study analysis based predominantly on the Eisenhardt (1986) approach was employed, focusing on capturing the dynamic research potential of offsite innovation in an organisation by using multiple levels of analysis within a single study. A literature review was firstly undertaken, including content analysis of industry reports (i.e. annual reports, company websites and business strategies). After reviewing the innovation strategies of the six leading UK contractors one was chosen to be investigated due to its company strategy being strongly aligned towards offsite innovation. Nine members of staff were interviewed, representing a variety of seniority levels and roles within the firm, from site civil engineers, to construction managers, to senior commercial managers. This sample enabled comparisons between the opinions of technical and commercially orientated staff's views of the firm's innovation and offsite strategy.

Semi-structured interviews were employed to enable maximum input from the interviewees whilst allowing data to be collected uniformly (Glaser and Strauss, 1999). The first phase of the interview was structured using an interview pro-forma, followed by more in-depth discussions on key points identified by the interviewee. In order to identify the most appropriate people to interview a combination of purposive and "snowball sampling" (Dawson, 2009) was conducted. All interviews were recorded and transcribed. Thematic analysis was employed to compare the interviewees' responses amongst themselves and also against their firms' innovation strategy and the literature, in order to allow triangulation of the data (Glaser and Strauss, 1999).

ANALYSIS AND FINDINGS

Although OSC was mentioned by four of the six contractors in their annual reports as being a competitive advantage for the firm (Table 1), it was evident from their strategy that Firm C was making the most significant steps in achieving its own offsite capability. The six documents reviewed may not cover all aspects of the firms' commitment to construction innovation and OSC nevertheless the research considers them valid sources of qualitative data as they are the formal and official strategy. Other firms were more unclear as to how they were investing in and developing offsite, if it was mentioned at all. Most commonly it was through specialist suppliers on a project-by-project basis.

Competitive advantage stated in company literature	Contractors					
	A	B	C	D	E	F
Sustainability			X		X	X
Quality			X		X	X
BIM	X		X			
Culture	X	X			X	

More comprehensive capabilities than competition	X	X				
Asset Management	X					
While-life cycle services	X	X	X		X	X
OSC	X		X	X		X
Supply chain engagement	X	X				

Table 1: Summary of the leading contractors' competitive advantage propositions according to their strategy or annual reports from 2011 and 2012

Offsite strategy implementation in firm C

The analysis aimed to investigate whether the employees of firm C were aware of and actively implementing elements of the business strategy put in place to increase the usage of OSC throughout the organisation. Various benefits of offsite were presented in their company strategy; six aspects of the strategy were considered - 3 were strategic objectives (offsite as core process, commercial benefits and cost savings) and 3 were benefits on projects (quality, safety and sustainability improvements) and these were used for the interviews.

In terms of the benefits highlighted in the firm's annual review, business strategy and discussed with the interviewees, 7 of the 9 respondents felt that offsite was giving the company a slim "edge" over the competition. 6 respondents felt offsite provided quality improvements. With regards to safety, 6 respondents felt that safety improvements were provided by offsite. The greatest disagreement was when respondents were asked if they felt offsite created cost savings for their firm, with 4 positive, 2 negative and 3 with divided opinions. The more senior engineers explained that the upfront costs for projects could be offset by the reduction in site labour and programme duration. Some stated that they "knew" the firm was currently subsidising its offsite activities, but believed that in the long-term cost savings would materialise and hence increase profit margins. The current main saving cited was a reduction in material deliveries in comparison with in-situ construction, leading to far less deliveries, as well as a reduced carbon footprint, depending on the size of the item.

All 9 interviewees claimed that quality improvements were achieved through the usage of offsite. However, two did express their concern regarding the achievable quality improvements as they experienced quality issues and defects on some projects. The defects did not occur during the manufacturing phase but predominately during the delivery and installation process. This could be attributed to lack of experience in offsite and installation of some of the site staff. Two respondents (who had both operated in technical on-site roles) provided examples of effective offsite implementation. One explained that offsite usage provided "a different set of challenges", supporting Nadim and Goudling's (2010) findings on the difficulties in utilising offsite solutions. Sizing issues with the offsite deliveries from the manufacturing facility were mentioned and it was explained that it is very difficult to adjust to incorrectly provided or late changes in dimensions, which could be managed more easily with in-situ techniques. Effective management of the "organic" or "live" environment of construction sites and contractor activities was also highlighted as very important. Drawing changes were also sometimes being made after offsite components had been manufactured and dispatched for the site, causing fabrication problems. This is supported by the literature as a lack of flexibility in offsite designs and as a barrier to greater uptake (Nadim and Goulding, 2010; Goodier and Gibb,

2007). A respondent also stated that “information management is very important for successful usage of offsite.”

Sustainability benefits due to offsite were mentioned by only 4 interviewees. Most interviewees understood sustainability solely as having environmental impact and dismissed or didn't mention the economical and social aspects. Nevertheless, some raised the concern that the adaptation of offsite at a national scale may result in the reduction of labouring jobs and reduced income for many construction operatives. In addition, all of the respondents except one felt offsite usage provided savings in the construction programme. Customer satisfaction was only cited by two interviewees as a benefit for offsite, both of whom were from a commercial background. This could suggest engineering staff are more focused on the benefits to site operations and project delivery, whilst commercial staff are better able to appreciate client driven aspects.

Issues affecting successful Offsite

The most commonly mentioned barrier was the up-front cost to set up a manufacturing facility, particularly with the current UK economic circumstances. This was mentioned by all respondents to differing degrees. An additional barrier was the availability of good external specialist suppliers. By using only one source of manufacture, there was a high risk that problems at the source would affect all of the supplied projects. Strong management of information and quality within the manufacturing facility is needed to combat this. It was explained that in their experience, external suppliers cost the same as if the firm produced its own offsite components. The initial cost to develop offsite capabilities can be seen as unnecessary if the production costs are not cheaper in the long run, but it is worth noting, as stated by few of the interviewees that when components are self-produced, money is being kept within the contractor's business, which can have positive impacts on cash flow and company turnover. Additionally, offsite was sometimes seen as a potential barrier to winning work, with the firm's offsite strategy encouraging and promoting its use where appropriate. Care therefore had to be taken to ensure that offsite was not employed where an in-situ or bespoke solutions would be more appropriate. Further barriers also included geographical location, as some projects may be too far for delivering components. The time delay for successful training of a manufacturing workforce must also be considered, and was cited by two respondents. The case study contractor is a privately owned construction company, whilst the contractors with similar levels of turnover and delivering similar projects were publicly owned by shareholders. The requirement to satisfy shareholders was seen to be a barrier to significantly changing a companies' business model and strategy in order to adopt a more offsite capability. It was felt that the nature of the construction industry, with companies currently taking work at very low profit margins, was leading to more short-sighted planning and business decisions rather than forward thinking innovations, supporting the Nadim and Goulding (2010) survey of construction companies. Many felt that smaller companies did not have the necessary volume of work to make offsite use economically viable.

Implementing the Offsite Strategy

It is evident via the interviews and the company strategy that the firm is committed to supporting the implementation of offsite via various methods. These include a company intranet, which provides basic information and raises awareness of best proactive examples through an online catalogue of the offsite components available to

site teams, and a graduate development programme that focuses on educating the inexperienced engineers with regards to the importance of offsite and its application. The company holds two "road shows" per year, where business leaders and directors communicate with all employees, with the aim of motivating the staff and keeping them focused on the firm's offsite targets. This provides a structured way for project leaders to communicate to site teams particular offsite solutions that may be best for individual projects.

When asked if the aim of the firm's strategy was achievable, the general response was positive, but with conditions. One third of the respondents were entirely sure that the aim could be achieved. Many issues with over-expectation were provided by the other 6 respondents. The suitability of all project types was mentioned; not all projects can use offsite solutions, such as refurbishment contracts. Examples were provided where the site team found the utilisation of offsite solutions on refurbishment projects to be challenging, particularly where assembling prefabricated components indoors was not possible. This supports Blismas et al.'s conclusions (2005) that projects should be considered individually before offsite is recommended, to ensure suitability. Nadim and Goulding (2010) also predicted that there would be a rise in offsite usage for construction projects, but not refurbishment projects. Three respondents felt that achieving the strategic offsite implementation aim by 2020 was unrealistic, with one respondent remarking, "it could be achieved perhaps, but perhaps the business is pushing a little too hard for it."

DISCUSSION

The research showed that the innovation strategy employed by the case study firm was targeting many of the offsite benefits cited in literature and the strategy claimed that the vast majority were being realised on projects. Although all the companies in Table 1 mentioned "innovation" multiple times in their annual reports and strategies, investing in R&D was not mentioned in any, which is crucial for increasing productivity (Latham, 1994; Egan, 1998; Fairclough, 2002).

The UK government has been prompting improvements in the industry's performance and profitability for many years, suggesting OSC as a possible solution (Latham, 1994; Egan, 1998; Crane et al., 2002; Constructing Excellence, 2009). According to the interviewees, the costs of providing manufactured solutions are very similar to using in-situ solutions. Nevertheless, the firm's strategy is hoping to have savings due to reductions in wasted materials, labour requirements on site and shorter programmes. A major contractor providing its own offsite manufacturing capability is an innovation to the traditional contractor business model. However, the techniques utilised are not all completely new and there are many established companies who have been providing offsite solutions for many years. A risk-averse culture is resistant to change (Kulatunga et al., 2009), but effective management can minimise the risks of R&D and will provide far greater benefits for industry than simply rejecting R&D altogether.

Although the firm has a precise strategy with targets for offsite, the respondents indicated that offsite is used on a project-by-project basis and wherever it is seen as appropriate. It was made clear that there are no formal measures in place to force offsite upon project teams, supporting Blismas et al.'s (2005) advice on considering projects individually for OSC suitability. Only two of the respondents could quote the firm's set targets for offsite on projects. All respondents felt that having a robust offsite strategy will provide the firm with a future commercial advantage in the UK

construction market place. However, there was some scepticism with regards to the return on investment as the cost for providing such capability will take “a long time to pay off”. The firm’s annual review explained that the offsite agenda is currently being subsidised within the business, and that on-going R&D was required, with £7m being spent in 2011-12. In the short-term, offsite capability may not be providing the firm with a financial advantage. But when work-winning for future projects and leading the market place in the future, the respondents believed that there may be significant benefits from differentiating their operating model from the more traditional one (and from others). Most believed that this speciality of the firm allows them to undertake projects that other competitors may not have the capacity or reputation to undertake. However, concerns were expressed as to how clients and local people would react to decreased employment opportunities as a result of reducing labour on site.

With regards to employee buy-in, the respondents were aware of the firm’s dedication to an offsite agenda and agreed it would be the future for the business. The aim to achieve offsite capability was introduced in the firm’s 2007 annual review, suggesting that on-going planning was taking place. Technologically, a company taking on the entire responsibility for manufacture and installation without specialists is seen as a great innovation (Teece, 2010). All interviewees were confident that the firm had the resources in place to achieve its offsite goals, but not by 2020 (as per the firm’s aim). It was also made clear that there were two sides to the issue, as there may be an advantage to some projects but on the contrary, the firm may alienate itself from other potential projects where offsite is not suitable. There was a general belief amongst all the respondents that competitor firms were waiting to see whether this offsite initiative would be successful. Indeed, successful business models are usually copied, ultimately giving rise to many competitors within single industries (Teece, 2010).

Bessant and Tidd (2007) claim that, “the survival and growth question poses a problem for established players but a huge opportunity for newcomers to rewrite the rules of the game”. OSC may offer a construction contractor significant commercial success if they are able to implement it and provide it for clients in an attractive way. Innovation is also credited to larger organisations in most cases due to their ability to invest in R&D and create new ideas and concepts to bring it to the marketplace (Mann and Chan, 2011).

CONCLUSIONS

Three main strategic measures appear to be required in order for a major contractor to successfully obtain an offsite capability. Firstly, a leadership team who are committed to achieving innovation through OSC, exhibited in this case through the development of an in-house consultancy cross-cutting the organisation, with an emphasis on innovation. Secondly, clear communication is needed to employees at all levels regarding the intention to use OSC e.g. communication best practice examples from project leaders to site teams on individual projects and training of graduates who may go on to become future site managers or business leaders. This commitment to communicate the importance of offsite was also exhibited here through the firm’s online intranet and in-house catalogue of available offsite components. Thirdly, it must show commitment through investment in R&D and a clear business strategy.

FURTHER RESEARCH

A similar interview based case study research should be undertaken with employees of other major contractors to gauge their thoughts on OSC and compare perceptions. A

detailed cost-benefit analysis should take place on the construction and operation of an Offsite manufacturing facility to provide quantitative data for future business cases for Offsite manufacturing capabilities. Contractual agreements should also be investigated as they may act as a hidden barrier to OSC. Finally, an undated investigation into client perceptions of OSC will provide clarity on whether the UK construction is increasing the usage of OSC as dated literature claims.

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