CLIENTS AS DRIVERS OF INNOVATION: LESSONS FROM INDUSTRIALISED CONSTRUCTION IN SWEDEN

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In the construction sector, the rate of innovations is perceived to be low. Stakeholder pressure has been identified as an important trigger for innovation. But do Swedish construction clients positively respond to, and thus drive, innovation? The purpose of this paper is to increase understanding of the client's role, as a decision maker, for improving the rate of innovation in construction. This by learning from the case of industrialised construction (IC) in Sweden. Swedish construction clients are generally positive to the expected benefits of IC, but are not actively driving the change towards industrialisation. IC challenges common practice as well as stakeholder expectations and schemata on which decisions are made. Case studies addressing Swedish clients' response to IC show that the uncertainties related to potential future regret are prominent issues. Empirical evidence also indicates high levels of equivocality which, according to information processing theory, cannot be reduced by simply increasing the amount of information. To enable client-driven change, improved information processing capability is suggested. Clients that gather and process information on innovation can reduce bias in decision making. Early adopters of innovations such as IC must also manage high levels of equivocality as the amount of information is low and common practice is challenged. A higher involvement of clients in innovation development is advised.

Keywords: Construction client, Decision making, Industrialised construction, Innovation, Uncertainty

INTRODUCTION

Innovation is necessary for companies striving for competitive advantage and to achieve change within a society striving for sustainable development. However, in the construction sector the rate of innovations such as new technical solutions, new methods of construction and new forms of cooperation is generally perceived as low. In a study on (green) innovation in Sweden, Gluch et al. (2009) concluded that stakeholder pressure is an important trigger for innovation. The construction client has been identified as a key stakeholder in this respect (c.f. UK studies by Abidin and Pasquire 2005; Pitt, Tucker et al. 2009). What about professional Swedish construction clients\(^2\), do they positively respond to, and thus drive, innovation\(^3\)?

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\(^3\) Innovation, as further referred to in this paper, is defined as ideas, practices and/or objects (processes, products, services, technologies, management approaches) that are perceived as radically new by the
This research focuses on how the client as a decision maker and consequently the decision to invest in new-build is affected by the uncertainty, or even equivocality, surrounding construction innovation alternatives. Can the slow uptake of innovations be explained by how clients make their decisions when information is limited or when established rules of thumb might be inappropriate for evaluating new alternatives? The purpose of this paper is to examine the role of the client decision maker in order to improve the rate of innovation in the construction sector, this by learning from the case of industrialised construction (IC) in Sweden. First, the impact of client uncertainty and equivocality on decision making is discussed based on information processing theory and decision theory. Thereafter, the implications for client response to innovation in the construction sector are discussed based on an analysis of the case of IC in Sweden.

IC, as referred here, focuses on volumetric construction/prefabrication of timber framed multi-dwellings. Among different levels of IC, this represents the most industrialised alternative, or level 4; “complete buildings” as defined by Gibb and Pendlebury (2006). After several Swedish cities burnt down in the late 19th century, timber frames were forbidden in multi-storey (>2 storey) houses and remained so until 1994 when a change in the Swedish building code once again allowed the use of timber. Subsequently, multi-dwelling housing is dominated by on-site caste and prefabricated concrete; thus timber frame represents newness to most clients in Sweden. Höök (2005) concluded that volumetric prefabrication of timber framed multi-dwellings could be classified as a system innovation, presenting uncertainty to the client decision maker.

The paper is based on reviews of; information processing theory and decision theory (with main focus on the influence of uncertainty and biases in decision making); and empirical findings from studies on IC in Sweden (with main focus on studies addressing construction clients). In addition, a re-analysis was made of data files consisting of background data from property owner organisations in Sweden addressing their perspective on IC, collected between the years 2006-2009 (for description of empiric data and methods employed, c.f. Levander and Sardén 2009; Levander 2010; Levander 2010). The discussion is developed by focusing on the general hindrances for making value maximising decisions and the particular influence these hindrances have on client organisations for driving innovation in construction.

A DECISION MAKING PERSPECTIVE ON INNOVATION

The rational model of decision making assumes that the decision maker follows a process of six steps in a fully rational manner (c.f. text books on decision making such as Bazerman 1998; Robbins 2005). These six steps, sometimes conflated to five or three, have been described by numerous researchers approximately as follows: (1) define the problem that needs to be solved, (2) identify all criteria relevant for the decision making process, (3) weight the identified criteria according to their relative


In the UK, the terms ‘modern methods of construction’ (MMC) and/or ‘off-site production’ are more commonly used for IC.
value or importance, (4) generate a full list of alternatives or possible courses of action for solving the problem, (5) assess and rate each alternative on each criterion, and finally (6) make the decision by following the result from the computation of which is the optimal (value or utility maximizing) alternative. Although logically appealing to most people, this normative model is based on assumptions that are very seldom fully met.

In the real world, this normative model is applicable for routine decisions where the same decision has been made many times, following an experience based, formal procedure (Butler, Davies et al. 1993). Moving beyond the routine decision, Simon (1957) and March and Simon (1958) suggested that individual judgment is bounded in its rationality.

The modern understanding of judgment is represented by the work of Kahneman and Tversky (e.g. Tversky and Kahneman 1974; Kahneman and Tversky 1979). The more information a decision maker is missing, the more likely it is that the decision maker relies on rules of thumb, i.e. heuristics (c.f. Tversky and Kahneman 1974), to simplify information processing and fill information gaps (March 1994). Although often helpful, these cognitive processes also lead to biases, which explains why decisions made do not follow the suggested normative model and many times do not result in the highest expected utility (Tversky and Kahneman 1974). In their work on prospect theory, Tversky and Khaneman (1979) also discuss how individuals react differently to gains and losses. For example, they found that decision makers are risk-adverse with respect to gains, but are risk-seeking with respect to losses. This implies a higher probability choice is preferred even if it offers lower expected utility than the alternative.

Other biases suggested as playing a strong role in decision making under uncertainty are anticipated regret (Bell 1982) and the status quo bias (Samuelson and Zeckhauser 1988; Ritov and Baron 1992). Referring to, for example Bell (1982) and Kahneman and Miller (1986), Toole (1994) argues that decision makers appear to compare levels of future regret rather than benefits, and that alternatives with relatively higher levels of regret are avoided. More uncertain alternatives are associated with higher levels of potential regret and the reaction of the decision maker is exemplified by Toole (1994, p. 34) in the following illustration: “If a more uncertain alternative was chosen and an undesirable outcome occurred, the decision maker would have a high level of regret (e.g., ‘I knew that was too risky!’) … if the less uncertain alternative is chosen and an undesirable outcome occurred, the regret level would be low (e.g., ‘I really didn’t have any choice since I didn’t know what the other alternative was about.’)”. Empirical tests of predictions from regret theory have provided mixed results; nevertheless, the notion that people take regret into account when making decisions is supported (Zeelenberg 1999). In particular, it is found that decision makers are motivated to avoid post-decisional regret and therefore tend to make choices that “shield them from threatening feedback on foregone courses of action” (Zeelenberg 1999, p. 101). Zeelenberg (1999) discusses conditions inflicting on regret and suggests that the regret will be a more prominent bias when for example trade-offs is implied between important attributes of different alternatives and when the decision cannot be reversed. He also suggests that decision makers tend to discount outcomes that are distant in time and base their decisions on outcomes that are closer in time (see also work on intertemporal choice by e.g. Loewenstein 1992).
Clients as drivers of innovation

When the decision maker is faced with new alternatives, (s)he often sticks with that of current or previous decision, i.e. the status-quo alternative (Samuelson and Zeckhauser 1988). To stick with status-quo could, for example, be about following regular company policy, re-electing a sitting representative or purchasing the same product brands (ibid.). The status-quo bias seems to be stronger when the number of alternatives is high, and weaker when there are strong individual decision maker preferences for an alternative (ibid.). Samuelson and Zackhauser (1988) suggest such explanations for the status-quo bias as presence of uncertainty, transition costs, cognitive misperceptions, psychological commitment, regret avoidance and drive for consistency.

MANAGING BIASES IN DECIDING ON INNOVATION: AN INFORMATION PROCESSING PERSPECTIVE

Prospect theory, regret theory, and status quo bias provide similar theoretical explanations for why people often are biased against choices that offer higher expected utility, but are more uncertain. A decision maker may reject an innovation that provides superior performance and that may have the same chance of failure as the solution currently employed because of the higher level of regret associated with the potential failure of the innovation, whilst a potential failure of the conventional solution is associated with low regret since the decision maker did what he and others have always done (Toole 1994).

Following from these decision theories, Toole (1994) concludes that if uncertainty is high, potential adopters of innovations would rarely adopt without gathering additional information because the decision would probably reflect status quo or regret bias. The bias against a high uncertainty innovation would be so excessive that the existing product or method would always be judged to offer higher relative advantage (Toole 1994). The research by Toole (1994), where he studied homebuilders and their adoption of innovations, showed that those more apt to adopt innovations had superior information-processing abilities related to building innovations, they used more sources of information about new products than did non-adopters, and they involved more functions in making the decision.

Since Galbraith (1973) proposed his model relating structural design to information processing requirements, it has become accepted that the purpose of information is closely related to uncertainty; that is, the purpose of information is to reduce or preferably remove uncertainty. Most decision makers want to achieve certainty in an uncertain world. Bazerman (1998) states that they fail to accept that decisions often need to be made in the face of uncertainty. Galbraith's (1973, p.5) definition of uncertainty is frequently cited and defines uncertainty as: “The difference between the amount of information required to perform the task and the amount of information already possessed by the organisation”. Thus, uncertainty is about lack of explicit information or data, i.e. not having data on defined variables.

To reduce uncertainty, organisations need to enable additional data processing (Galbraith 1974; Galbraith 1977; Tushman and Nadler 1978) and need to ask a large number of questions, acquire information and obtain answers to explicit questions in order to solve known problems (Daft and Lengel 1986). However, an organisation’s situation can often be interpreted in more than one way, and the participants can either find themselves in a position of not knowing what questions to ask, or of there not being any clear answers to the questions asked (March and Olsen 1976). In such
cases, one has to deal with equivocality rather than uncertainty (Weick 1979; Daft and Lengel 1986).

Equivocality is about confusion, lack of understanding, disagreement, lack of clarity and ignorance, i.e. not being able to define influencing variables or interpret available information (c.f. Weick 1979; Daft and Macintosh 1981; Daft and Lengel 1986; Daft, Lengel et al. 1987; Weick 1995; Weick 2001). An illustrative distinction by Daft and Lengel (1986) is: “While low uncertainty is about having access to the data that answers questions, low equivocality is about being able to define which questions to ask.”

While uncertainty can be reduced if additional information is available and thus reduce biases and make the decision making more rational, high levels of equivocality implies that the identified problem may not be the problem at all, that criteria may be irrelevant, that ranking criteria is not a relevant task, and so on, and that more data and facts may just distort decision making even more. The solution for resolving equivocality differs from that for reducing uncertainty. Instead of seeking answers, the organization seeks clarification, problem definition and agreement through exchange of subjective views and opinions (Daft and Lengel 1986). Weick (1995) adds that confusion created by multiple meanings (i.e. equivocality) calls for social construction and invention, while ignorance created by insufficient information (i.e. uncertainty) calls for more careful scanning and discovery. Daft and Lengel (1986) conclude that, to reduce equivocality, 'richness of information' rather than 'information amount' is the key. They also provided a conceptual framework for ranking media with respect to their capacity for reducing uncertainty or for resolving equivocality for decision makers. This media richness theory ranges media from the richest (face-to-face meetings and communications) to the leanest (rules and regulations, non-personalised written information). A mismatch between equivocality and richness, i.e. high equivocality and low media/information richness, is suggested as one possible explanation for communication and decision-making failure (Daft et al. 1987). Adoption of innovation should from this perspective not only be a question of gathering and processing high amounts of information, but also about how information is gathered and processed. This argument is consistent with Toole's (1994) findings that adopters of innovation involved multiple functions in the decision making.

**CLIENT RESPONSE TO IC IN SWEDEN**

IC in Sweden has been put forth as a way to meet clients’ demands for lower costs, improved quality and shorter time frames within construction (Engström, Stehn et al. 2009). With its off-site characteristics and process-orientation, IC is seen as a means to attain advancement in construction (e.g. Statskontoret 2009). IC has also been suggested to contribute to sustainable construction (Jaillon and Poon 2008).

Volumetric prefabrication of timber-framed multi-dwellings, i.e. the IC alternative in this paper, entails all of the identified advantages of IC, such as indoor prefabrication, long-term relationships, less subcontracting, and less specialisation (Nord 2008). Not surprisingly, Swedish clients are generally positive to the expected benefits of IC. However, the clients are not actively drive the change towards industrialisation (Engström, Stehn et al. 2009). For example, according to a governmental investigation (Statskontoret 2009) one of the recurring problems of the construction sector in Sweden is that clients do not facilitate IC, and are, in general, not buying buildings that can be produced in series.
IC challenges common practice in the sector since it encompasses novelty in multiple dimensions: new methods of construction, new forms of organisation and cooperation within the construction process, new and non-local actors, new framing materials and subsequent technical solutions. Even though it could be argued from a contractor point of view that IC methods have been employed for many years; the forms of cooperation are well documented; the contractors are well established; and the material and technical solutions have been tested, IC differs from what clients are accustomed to and brings about the characteristics of an innovation seen from the clients’ perspective, see further Table 1.

Table 1: IC brings about the characteristics of an innovation, and thus, challenges common practice – examples from clients’ perspective.

<table>
<thead>
<tr>
<th>Dimensions of novelty in IC</th>
<th>Example, clients’ perspective</th>
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<tr>
<td>methods of construction</td>
<td>The leading timber framed volume contractors have a prefabrication degree of 80-90 % (c.f. Höök 2008). Hence, the construction process is transformed into a process where industrialised principles for production are employed rather than conventional construction project management practices. Though supporting production control, the construction process becomes less visual and transparent for the client.</td>
</tr>
<tr>
<td>organisation and cooperation</td>
<td>General contracts are the most common form of contracts between clients and contractors in Sweden. The industrialised building process, however, implies a design-build contract*, which means that the contractor takes full responsibility for both design and construction. The design-build contract results in design decisions having to be made at an earlier stage in the building process along with altered, and unfamiliar, cooperation forms with contractors.</td>
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<td>non-local actors</td>
<td>Volumetric prefabrication of timber-framed multi-dwellings has been driven by small and non-local contractors, as opposed to the local on-site contractors often earlier engaged by the client and to whom relations are already established (Levander 2010).</td>
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<td>framing materials and technical solutions</td>
<td>Timber is utilised as frame material in volumetric prefabrication because of the material’s high strength/weight ratio and manufacturability, which support factory production and long-distance transportation of modules. To manage the peculiarities of the material and fulfil functional demands, new technical solutions are developed and employed.</td>
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Note: * For the contractor, who often incorporates all different trades within one single company, this means an opportunity to make use of the advantages of the industrialised process.

When clients face innovation within construction they are likely to experience not only high levels of uncertainty stemming from lack of data, but also high levels of equivocality stemming from the confusion of different understandings and frames of references. This is found to be the case with IC in Sweden as empirical evidence (Levander 2010) indicated high levels of client equivocality concerning IC, hence
cannot be reduced by simply increasing the amount of information. Case studies addressing Swedish clients’ responses to IC also show that the uncertainties related to potential future regret are prominent issues. In the data material from a series of studies on client uncertainty concerning IC (Levander 2010), several indicators of anticipated regret is found, see table 2.

Table 2: Indicators of anticipated regret being a prominent issue when making IC investment decisions.

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<th>Indicators</th>
<th>Results found in transcribed interviews from empirical studies presented in (Levander 2010)</th>
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<td>Clients expect negative outcome from already made investment decisions on IC investments</td>
<td>Clients, even those who already had decided on IC, explicitly expressed a fear or anticipation of future regret following on the choice of IC. Clients had considerations concerning the long term performance of timber as frame material as well as the technical solutions presented by the IC contractors. Clients expressed uncertainty with respect to their own ability to evaluate future maintenance needs and costs.</td>
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<td>Clients experience trade-offs</td>
<td>For clients, the choice between conventional and IC implies a trade-off between important attributes, for example the trade-off between more well-known, flexible solutions and lower initial costs.</td>
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<td>Clients find the definite decision point in IC as problematic</td>
<td>Clients want to be able to make changes along the course of the construction process, something that is not easily facilitated by the employed industrialised process.</td>
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<tr>
<td>Clients discount outcomes that are distant in time and base their decisions on outcomes that are closer in time</td>
<td>Clients’ main motive, i.e. decision criterion, for choosing the IC alternative over others has been identified as economic, with an emphasis on the initial construction costs. In addition, lowered credit costs due to production advantages such as short building time on site are mentioned.</td>
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<td>Clients are missing information</td>
<td>Clients lack information on IC performance data, e.g. information on the capacity of the timber frame to handle building physics and statics.</td>
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<td>The information processing practice (IPP) within the client organisations is not supporting reduction of uncertainty, equivocality or decision-making biases</td>
<td>Decisions are generally made by one or a few individuals from the same department without access to experience data from others since IPP is characterised by: - a lack of communication between the property-development and property-management departments within the organisation - deficient follow-up of running costs (i.e. lack of experience data from property management) on individual properties in stock - inconsistency between goal attainment and investment decision criteria - a neglect to collect and store feedback data from earlier construction projects as well as from operations and maintenance (property) management</td>
</tr>
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The anticipations of future regret could be part of the reason for the slow uptake of IC in Sweden. According to descriptive decision theory, decision makers are biased.
against choices that are less certain, even if the expected outcome is highly desirable. Consequently, clients are more likely to choose tradition over innovation, even when the latter is considered the better provider of desired outcomes, such as short time spans and low cost. This is also consistent with Toole (1994) who referred to future regret when seeking to explain the slow diffusion of innovations amongst home builders in the US.

In order to enable timely decision making concerning complex issues in complex environments it is necessary to reduce the influence of individual biases and to establish and use a common frame and common decision criteria. These organisational formal rules of thumb, i.e. 'organisational heuristics', are helpful and oftentimes contribute to an effective and efficient decision. The formalisation brought on by these heuristics also help the organisation to reduce equivocality since they guide the individuals in the organisations on what decision criteria to set up and what questions to ask in order to gather the adequate information to evaluate different alternatives. However, these organisational heuristics are based on knowledge and experience of the status-quo alternative, but the more a new alternative (innovation) differs from the status-quo, the more it is likely that these organisational heuristics will bias the decision. This is due to that the organisation are not posing the right questions on the innovation and are not interpreting the available information correctly (not managing equivocality brought on by the innovation). Hence, influencing the decision on innovation is not only individual judgements and biases but also the organisation’s internal procedures which are based on the status-quo alternative. The impact of the organisation’s formal procedures on misunderstanding and misinterpretation of (sustainable) innovative solutions is also discussed by Demaid and Quintas (2006). If client organisations do not take all biases into consideration, individual as well as the built-in organisational, it is more likely that the decision making will result in choosing the status-quo, or the innovation from evaluating the “wrong” decision criteria.

CONCLUSIONS

What is a “good” investment decision made by clients? In this paper it is regarded as one where the client organisation maximises its expected utility/value by gathering and processing information on new alternatives and thus, drives innovation. It is concluded that this is not the actual behaviour of the studied client organisations when choosing between the conventional (status-quo) alternative and IC, the innovation.

As the results from the case if IC have shown, there is a risk that the main decision criterion when choosing innovation will be initial cost. The risk following from this is that clients will drive innovations characterised by lower initial construction cost, rather than by long-term criteria, e.g. improved lifetime quality, reduced life cycle costs or reduced environmental impact. For clients striving for sustainable development this could hardly pass as a good decision or for that matter a good strategy for driving innovation in construction.

To drive innovations such as IC that can change status-quo on a sector level, client organisations must be able to manage high levels of equivocality as the amount of information is low, and common practice is challenged. A higher involvement of clients in early innovation development is therefore advised. Similar conclusions have previously been drawn on project level; e.g. Gibb (2001) stresses that critical information needs to be agreed on by all parties at an early stage in the project, and that the more unfamiliar the stakeholders are with the contents of the project, the more
vital is early agreement. However, at this point in time, the client has already made a vital choice on what project to embark, and the IC alternative might have been made impossible to choose.

It should be noted that we have not (yet) studied how decision makers within the client organisations make decisions when they face the choice between the conventional solution and the innovation IC, that is; what functions within the organisation that are involved in the process; how decision criteria are established and; how information is gathered, processed and employed within the decision process. This decision making process has, to our knowledge, neither yet been studied by others. Nevertheless, the client organisations’ information processing capabilities will most likely affect decision making, and as suggested by Toole (1994), organisations with high capability can reduce uncertainty and manage equivocality presented by innovations. With this paper we want to shed light on the fact that how client decision makers utilise their information and make their decisions greatly may influence what overall long-term improvements that innovations within construction may entail. We also suggest improved information processing capability within client organisations in order to reduce both uncertainty and equivocality, and subsequently, reduce biases in decision making. Thus, better supporting client driven innovations.

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