RADICALITY OF IDEAS: CHALLENGING RADICAL VERSUS INCREMENTAL CHANGES IN CONSTRUCTION

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It has been suggested in key governmental reports and recent research findings that radical changes are needed for construction industry along with a continuous flow of incremental improvements. The majority of the literature on radicalness has been primarily focused on innovations, i.e. final result of innovative process; whereas radicality of ideas – the beginning of this process – was out of the scope of researchers. The aim of current study is, therefore, to investigate innovative ideas and their radicality. We have classified ideas by their radicality degrees, identified and highlighted the importance of radical ideas in construction industry, found out barriers and ways for managing them towards successful implementation into innovations. An experimental framework which reveals the correctness of the proposed ideas was conducted. In order to achieve this the following factors were chosen to explore – peoples' perception of radicality, in other words what people take into account in order to evaluate ideas by their radicality degrees and their preferred rewards. The preliminary results shows that suggested definition and classification of radicality of ideas is matched with peoples' perceptions. Intrinsic rewards are more preferable than extrinsic ones for contribution of ideas and solutions to problems. Some managerial implications are provided.

Keywords: idea, innovation, management, radicality.

INTRODUCTION

Because of rapid technological changes, companies no longer develop their products or/and services only by their minor improvements. Consequently, to innovate, organizations need to make radical changes at work along a continuous flow of incremental improvements. With possibilities of radical changes to occur, it is useful to better understand employees' perception of radicality of ideas, important factors for evaluation of ideas by radicality degrees and preferred rewards for their contribution. Radicality as defined in this paper has not been studied to such an extent as radicalness or some other related concepts. Radicalness of innovation for instance has been studied over the last few decades (Damanpour 1988, Rice *et al.* 2001, Stüer *et al.* 2010). However, there is a fundamental difference between the two concepts. These studies have primarily focused on innovations as already implemented ideas. Yet little is known about radicality of ideas at the beginning of innovative process and how they can be classified by degree of radicality. The both two extremes of changes play a vital role in the existence of companies because they provide a source for minor

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improvements as well as major radical steps in new directions. Using experimental approach including questionnaire this study seeks to provide an attempt to demonstrate radicality of ideas as classification framework companies can use to appropriately respond to various degrees of change.

The investigation starts with a review of mainstream management literature on radicalness of innovation. This is then followed by classification of ideas by degrees of radicality. In the next section we discuss the challenge of radical versus incremental ideas in construction industry, identify the barriers for radical ideas and ways to manage them. The chosen research method is justified, followed by the preliminary results. Some managerial implications are provided finally followed by conclusion.

INNOVATIONS AND THEIR RADICALNESS

Innovation process: from idea generation into implementation

Majority of the studies on innovation have considered several phases in this process (Pierce and Delbecq 1977, Rogers 1983, Tushman 1977, Utterback 1971, Zaltman *et al.* 1973). These studies have concluded that the innovation process can be considered as three overlapping phases.

1. The idea generation (production of a design concept or technical proposal, recognition of needs or problems).
2. The development of this idea (origination of a technical solution or an invention, production and testing into a concrete product, process or service).
3. The implementation of the idea (introduction of the solution into the market, transforming of the tested idea into adoption of users).

Before ideas are implemented they need to be firstly generated, contributed by employees and further developed (Sergeeva and Radosavljevic 2009). In this paper we will focus on the radicality of created ideas by employees before their implementation.

Classification of innovation in management literature

In reviewing the management literature, radicalness of innovation has been described from various different perspectives.

Radicalness of innovation as degree of newness

Hage (1980), Sheremata (2004) have defined radicalness of innovation as a degree of newness, e.g. employees' perception based on the amount of their experience in the company during innovative process adoption. If an innovation takes organization into areas where there is sufficient amount of knowledge about the new technology or novel routines are demanded, the innovation is more radical.

Radicalness of innovation associated with required information and learning

Forrester (2000), in contrast, has considered radicalness of innovation being associated with needed learning. The most radical change, the more profound impact as a form of change, e.g. the more new information and learning are required into existing knowledge, the more radical innovation is. For instance, the same innovation can be considered more or less radical depending on the previous state (knowledge and experience) of the innovating company.

Radicalness of innovation as degree of change

Damanpour (1988) has defined radicalness of innovation in relation to the degree of change in the existing practices of an organization. Consistent with this idea Rice *et al.* (2001) have described radicalness of innovation as the degree of change in the

existing product, process or service with emphasis on technology. The more revolutionary the change in technology, the more radical innovation is.

Radicalness of innovation associated with risk, uncertainty and cost
Another perspective on radicalness of innovation is based on the degree of risk, uncertainty and cost. For instance, Green *et al.* (1995) have viewed it as continuum variable which has been represented based on four basic dimensions.

- Technological uncertainty (unpredictable, complex, rapid development in scientific society; may not be well understood by managers and researchers).
- Technological inexperience (novel for the company technology, but well understood by others).
- Business inexperience (the development of new product or process as the result of engagement in business practices).
- Technology cost (radical change is associated with high risk and uncertainty whereas incremental change is characterized by low risk and uncertainty).

O'Connor and McDermott (2006) have detailed this approach and defined radical innovation as a new product, process or service with performance for 5-10× (or greater) improvements in performance or a 30-50% (or greater) reduction in cost.

CHALLENGING RADICAL VERSUS INCREMENTAL IDEAS IN CONSTRUCTION

Where do ideas come from?
Utterback (1971) has found that about 75 percent of the ideas used for development of product innovations come from outside the organizations. In the study of von Hippel (1981) it has been shown that ideas for most new products innovations nurture from customers. However, these studies were limited to product innovations only, whereas ideas could be about changing or improvements of not only products, but also organizational processes and practices. These creative ideas or suggestions are mainly generated by motivated employees. For instance, Van de Ven *et al.* (1999) has emphasized the role of workforce who are the resource of ideas and recommended that companies should motivate people to actively and creatively participate.

The history of innovations in construction industry
Construction innovations can impact all stages and processes including design, fabrication, building, contract administration, labour relations, management, procurement, maintenance, equipments, materials and methods. Minor incremental changes are more frequent in the construction industry but radical changes are the most powerful (Koskela and Vrijhoef 2001). Along with a continuous stream of small improvements rare breakthrough innovations are therefore also implemented. Few examples are illustrated in Table 1.

Radical innovations are characterized by having a positive, important effect on construction, improving the quality, reducing time and cost. More recently, there has been a tendency for radical changes and improvements in construction. For instance, Building Information Modelling (BIM) is a relatively new technology with the potential of radically changing the way construction clients procure their structures. The importance of radical changes is supported by key government reports and industry publications (Egan 1998, Latham 1994, Wolstenholme 2009).

Table 1: History of radical innovations in the construction industry (Gann 2000; Wolstenholme 2009)

Time	Description	Benefits
18th century-early 19th century	Creation of factories and improvements in metal work	- Less work had to be performed by hands. - Rapid increase of the rate at which building could be completed.
19th century	Creation of high-speed electric elevator	- Rapid way to reach the heights in the skyscrapers. - Efficiency, relatively low installation cost.
19th-20th century	Creation of new materials: structural steel and reinforced concrete	- Steel is a strong material that needed for the interior of the large scale building projects. - Combination of steel and concrete provides strong support system that cost lower than using brick or other materials.
21st century	Introduction of Computer-aided design (CAD)	- Design of all types of building with benefits of lower product development cost and saving time for their drawings.
Future	Issues of sustainable development and ecology	- The issues of sustainability have become important for construction industry. Over £3m has been invested in the UK for projects leading to carbon buildings, and over £30m of capability building work is planned for the next 2 years (Strategy for Sustainable Construction Progress Report, 2009).

Types of innovation in construction industry

Slaughter (1998), Koskela and Vrijhoef (2001), Weller *et al.* (2001) have distinguished innovation according to whether it is incremental (minor changes which are based on existing experience and knowledge about product, process or service) or radical (breakthrough changes in technology or science). Bresnen and Marshall (2001) have provided the following classification of changes in construction industry.

- Radical change (acceptance of new approaches resulting in restructuring and cultural transformation).
- Reformism (less radical change includes modification of circumstances to fit new approaches).
- Pragmatism (adaption of new approaches into existing circumstances).
- Rejection (inappropriate and unworkable change or problem solutions or approaches).

OECD (the Organization for Economic Cooperation and Development) characterized innovation from a wider perspective based on international research involving various different industries as being either "technical" or "organizational". While the first refers to "product" or "process" innovation the second one includes changes or improvements to organizational structure or new and advanced managerial practices and their implementation. From a construction perspective Barrett *et al.* (2007) have identified three types of innovation in the construction industry.

- Sector-level innovation (characterized by radical changes; for instance, wide range of products and materials, structural integrity or new regulations).
- Business-level innovation (associated with producing either radically new or incrementally improved materials, products, processes and practices; for instance, supply chain arrangements, new business processes, human resource management).

- Project-level innovation (characterized by incremental changes or improvements; for instance, everyday problem solving on site during the production process).
- There seems to be an agreement among scholars on classification of ideas by radicality.

The importance of both radical and incremental ideas

It is generally considered that there is a need for more innovations in the construction industry (Slaughter 1998, Winch 1998). Koskela and Vrijhoef (2001) even claim that the past theory of construction being deficient and implicit is the main barrier for successful implementation ideas into innovation. Thus, they have concluded that a new approach is required for construction industry that allow to apply radical changes based on a more appropriate explicit theory of production and recognition of what the construction features are. Slaughter (1998) found that implementation of these different types of ideas (radical/incremental) required different levels of management and supervision in the organization. By definition construction industry is creative since all projects are different and required always new and innovative problem solving at the practical level (Dale 2007). In the survey conducted by CIOB in 2007 99.7% of respondents felt that R&D was significant to their companies and 100% also agreed that innovation are very important for the future of construction industry. However, the majority (66.25%) felt that these investments in R&D are not sufficient. Although, companies could benefit from radical ideas more than from incremental, they are more risky in their nature and their level of uncertainty is much higher. These disruptive changes very difficult to manage and construction industry is not an exception. Radical ideas engage unknown development frontiers outside the existing standardized practices, requiring new perspective and considerable changes. This consequently implies a considerable amount of resources in the conditions of high uncertainty during the problem solving process. Incremental ideas, on the other hand, are less beneficial, however, easier to perform and they are less risky.

The barriers and the ways for managing radical changes in construction

Thus, the barriers for development and implementation of radical ideas could be following.

- Risk of failure that could prevent contractors from using ideas that are not fully developed.
- Lack of knowledge about the field may prevent further development of idea.
- It might be less incentive to invest into radical ideas than incremental.

Therefore, the possible ways to manage and put forward radical ideas could be following.

- Ideas should be clear, fully developed in order to reduce possible risk of failure.
- Improving the knowledge about the field of suggested changes; this could be achieved by learning and trainings employees.
- Better understanding what drives employees to come up with radical breakthrough ideas.
- Recognition of ideas that might be not explicitly communicated by workers; that is not only the question of employees being self-driven or motivated by also organizational settings to encourage them to act.

- Involvement of all employees to have an opportunity to speak up their suggestions, not only "key individuals" or "champions", since the more ideas are suggested – the more the probability of radical changes to occur.
- Managers should be open to new experience, rethinking or redesigning the ways in which the business processes are performed. They should be willing to accept not only incremental suggestions for improvements but also radical ideas or solutions.

IDEAS AND THEIR RADICALITY

In this research radicality of an idea is defined as a degree of change this new idea brings in relation to the standard IPO (input-output-process) model (Van Horn 2005). The IPO model consists of inputs, outputs and processes that convert inputs into outputs, and represents the most basic generic representation of a production system (Figure 1). In order to classify ideas by the degree of radicality there is a need to define what inputs, processes and outputs can be changed.

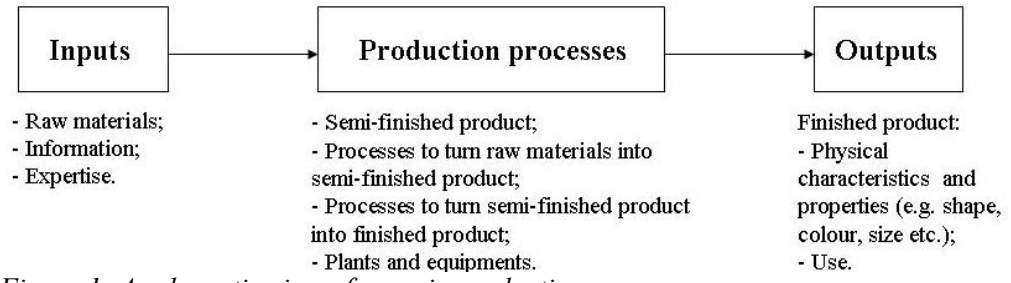

Figure 1: A schematic view of generic production process

The research focuses on a production process for easier demonstration of the concept of radicality. In a production processes inputs include raw materials, information and expertise. The production processes include processes that turn raw materials into semi-finished product and semi-finished product into finished product by using a variety of machines, people, material-handling equipment and other tools and equipments. Workers process materials within the system which gain value as the materials progress from one sub-process to another. Production system outputs may be finished or semi-finished products. Semi-finished goods serve as inputs to some other processes at other locations and so on. Finished products have their characteristics, physical properties (e.g. shape, colour, size, density etc.) and function or use.

Considering all of the above, a contributed idea could be about changing inputs, production processes (technology), outputs or numerous combinations of all. Some ideas would clearly result in only minor amendments that would not bring anything new to an existing product but some may result in changes in all three IPO elements generating a new product. This shows a clear departure from the concept of radicalness. With the degree of radicality one would need to consider even those changes that by default are not considered innovations but may well be a major challenge for the existing production process. Various examples of such minor changes can be found in Shingo (1985). Most of those changes were never considered as innovations but they aggregated into major improvements to the existing production in Toyota. The real question is how many degrees of radicality there should be. While in this research we suggest the classification of ideas into three degrees of radicality (low, medium and high) there clearly is scope for further research generating more detailed classification (Table 2).

Many of these changes would not have any effect on the external appearance of a building and users may not even be aware that it is made of steel as opposed to concrete but such changes clearly have an impact on the production process. On the other hand, people involved in the production process may be severely affected by some of these changes.

Table 2: A suggested classification of radicality of ideas

Radicality	Description	Examples
Low	Insignificant changes or improvements after which the product does not change much and with no impact on the production processes	- Minor changes to external design of a building (e.g. painting in different colour).
Medium	Moderate changes or improvements after which the product is changed with a moderate impact on the production processes	- Changing of the shape and potentially raw materials of parts of a building (e.g. various types of pitched roof, different cladding systems etc.).
High	Fundamental changes or improvements after which the product is completely changed with significant impact on the production processes or new product	- Changing raw materials that demands different construction method (e.g. steel structure versus concrete structure). .

RESEARCH METHODS

Since employees are the main resource of ideas and suggestions, this research is based on workforce' evaluation of ideas by their radicality degrees. However, because employees' perceptions of radicality may vary, it is important to determine factors that impact ideas evaluation. In order to understand how employees could be encouraged to generate low, medium or highly radical ideas, managers should first understand what the preferred rewards for them are. Psychological experiment is the main research method used in this study and includes experimental tasks and a questionnaire. The experimental approach provides an opportunity to test whether suggested classification of radicality corresponds to the one perceived by employees and to explore relationships between radicality degrees and preferred rewards.

Participants were 36 construction and non-construction employees (mean age = 31 years, SD = 6.1, range = 23-52). Firstly, participants were asked to generate ideas on the existing objects showed on the provided images during limited amount of time. Secondly, participants were given ideas prepared by experimenter on the same objects and asked to familiarize with the ideas and treat them as their own contributions. Finally, participants were asked to evaluate all ideas by the three radicality degrees. The questionnaire was issued at the end and includes questions regarding the factors which participants took into account when evaluating ideas by their radicality degrees and the preferred rewards for idea contribution.

PRELIMINARY RESULTS AND DISCUSSION

Table 3 presents the means and standard deviations of factors that employees consider for idea evaluation. Examination of the mean values in Table 3 shows that employees consider impact of change of the production technology and the degree of actual change as the most important factors. This is then followed by the degree of novelty and required information, learning and knowledge, and impact of the change on the cost and requirements of financial risk.

The lower support for highly radical ideas in comparison to medium and low levels of radicality could be explained by the impact of degree of novelty, cost and financial

risk. More radical ideas require greater changes to all three IPO elements leading to far greater financial risks, which may well deter employees from supporting such ideas. Figure 3 presents correlation between radicality degree and preferred rewards. Rewards were split into two groups:

Table 3: Importance of factors considered for idea evaluation by radicality degrees (evaluation in the range from 1-least important to 5- most important)

Variables	M	SD
1 Impact of change on the production technology of the existing object	4.25	.97
2 Degree of change of the existing object	4.14	.90
3 The extent to which idea required new information, learning and knowledge	4.06	.92
4 Degree of novelty of change	4.06	.92
5 The extent to which idea is financially risky	3.58	1.11
6 Impact of change on the cost of the existing object	3.58	1.13

- Intrinsic rewards – greater satisfaction, increased confidence, better knowledge and understanding, sense of achievement and development and enhanced skills.
- Extrinsic rewards – cash bonus, career promotion, recognition from immediate superior, recognition from colleagues, increased salary and support from boss.

The result shows that both construction and non-construction employees prefer intrinsic rewards more than extrinsic rewards for all types of ideas. From low to highly radical ideas there is a tendency to value rewards higher.

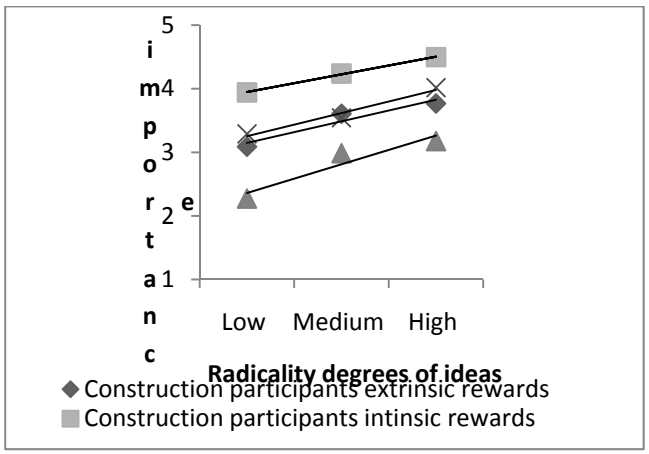

Figure 3: Importance of extrinsic and intrinsic rewards for ideas contribution process (based on the 1-5 Likert-scale where 1-least important, 5-most important).

Some managerial implications

Businesses that wish to adopt radical changes alongside minor improvements should encourage employees to continuously contribute new and creative ideas. Since the personal (intrinsic) rewards are more preferable than organizational (extrinsic), organizations should also pay more attention to employees' personalities. Table 4 presents some managerial implications.

CONCLUSIONS

In this paper the mainstream and construction management literature on radicalness of innovation have been reviewed in order to support the development of a classification of ideas by the degrees of radicality. The experimental study shows evidence that the suggested classification is mostly in line with employees' perception of radicality which is defined as the degree of change over existing object (product) depending on

the impact of the change on the three elements of IPO model and by taking into account the degree of novelty, required new information, learning, knowledge and understanding, impact on cost and financial risk. The preliminary results show that suggested classification of radicality of ideas (low, medium, high) could be a good

Table 4: Possible managerial implications

Drivers for idea contribution	**Actions**
Greater satisfaction, sense of achievement and development, increased confidence	Do not reject ideas based on personal judgements or immediately without consideration instead accept useful and appropriate ideas instead. Negative experience in the past could lead to lower self-confidence in the future whereas positive experience could lead to increased confidence and more ideas/suggestions in the future.
Better knowledge and understanding	Possibility for employees to obtain information and learning not only internally within an organization but also from external sources.

starting point for further investigation. It has been confirmed that employees prefer intrinsic rewards for their ideas as opposed to extrinsic rewards.

This preliminary study shows that more attention should be given to various degrees of radicality of everyday problem-solving ideas that may not be even categorized as innovations. Managers should therefore make greater effort in evaluating different ideas regardless of their radicality degree in order to prevent the future drain of ideas that may prevent an organization to continuously improve its processes and products.

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