THE ARCHITECT AS A SYSTEM INTEGRATOR?

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Innovation is an important topic in the Dutch building industry. Studies on innovation usually focus on constructing parties, more in particular on their possibilities of forward integration into the building process. Conducting research on process innovation from the perspective of designers is not as common. Lourens (2006) stated that, based on indicators such as the level of innovative power in entrepreneurship and process integration, about 30% of design firms in the Netherlands could be described as an innovative organisation. In theory, therefore, architectural designers may be expected to make a valuable contribution to innovation and integration in the area of construction. The present study will focus on the reason why designers have made a limited contribution to process innovation so far. It will focus on the activities of architectural practices in the Netherlands in connection with innovation and integration. A literature review has served as a basis to set criteria on what architects as a system integrator should achieve. We selected four architectural firms that are currently known to be innovators and/or system integrators, and held interviews with them in respect of their design and process strategies. The results of the interviews were discussed in a workshop with parties from the industry. This paper will discuss the results of the interviews and the workshop on the architectural firms' system integration. The study will highlight the competences required from architects in respect of system integration and it will assess the indicators for innovation from the perspective of designers in the construction industry.

Keywords: architectural practice, design strategy, innovation, system integration.

INTRODUCTION

As is the case in any other branch, innovation is an important topic in the Dutch building industry. Studies on innovation usually focus on constructing parties, more in particular on their possibilities to integrate forward into the building process. Contrary to the literature, forward integration into the Dutch building practice means that construction firms are involved in the building process even before preparations for construction have started. It is important for these firms to be involved early on in the building process so as to be able to change their organisational position and explore innovative ideas. In order to expand the role of architects, one could consider backward integration: formally involving architects in the construction phase and having them assume responsibilities that are normally assumed by contractors. So far, these types of change have not been explored in any research on design and construction.

This study came about as a result of another study, conducted by the Dutch Economic Research Institute for the Building sector (EIB) on process integration and innovative power in entrepreneurship at design firms (Lourens 2006). The latter study defines the

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level of process integration as the extent to which design and consultancy firms are active in phases other than the design phase. Most of the design firms analysed did not perform tasks others than those involved in the design phase. Architectural firms appeared to be predominantly active in the initial phase (formulating the programme of requirements), the preparation phase and the construction phase (supervising). In order to measure the degree of innovative power in entrepreneurship, Lourens (2006) measured the extent to which design firms anticipated changes. These changes related to the way in which the firms analysed approached the market, how they established their corporate policy, the extent to which they contemplated research and development, the way in which they measured client satisfaction and the level of risks the firms were willing to take. The EIB study showed that, based on these indicators, approximately one third of the design firms could be described as innovative. Consequently, there appears to be a significant innovative potential among design firms.

In her PhD research, Oostra (2001) described the different forms of innovation and the role of architects with respect to innovation. According to Oostra, innovation is characterised by the novelty of an invention and the willingness of the market to embrace the innovative product. She distinguished three forms of innovation: product innovation, process innovation and market innovation. These three types may also be seen in combination. The extent to which architects can integrate into an innovation process depends on their suitability. Architects appear to be one of the main initiators of product innovation. Innovations are usually a result of an architect's viewpoint on how to design a building. More often than not, architects are to solve unique problems for which there is no standard solution or problems for which there are insufficient solutions from the perspective of quality. An architect's sense of responsibility for quality levels may prompt his drive to solve problems. Most architects consider caring for product quality an integral part of their services as a designer. In actual practice, however, architects appear to be unaware of the impact their designs have on innovation.

In other areas, such as software or product design, a system integrator's concept appears to be reasonably successful as a driver for innovation. When considering the competences of architectural firms, the idea came up that architects may assume the role of a system integrator. Davies *et al.* (2007) described a system integrator as follows: 'In its pure form, a system integrator is the single prime contractor organisation responsible for designing and integrating externally supplied product and service components into a system for an individual customer.' Rutten (2007) divided the definition for the construction sector into two main tasks: a system integrator sets up a network of various organisations and coordinates the activities within. For individual clients, the system is developed by a network of various organisations. The system integrator chooses the organisations involved in the network and organises the activities of the network members to guarantee the coherence of the network output. According to Rutten (2007), system integrators operate on two levels: configuring a system and innovating a system. Lakemond *et al.* (2006) and Bozdogan *et al.* (1998) found similar characteristics in a study focusing on coordination strategies in product development. Since most of the components required are delivered by external parties, a system integrator configures them into a complex product system. On the level of innovation, the second level of system integration is considered to meet changing customer requirements or changing regulatory requirements in general. There are two types of system integration: modular innovation and architectural innovation. Whereas

modular innovation focuses on one single project, architectural innovation looks at the longer term so as to improve the company's competitive position.

Based on these short literature review one could conclude that architects, in theory, would be able to function as a system integrator perfectly well since they are accustomed to including the individual contributions of the various disciplines in their design and role towards (product) innovation. Further literature study did not produce any interesting findings on this subject matter. Therefore, this study will investigate the opportunities for architectural firms to assume the role of a system integrator. The study is based on an analysis of the current practice of Dutch architectural firms.

MATERIALS AND METHODS

To analyse the present situation, we held interviews with architectural firms that are currently assumed to fundamentally work as a system integrator. To select the firms, we used a set of criteria derived from the above literature; to be strongly involved in clients; to conduct tasks other than actual design tasks and consultancy tasks; and to realise innovations on project level or beyond. We approached a selection of architectural firms, such as Cepezed, Paul de Ruiter and Zwarts & Jansma. These firms are known to realise innovations on project level and beyond. Cepezed is also known for its exceptional way in which it serves the market. We also approached Octatube, an organisation known for its innovative product designs. We held five interviews in total. We asked the interviewees whether they knew of any comparable organisations, but they did not. It has remained unclear whether this should imply there are no innovations in the field or as an invalid definition. The interviews were based on a semi-structured questionnaire, each taking approximately 1.5 hours. The interviews were held by two researchers and were recorded. The transcripts were used for analytical purposes. To conclude, the findings were discussed in a meeting with stakeholders, such as clients, architects and other researchers.

RESULTS

Drivers for innovation

The interviews have shown that drivers for innovation from the side of architects relate to a shared ambition of the client and of the architect. Paul de Ruiter stated: 'Every kind of innovation grows from ambition. If a client wants something special, he will select an architect with a special vision or with an innovative track record. If a problem related to the project occurs to which the market does not have a suitable answer, it could result in a new product.' The other firms also affirmed that clients approach them in search of solutions that are off the beaten track. Sometimes, it is the other way round: architects approaching a specific client, pursuing a strict marketing policy or publishing their vision so as to secure projects with a potential for innovation. Most of the firms interviewed operate in a network of organisations with similar ambitions. They actively keep track of the market. All firms expressed their ambition to build 'excellent objects' without compensating on finance or function. In general, constructing and realising designs receive ample attention.

Characteristics of the organisations

The firms interviewed asserted that, in the building process, knowledge is power. Consequently, the firms strongly focus on developing and transferring knowledge. Strikingly, all of the firms interviewed work with team structures and with highly educated design staff. Most of the staff members have a combined background,

preferably in architecture and building technology. If they do not have this combined background, they receive on-the-job training. External courses are offered and staff members accumulate specific knowledge on specific themes, such as fire safety. The organisational structure of the firms is relatively flat, which means that hierarchy is low. The staff members selected by the firms are open to creative solutions, have an eye for quality and are driven by a passion for the profession. For the various segments of their organisation, Octatube and Cepezed made a distinction between "do-ers" and "inventors". Octatube stated that its project management struggles hard to keep all experience within the own organisation. Relatively small organisations, such as Zwarts & Jansma or Paul de Ruiter, reluctantly hire external parties to compensate for the lack of competence within their own organisation. Cepezed creates a new team for every project. This means it seeks partners with similar viewpoints for every project it takes on. All of the firms included in this research did not carry an ISO certification. Nevertheless, they did have a point of view with regard to quality assurance. For Octatube, an internal quality system is inevitable. It developed one such system itself. For Zwarts & Jansma, its internal quality system is in place due to the fact that all of its staff members do both designing and drawing; its staff members have to look beyond their own discipline, which is to guarantee the quality of designs. With regard to their ongoing business and staff, Cepezed and Octatube make very specific investments in Research and Development. Zwarts & Jansma and Paul de Ruiter merely conduct R&D projects in the event of over-capacity. They do so out of their own interest if there are any problems in a certain project that need to be solved.

Product innovation

All of the firms interviewed stated that new products usually originate as a consequence of project related questions. A lack of existing solutions or uncertainty as to the quality of existing solutions combined with an idea of how things could be are drivers to develop a new product. If the market shows no interest in developing a new product, the firms will develop the product themselves. Developing a new product requires ample financial resources and, therefore, considerable investments. The margins of the architectural firms are too small to make such investments on a regularly basis. Therefore, most of the firms interviewed for this study have incorporated separate production companies. These companies invest profits in new developments or in further refining the existing products. Paul de Ruiter occasionally attempts to find clients who are willing to financially participate in a development. These investments are always project related. Due to high investment costs and "the thin layer in the market", Octatube focuses on marketing only a limited number of innovations. Once the systems are accepted by the market, they can be produced more efficiently.

Since products can be multiplied, product development is an interesting subject matter for architects. Architecture is usually a one-off event, whereas autonomous products can be developed and enhanced. According to the firms interviewed, those are the "fun" activities. Product suppliers or product developers seldom engage an architect as a designer for product development, and they seldom have them participate in an advisory panel to investigate the need for a new product.

Innovation brings not only the benefits of new developments, but also problems relating to production and after-care. Developing products also involves giving warranties and rendering services. In addition, aspects such as copyright are to be taken into account. Octatube was of the opinion that giving warranties and rendering

services will play a key part in the future organisation of design. Cepezed stated that many uncertainties exist as to the responsibility for designs in the current market, particularly in respect of integrated contracts in public private partnerships. Organisations such as Cepezed and Octatube therefore assume all responsibility for their current projects so as to prevent problems at a later stage.

To analyse the forms of cooperation and innovation within the context of project bound (product) innovation, we developed a framework that sets out the roles of architects against a benchmark based on the organisations investigated. The emphasis is placed on the roles claimed by the firms within the context of developing a new product.

Table 1: Roles of architectural firms

	Zwarts & Jansma	Paul De Ruiter/ Boil	Cepezed/ BGC/ Systems	Mick Eekhout/ Octatube
Idea generator	x	x	x	x
Initiator	x	x	x	x
Designer	x	x	x	x
Developer	x	x	x	x
Product champion	x	x	x	x
Process guard	x	Boil	BGC	Octatube
Coordinator of building parts and aspects → system integrator	-	Boil	BGC	Octatube
Producer	-	Boil	-	Octatube
Observations:		Spin-off company created (Boil)	Spin-off companies created to manage process and produce products (BGC/Systems)	Spin-off company to produce systems (Octatube)

Strikingly, all of the architects profiling themselves as a product developing architect claim a role up to the level of product champion. This means that the architects consider the idea, initiate the development and make the design. After that, there is a differentiation between those who restrict themselves to the tasks of the architectural firm and those who have established separate sister companies, irrespective of their purpose.

Market innovation

Market innovation means that an innovative idea generates changes in the market situation. The way in which architects respond to the Dutch private client market is an example of market innovation. The housing market in the Netherlands is still relatively traditional, almost all houses are still produced on site and based on a unique design. Several architectural firms have designed prefab housing systems and organised a network to realise these houses. This development appears to be fairly successful. Since this development is new to the Dutch housing market, the firms do not face competition with traditional parties, but merely with the traditional market. These examples of market innovation often result in process innovation and – in some cases – in product innovation. These types of innovation are not project related. Client may choose either an integrated approach or a traditional approach to their building process.

According to Paul de Ruiter, contractors do not invest in developing new products. They appear to be merely willing to invest in improving their own primary processes in the sense of increasing the efficiency of their part of the building process. For

architects, it is difficult to penetrate into the heart of construction organisations since the latter do not share the same responsibility for products. The major party usually bears most of the responsibility. However, Paul de Ruiter also stated that contractors are interested in cooperating if they have an issue that requires integral thinking and they see no other way out. The shared ambition to resolve an issue creates a sound basis for an inspired collaboration. A shared ambition and a shared problem have proven to be an excellent breeding ground for innovation.

The interviewees were not very keen on involving construction workers from the market. As a matter of fact, organisations such as Octatube and Cepezed prefer to realise their designs themselves in order to avoid having to work with construction firms. By designing their own construction systems and building their own network of suppliers and producers, they avoid traditional construction situations that require an independent contractor.

Client relationship

The firms interviewed turned out to pay ample attention to the relationship with their clients. Their cooperation is based on a shared vision and a shared ambition as well as on the confidence clients have in the firms' competences. All firms interviewed prefer a direct relationship with their clients so as to ensure an optimal relationship between quality and price. This is not as relevant to contractors since they have different objectives. It is important that clients give an architect sufficient mandate to play a key role in the building process. The firms included in this study stated that – as a representative of his client – the architect alone ensures the actual realisation of that client's ambition. Octatube also stated that quality is most likely to be achieved if the architect involved has perseverance and ambition and if he knows what he wants and how he wants it. Octatube uses solid project management to optimally control its processes. Since it avoids the "gap" between design and construction, it is certain that its designs will be built as intended. Consequently, they assume all responsibility. Liabilities are managed by the product manufacturers. The same applies to Cepezed; its spin-off (Bouwteam GC) can be deployed to compensate any financial losses incurred in the design phase during construction.

Integrated design

A concept frequently mentioned during the interviews was integrated design. Integrated design means that the design process and the product process are closely intertwined. It is therefore considered a key to innovation. The firms interviewed stated they work with "good advisors". A good advisor has a passion for the profession and sufficient know-how, and he is able to think as a designer. Every project is usually assigned a new team, preferably from the firm's own network, in which context social aspects play an important part. If a firm cannot draw from its own organisation, structural engineers, building consultants, climate advisors and other professionals are involved in the process as soon as possible. According to Paul de Ruiter, 'the art is to raise architectural design out of the interaction between the various disciplines'. Cepezed is of the opinion that incorporating the Dutch organisation for Integrated Operating Architects (IWA) is a sign of the fact that more architects wish to position themselves as a generalist. It believes an architect's strength also coincides with him being a generalist.

Forward and backward integration

During the interviews, the firms were asked to what level they operate in the construction phase. All firms were convinced that the quality of a building is determined by the role the architect claims during construction. Aesthetic guidance is the bare minimum an architect should offer during construction. The firms interviewed had different opinions on how significant that role should be. For Zwarts and Jansma, an architect offers his clients a great deal of added value primarily by offering aesthetic guidance. Since the architect has designed the building concerned, he knows where to economise on costs while retaining the quality level of the design. However, Octatube and Cepezed were convinced that forward integration can only take place if there is sufficient experience in construction (backward integration). They were of the opinion that know-how of construction and performing tasks during construction are essential for a good position at the negotiating table.

Whereas the firms interviewed considered construction as backward integration, they considered project development as forward integration. Initially, Paul de Ruiter made a start with project development so as to generate his own work. In retrospect, he considers project development to be a complex business that is totally different from what he believed it to be. A lot of money can be made with it, but he also finds it 'boring work'. Cepezed started with project development under the flag of Cepezed systems bv. The projects it developed were designed by its architectural firm and construction was coordinated by its other spin-off; Bouwteam General Contractors.

The majority of the interviewees were not interested in process integration as a primary objective. The core activities of the firms are design and design related activities. The interviewees did not find that process integration adds much to their work as an architect, apart from an increase in turnover and a lot of red tape. According to Zwarts and Jansma, performing the role of a project developer does not alter a corporation and merely creates 'uninteresting activities'. He stated that architects are generally not typical business men. In addition, process integration as a primary objective appears to be far more difficult than when it is linked to product innovations. Paul de Ruiter named Cepezed as a well-known example of how to run an architectural firm as a business. According to him, '…only a combination of business, technical creativity and courage can lead to innovative and integrated processes'.

System integration

The interviewees agreed that an architect's strength primarily coincides with him being a generalist. Architects are not bound by any specific know-how and do not suffer from "tunnel vision". Due to this general way of thinking, they are eminently suited as a system integrator. Cepezed described it as follows: 'A system integrator is a generalist who can manage a complex process. Only he can assess the interaction between technology, money and spatial functionality. An architect is pre-eminently a generalist.' Zwarts and Jansma stated: 'The building process is becoming more and more specialised, the idea being that, when it does, good will happen. Therefore, an engineer merely looks at construction and not at installations. A project manager reviews plans only up to the programme of requirements, whereas an architect experiences everything; he looks at construction, installations… everything. He knows the exact reconciliation between the various components and therefore has a very major and essential role.'

Taking responsibility is another task of the system integrator. The interviews have revealed this to be a rather delicate issue. To some extent, the interviewees were willing to take certain risks, but only for the tasks corresponding with their own profession; designing. One would assume that most of the risks are taken by the party with the largest financial share in a project. Only the most innovative firms, Cepezed, stated it takes full responsibility towards its clients, literally: 'Give us the assignment, and then we arrange it for you.' At the end of the day, however, they also make sure the risks are divided among the various Cepezed companies. Only Octatube – as a product developer – takes full responsibility itself. It takes the entire process from design to implementation into its own hands, as a result of which it is no longer an architectural design firm.

CONCLUSIONS

Based on the results of this study, the conclusion may be drawn that architects certainly have opportunities to act as a system integrator in the building process. The system integrator's role may be assumed by an architect as an individual or by his firm. Although this study focused on the existing practice with respect to leading innovative firms, other types of architectural firm with ambition also appear to be able to secure a position as a system integrator. The results indicate that the profiles of the firms acting as a system integrator are strongly impacted by:

1. their vision and ambition;
2. the feasibility of the design;
3. architectural, functional and technical aspects of design quality.

Based on Rutten's definition (2007), an architect could operate as a system integrator at two levels:

1. The architect as a designer and a coordinator in construction. If we consider a building as a system that is designed by an architect, the system can be considered a unique object for clients. As a design is primarily based on the architect's ideas and know-how, most of the coordinating activities in the design phase are assigned to the architect. Essentially, an architect may be considered a generalist with a design assignment. In order to make use of the architect's generalist competences and the specific project know-how he acquired in the design process, the architect could also be assigned coordinator in the construction phase. This would enable the architect to ensure to his client that his design will be constructed as it was designed.
2. The architect as a driver for innovation on building level In theory, architectural design may be considered an innovation since design involves a unique solution to a problem. The present study implies that design for innovation merely relates to the objective of having feasible designs, the objective of achieving a high quality level or finding a solution to a project related problem. Architects are driven by architectural ambitions (product innovation), on the one hand, and rendering services as an entrepreneur in a market situation (market innovation), on the other.

The way in which an architect fulfils the role of a system integrator in a project substantially differs from the way in which a contractor would fulfil that same role. Consequently, the outcome of the project will vary accordingly. The variations can be explained by the different business approach of the organisation. A traditional contractor generally does not aim to deliver as many products as possible. His major objective is to provide building capacity to build. Price is an important criterion for

clients in their selecting a party in construction. In order to reduce prices, a contractor organises production processes as efficiently as possible. Conversely, architects distinguish themselves by the originality of their designs. However, price is not the major criterion for clients in their selecting an architect. Architects prefer to look upon themselves as a service provider to their clients so as to create maximum design quality. Hence, their predominant focus is not process efficiency but an optimal realisation of a product within the boundaries of the project. Hence, a contractor focuses on an efficient delivery of a system in general, whereas an architect focuses on the output of the system.

In the area of architecture, the ambition to strive for the highest quality of a product generates a focus on the core activities of designing. When they assume the role of a system integrator, architects have to broaden their activities. On one hand, this gives them the opportunity to integrate and realise their designs as intended. On the other hand, it entails more administrative activities and managerial activities; activities that are usually not among the core competencies of any architect. Communication and collaboration with suppliers and consumers, social networking and marketing of the firm will become more important (Larsson *et al.* 2006; Bozdogan *et al.* 1998; Cousins and Lawson 2007). This study has shown that most firms that assume the role of a system integrator have created a new spin-off organisation to compensate for these weaknesses. These types of spin-off may be characterised as project development firms or project management firms whose staff members are of a different kind than designers. Together with the original architectural firm, a network is created to deliver the total building as a concept product. Responsibility and reliability are usually assumed by the spin-off organisations due to the design firm's weaker financial position.

To conclude, the position of a system integrator opens up new possibilities for architects who are driven by innovation as well as by design quality. By assuming the role of a system integrator, they make use of their competences as a generalist and as an "out-of-the-box" thinker while controlling the building process and ensuring the quality of the building as intended. Still, it may be advisable to find a business partner for the managerial activities involved, since for a designer those are usually not considered that challenging.

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