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Framework for managing uncertainty in property projects

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A primary task of property development (or real estate development, RED) is making assessments and managing risks and uncertainties. Property managers cope with a wide range of uncertainties, particularly in the early project phases. Although the existing literature addresses the management of calculated risks, the management of uncertainties is underexposed. A framework and method are presented for uncertainty management, both of which focus on the early phases of complex RED projects. To develop this method, a design method for the development of consumer-based software (SCRUM) is adapted. The traditional uncertainty management in property development was compared with the SCRUM approach. SCRUM is found to be a highly useful tool for uncertainty management in real estate, but it requires adjustment to the specific context of property. An adjusted method 'RESCRUM' was developed and a first test of its accuracy and usefulness in practice is presented.

Keywords: design process, process approach, project management, property development, risk management, uncertainty management, collaboration

Une des tâches principales des promoteurs immobiliers consiste à évaluer et à gérer les risques et les incertitudes. La profession est confrontée à des incertitudes nombreuses et variées, notamment lors des premières phases d'un projet. Bien que la littérature spécialisée traite de la gestion des risques calculés, la gestion des incertitudes reste insuffisamment étudiée. Cet article présente un cadre et une méthode de gestion des incertitudes, qui se concentrent sur les premières phases d'un projet immobilier complexe. Pour développer cette méthode, on a étudié le développement d'un logiciel basé sur le consommateur (SCRUM). La gestion classique des incertitudes dans le cadre du développement immobilier est comparée à l'approche SCRUM. Cette approche s'avère être un outil très utile pour la gestion des incertitudes dans l'immobilier mais elle nécessite des adaptations au contexte spécifique de la propriété. Une méthode ajustée appelée RESCRUM a été mise au point et un premier test de sa précision et de son utilité pratique est présenté.

Mots clés: processus de conception, approche du processus, gestion de projet, promotion immobilière, gestion des risques, gestion des incertitudes, collaboration

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Introduction

In order to achieve a good investment with expected returns, property (real estate) projects must be managed properly. This includes managing not only the design of these large-scale building projects (Chan and Yu, 2005), but also their value in order to enhance value in projects (Male *et al.*, 2007). Another important aspect is risk management (e.g. Byrne and Cadman, 1984; Wedding, 2002; Shang *et al.*, 2005), which focuses mainly on assessing and controlling risks. Risk management is the main focus of this study.

Risk management is about making decisions based on quantified risks in order to execute risk-response measures: it is a basis for decision-making in a project (Miles *et al.*, 1997). Risks are defined as being uncertain events or conditions that, if they occur, have a positive or a negative effect on a project objective (Project Management Institute, 2000, p. 127). Risk management therefore focuses on analysing risks, implementing control measurements and evaluating. The literature on risk management focuses predominantly on the later project phases, such as preconstruction and construction phases (Royal Institute of British Architects (RIBA), 2007), where a definitive design is made and an object is realized. In this part of the process risks can be assessed and controlled because many certainties already exist. However, the most important decisions are made during the early project phases. In the early phases, the initial ideas of a project are translated into a design. This process is hard to control because of the involvement of many actors who act strategically and the lack of certainties. In the early phases managers cope with many uncertainties; managing all these uncertainties in property projects is vital. Uncertainty management has gained a lot of attention in the business management literature (Van der Heyden, 1996). Its importance in relation to project management has been acknowledged (e.g. Morris, 2001; Ward and Chapman, 2003; Ramgopal, 2003; Pipattanapiwong, 2004), especially in the early stages of a project's life cycle deserve more attention (Ramgopal, 2003; Winter *et al.* 2006).

The main goals of this research are to develop (1) a theoretical framework for uncertainty management, and (2) a method for uncertainty management, both focusing on the early phases of complex property development (or Real Estate Development (RED)) projects. To support uncertainty management, this research proposes that new process approaches are needed and so, for this specific purpose, the Agile Method SCRUM (which is a method for software development) was studied in more detail. This process approach originated in the development of consumer-based software products and may offer new insights for the construction industry. The questions that this research addresses can be formulated in the following way:

- What are the important aspects of uncertainty management in RED?
- What are the possibilities and limitations of SCRUM in uncertainty management?
- How can SCRUM be adjusted and applied to manage uncertainties in RED?

The next section explains the research's approach. The third section describes the theoretical framework and main characteristics of uncertainty management in real estate development, as found in the literature and in practice. The fourth section investigates the potential of SCRUM as a method for uncertainty management. The fifth section proposes a modified SCRUM method, called RESCRUM, which is adjusted to RED projects. The sixth section discusses the first test of RESCRUM in practice.

Approach

To arrive at a *theoretical framework* for uncertainty management, the research team first developed a theory based on a literature study and interviews with experts. The initial framework was then tested in a case study, which was an example of a common property development project. A *method for uncertainty management* was developed by exploring the possibility of applying a method used in software engineering. Testing this method on the use in property development was achieved by simulating it in a second case study.

The theoretical framework was developed by studying the literature on the (property) development process and on uncertainty management, risk management and process management. Additional insights into the property development process and its uncertainty management were obtained by conducting four semi-structured interviews with property development experts. The interview results were summarized, checked by the respondents and analysed according to grounded theory principles (Strauss and Corbin, 1998), mainly using open coding. The categorization of the developed codes resulted in a preliminary framework.

Qualitative research methodology was also used to develop and test the theoretical framework and the method. Case study methodology was chosen as the most appropriate method for collecting and analysing data as case studies focus on understanding the dynamics present within single settings (Eisenhardt, 1989), in the present case property development projects. Two cases studies were performed, using replication logic for their selection (minimal difference between the cases). Data were collected from the case studies by conducting semi-structured interviews and

via project administration in order to obtain source triangulation. The criteria that were important in the selection of the cases were as follows:

- The project should be performed by a property developer who initiates, develops and exploits projects as delegated investor (the same developer for both cases).
- Mixed-use development in an inner-city environment (complex projects).
- Availability of information (documentation, people), covering the early phases of the RED project.

The selected cases can be summarized as follows:

- Case A: 'Witte Keizer' project: the development of a 70m tall housing/office building with a garage for parking in the centre of Rotterdam.
- Case B: Parcel 14A of the Gershwin area at the 'Zuidas' in Amsterdam: the development of a more than 70m tall mixed-use building including houses, a hotel, a school, a restaurant, and a garage for parking.

Unlike the difference in geographical location, the cases are comparable because the complexity and procedures in both cases are alike.

For the first case (CASE A), five interviews were performed with several actors of the project, like the project manager, the architect, the building cost consultant, and the responsible property developer. The semi-structured interview was based on a predefined set of questions, which was based on the preliminary framework but tailored in the interview to the specific role in the project the actor had. Based on the interview transcripts and document analysis of the project administration, a case description was made which was checked by each actor individually. The case was analysed using the template approach (Miles and Huberman, 1994), to code the uncertainties, and to establish the (preliminary) constructs of the framework and some open codes. Based on the categorizations made, the theoretical framework was adjusted.

To develop a method for uncertainty management in RED, the scientific and professional literature (mainly from software development) about the agile design method SCRUM and its theoretical concepts was studied in detail. Based on a comparison of SCRUM with the theoretical framework and with the property development process, the research team was convinced of the potential advantages that SCRUM had for uncertainty management in RED, and also of the need to make a RED-specific version of the method in order to tailor it to the RED project environment. The adapted method, called RESCRUM, took into account the differences between RED and software development. RESCRUM was then confronted with the authors' theoretical framework in order to assess the (theoretical) usefulness of RESCRUM for uncertainty management in real estate. Simulation in a second case in practice (CASE B) was used to perform a first validation and verification of RESCRUM and to judge the practical possibilities and limitations of RESCRUM for uncertainty management.

The second case study conformed to the selection criteria described above (in order to obtain similar circumstances), but differed in the sense that in CASE A the design phase was finished (to identify which uncertainty management measures were applied and what their results were). In CASE B the design phase was just starting. In CASE B, a design of the design process with RESCRUM (which is not based on preconceptions of the actual organization of the process) could be made. CASE B was first described in a similar way as for CASE A based on interviews with the responsible property developer and on project administration. A model was then formulated based on the development process that had taken place (until the study began) and a description was made of the uncertainties in the project and how they had been managed. The expected process for the rest of the project was then modelled, including the expected uncertainties and how they would probably be managed. Finally, the process was modelled for the use of RESCRUM in the design phase of the project. This proposal was first presented and then discussed in a workshop comprised of the key 4 actors in the design process, namely the architect, developer, cost advisor, and concept developer. These actors had a strong influence on the development of the project and are involved in many other projects as well. During the workshop uncertainties in the project were identified, the main approach (using a new type of process organization for managing uncertainties) was validated, and specific aspects of the implementation of RESCRUM were discussed. The main points of discussion during the meeting were noted, summarized and checked by the workshop participants. These results were also presented to another developer who could judge them in an unbiased way and therefore validate them properly. From the workshop and the interview, opportunities and restrictions for the use of RESCRUM in real estate development were derived.

Uncertainty management in property development

Theoretical framework

To describe the property development process, the most commonly accepted model of the construction

process, namely RIBA's *Outline Plan of Work* (2007), which is an updated version of RIBA (1973), was used. Related models, for example, are the generic design and construction process protocol of Kagioglou *et al.* (2000) or more design-oriented models (Roozenburg and Eekels, 1995). More property development-specific models (Healey, 1991, 1992; Miles and Berens, 1996) fit in RIBA's *Outline*. The focus was on the preparation and design phases (stages A–E) of the work stage sequences of the traditional process, as depicted in Figure 1.

Uncertainty is defined as an unpredictable and/or uncontrollable risk – based on the work of Friend and Jessop, cited in Drogendijk (1997), who define uncertainty in relation to the causes (data and values) and consequences (decisions). Uncertainty about causes corresponds to *unpredictability*. In contrast with risks, no thorough inventory of uncertainties can be made; at most, only sources can be indicated. The consequence of unpredictability is that uncertainties are not quantifiable. Uncertainty about consequences corresponds to *uncontrollability*.

To be able to manage uncertainty, sources of uncertainty have to be identified. In different studies complexity, and especially social complexity, is mentioned as being one of the main source of uncertainties (Granath, 1991; Degrace and Stahl, 1991; Drogendijk, 1997; Bertelsen and Koskela, 2003). This complexity originates in the involvement of multiple, strategically operating actors in property development projects.

The management of uncertainties can be assessed by using two approaches (Lerdahl, 2001; Drogendijk, 1997). The first approach focuses on the *organization of the development process* and attempts to manage uncertainties by defining decision moments beforehand. These decision moments do not cope with the complexity and changes that occur during the project and are imposed by one actor. The second approach focuses on managing complexity through *cooperation* between actors. Complexity can be managed by adjusting goals and the means of individual actors (Teisman, 1992; Conklin, 2003), by generating commitment amongst the actors involved (Lerdahl, 2000; Koskela *et al.*, 2002), and by creating flexibility (Drogendijk, 1997). Both approaches will be discussed below in more detail.

Organization of the development process

The first approach attempts to manage uncertainties by using a phasing structure with decision moments. The planning of *phases* is seen as a management tool to support the organization of the process, but at the same time this is made difficult because of uncertainties. The main reason for using phasing in a project is to make decisions about the progress of the project; if it is decided to continue the project, then the actors involved accept the uncertainties and the actual risk of the project. Phasing, however, can also restrict the freedom of the actors and hinder the integral approach of the project (Lerdahl, 2001).

Decision moments determine the functioning of phasing. Without these moments a phase transition has no value and there is a risk of working in two parallel phases without any clarity about the direction and progress of the project. To allow phasing to work well

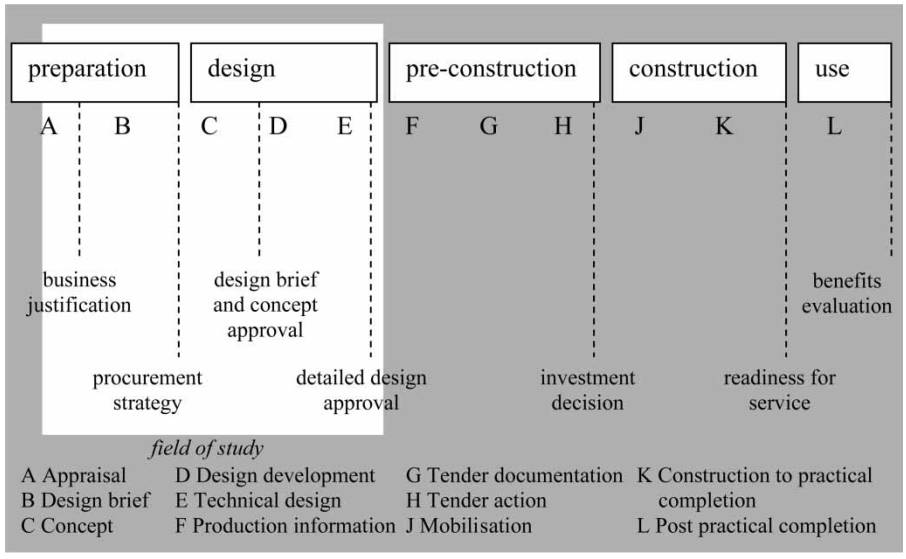

Figure 1 Work stages (phases) and gateways (decisions) in a traditional property development process. Source: based on Royal Institute of British Architects (RIBA) (2007)

in real estate projects, decision moments of several actors need to be well coordinated with the decision moments of the other actors and those on the project phasing (Gehner, 2003).

Cooperation

The success of the organization of the development process depends on the level of cooperation between the actors. Changes made by actors or the environment demand a flexible process. If the goals and means of both active actors and the market are specifically accounted for, then changes are more predictable and because of a high level of commitment, they can be implemented as well.

In most projects many different actors are involved; *adjustment of goals and means between actors* is very important. Involving the market (the clients and users of projects) in the process ensures better management of uncertainty. How the cooperation between the parties is best organized depends heavily on the complexity of the project itself (Teisman, 1992). The cooperation in a development process is mainly determined by the form this cooperation takes, such as that is stipulated in contracts. Contracts determine who is the coordinating actor, who is responsible for taking certain decisions and performing certain tasks, who is risk sharing, etc. Typical forms of cooperation are traditional, construction team, and design and build. In the construction industry, contractual and legal protection dominates rather than identifying and reducing sources of uncertainty and managing production along the lines of what was done in manufacturing (Slauson, 2005).

Generating *commitment* plays a crucial role in the management of complexity. Decisions are based on the interpretation of information by actors. Kohnstamm and Regterschot (1994) call communication and information a success/fail factor for the management of projects.

To manage the complexity of a project, *flexibility* in product and process is needed (Drogendijk, 1997). Without process flexibility it is not possible to react to changes in the environment, the project team or internal policy. When developers are flexible they can manage the uncertainties. Therefore, they need knowledge about changes in the market and the project team and have to be able to carry out these changes in the project (Lerdahl, 2001). Flexibility could be obtained by phase-exceeding control and the possibility still to have influence on the project (Granath, 1991). Flexibility could also be found in the product.

Management of uncertainty in the traditional process

The framework that was presented before was tested in the first case study (CASE A). Based on comparison with descriptions of property development projects in the literature (Healey, 1991, 1992; Miles and Berens, 1996; Ratcliffe *et al.*, 2006), it is concluded that the present case conforms to these projects and can therefore be seen as a common example of a traditional real estate development project.

The 'Witte Keizer' project in Rotterdam is a development of a residential/office tower in the centre of the city. It contains 108 luxury apartments, 2700 m^2 of office space and 145 parking places in a fully automated underground parking garage. Figure 2 shows the project during its construction phase.

The main technical uncertainty was designing the building with an underground car park incorporated within it. This was an innovative and therefore unpredictable design. The technical complexity led to a high level of dependency between the various actors. Because many actors were involved in the design of the underground car park, there was a high level of social complexity. Other uncertainties were the uncontrollable nature of the costs, the willingness of the municipality to contribute to the public space, the behaviour of the constructor (the constructor took over the risk of the construction), and finally the market dynamics.

The focus was on organization of the development process:

- Phasing: a strict phasing system was used with a decision point created at the end of each (sub)phase.
- Decision moments: at the end of each phase a decision point was created. Other informal decision moments were used by the developer to increase pressure on the project team. This gave informal power to the developer, which increased his control. The responsibilities of the actors were very clear and therefore restricted social complexity, for instance by the use of a detailed project management framework.

Cooperation was limited:

- Adjustment of goals and means between actors: no structured consultation of marketing or internal departments took place during the design process to guarantee certainty for the decision moment. Also, no direct communication between architect and supplier of the underground car park took place. The project was, however, able to cope with some complexity because of the creation of a building team that involved the architect, constructor and advisors. This included an intense meeting schedule as well as a high level of involvement from the architect in the preparation phase. Because of the early involvement from the

Figure 2 'Witte Keizer' project in Rotterdam under construction, 2004. Courtesy: http://www.skylinecity.info/

constructor and a project coordinator of the municipality, continuous testing was also possible and commitment of all the actors was kept high.

- Creating commitment: no attention to soft factors like the commitment to the project was given. There was a risk of strategic behaviour. Communication was normative.
- Flexibility: though there is no explicit attention given to the management of complexity, the traditional process offers space for further fill-in by additional methodologies.
  - Product flexibility: dependent on initiatives of developer. In the case, design iterations lead among other things to an extra floor and a

modified facade being introduced at a time when the design process had already progressed quite far.

- Process flexibility: limited. Because of the fixed and linear structure, only limited input of the desired changes could be made and there were limited possibilities for the implementation of these changes.

As illustrated by the above descriptions, it is possible to describe the uncertainty management approach for the case project and for similar descriptions of RED projects in the literature using the categories of the framework. It can be concluded that in the traditional property process the main focus is on developing certainties (via the organization of the development process in a linear phasing system with built-in decision moments) rather than coping with complexity (through cooperation).

SCRUM as a method for uncertainty management

This section describes an approach to deal with complexity, namely SCRUM, and its usefulness for property development.

SCRUM

SCRUM was developed by software developers and is based on the principles of AGILE and Lean Management (Schwaber and Beedle, 2002). *AGILE management* focuses on effectiveness, i.e. the value of the product to the client. Value management is an important part of AGILE management. It establishes the design process in a pragmatic way with team-based, bottom-up design processes. The evaluation of (preliminary) designs is important in this method (Koskela *et al.*, 2002; Yan and Jiang, 1999). *LEAN management* focuses on efficiency, i.e. optimizing the process. Planning techniques and flexibility are important parts of LEAN management, which come to the fore in flow and task management (Koskela *et al.*, 1997; Poppendieck, 2003).

SCRUM proposes a pragmatic, single-phase design process in which multifunctional teams design prototypes in 30-day sprints. After each sprint, evaluations of the process and the prototype of the product are conducted in scrums. During a *sprint* the team completes a sprint-log so that an entire finished log is available at the end of the sprint. The goal of each sprint-log is to reach a concrete result that can be continued in next sprints, and might also be used in the final product. The result of a sprint is a prototype for (part of) the product. During sprints daily meetings are planned for managing purposes. In these short sessions all the team members explain what they have done, what the results were and what they will focus on in the near future. Sprints are completely isolated from external influences and the team is totally free to choose a solution strategy. In the SCRUM process the lack of phase boundaries is important. Team members with entirely different backgrounds now complete all the activities that were traditionally separated in sequential phases together in a sprint. During sprints teams are given complete freedom to programme, design and realize according to their sprint-log. The close cooperation between team members with different backgrounds is one of the main bases for the success of the method (Schwaber and Beedle, 2002; Lerdahl, 2001; Degrace and Stahl, 1991). This also offers advantages not only in soft factors as there is more involvement, but also in the coordination of the content of a design and the generation of a prototype.

Scrums are characterized by structured meetings held to evaluate previous sprints, and the preparation of the next sprints. In scrums changes that could influence the developed prototype and new topics that need attention are listed and put on a backlog. From this list of priorities, which is managed by the SCRUM-master, new sprint-logs are abstracted to start new sprints (Schwaber and Beedle, 2002). During scrums the prototypes can be evaluated by potential customers. Parallel sprint-teams are coordinated during scrums. The evaluations held during scrums can suggest the need to involve other competencies in sprints, or declare the product unfeasible, or raise practical points like organizing a better space for sprints.

Due to openness and the involvement of several actors in the sprints, the project is (controlled) open to changes in the environment and the end result is only determined during the process itself. The intense level of collaboration in SCRUM induces a continuous adjustment of goals and means. Because of the cooperation and the freedom available in a sprint, SCRUM generates commitment as well as efficiency. Figure 3 shows the SCRUM process next to a simplified, traditional design process.

SCRUM as a new method for uncertainty management

If SCRUM is compared with the property development process and with the way uncertainty is traditionally managed in property (see, for example, the cases described) clear differences can be identified. These are listed below.

Organization of the development process:

- Phasing: in SCRUM iterations can be used when needed. A sprint can also be seen as iteration, developing a new prototype.

- Decision moments: defining priorities, distributing activities and evaluating prototypes, in particular between the sprints that are the only decision moments in SCRUM. No formal structure arranges

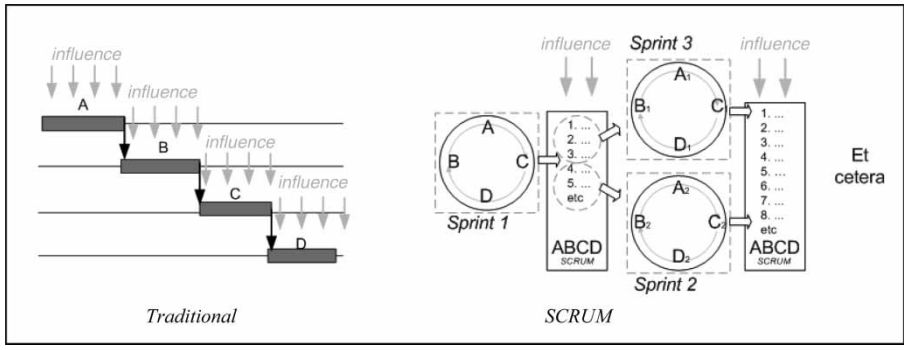

Figure 3 A traditional and a SCRUM process with main actors A, B, C and D

controllability; therefore, informal control is arranged. It is thus mainly focused on soft factors as the way of collaborating in the process. SCRUM does not lay down requirements for a design; in property projects, however, this is necessary because of the involvement of external parties. In traditional processes formal controllability is much more common.

Cooperation:

- Adjustment of goals and means between actors: All key actors are involved in SCRUM. The adjustment of goals and means happens in traditional processes top-down, in SCRUM it occurs bottom-up and is much more explicit. The SCRUM team guarantees active involvement of goals and means during the process. Cooperation is not arranged in contracts as is the tradition in real estate projects.

- Creating commitment: the SCRUM team organizes a high level of interaction and commitment between the actors in the sprint teams. In SCRUM the collaboration with external parties is not defined and formal contracts are not used; external parties have to commit fully to the project priorities. Open communication and coordination of interests are typical of SCRUM. Communication is intensive in a sprint-team. The openness of information sharing between the different actors is crucial in SCRUM and prevents strategic behaviour.

- Flexibility:

  - Product flexibility: the SCRUM process makes product flexibility more possible because of the close collaboration of several actors in a sprint.

  - Process flexibility in SCRUM is much higher than in traditional processes because of an incremental organization of the process and an open search for goals and solutions. A prototype can be structurally checked against market conditions and desired changes be proposed in scrums; changes can then be implemented in sprints.

When looking at the management of uncertainty, SCRUM focuses on the reactive and pragmatic management of social complexity. Much attention is given to the tuning of goals and means, the creation of commitment and the flexibility of the process. This focus is fundamentally different from the focus in the traditional process where certainties are defined by using phasing with decision documents which are defined before the project starts.

SCRUM for property development: RESCRUM

In order to combine the main advantages of both the traditional process (phasing and decision points) and the SCRUM process (managing complexity), the SCRUM process is inserted (theoretically) in the traditional phasing. This new process is called RESCRUM (Real Estate SCRUM) (Figure 4).

RESCRUM: a first proposal of SCRUM for RED

RESCRUM consists of a traditional phasing system that uses the SCRUM process of sprints and scrums. After each phase there is a traditional decision moment. Phasing in the RESCRUM process is indicated in Figure 4. To use RESCRUM properly, all parts of SCRUM need to be filled in properly.

In *sprints* all actors from the project must be involved. This means that construction firms and architects are part of sprints in the preparation phase as well. *Scrums* are used to evaluate the prototype. At the same time the backlog is turned into a new sprint-log and priority is given to the topics. A prototype is delivered after each sprint in the RESCRUM process; the team and RESCRUM-master can then evaluate whether it can be seen as an official product (such as a concept design or detailed design) or whether it

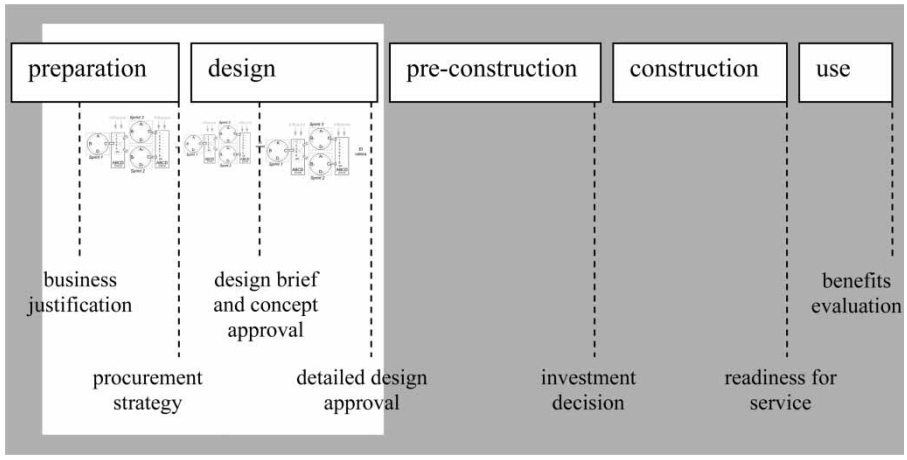

Figure 4 RESCRUM process: SCRUM inserted in a traditional property development process. Source: based on Royal Institute of British Architects (RIBA) (2007)

needs to improve in a later sprint. In RESCRUM a prototype is defined as a concept partial product (or part of it). The main difference between this and traditional partial products is that all the prototypes/partial products are tested from several points of view (spatial fitting in, financial feasibility, market demand, juridical feasibility, constructive feasibility) and therefore at that moment are seen as being feasible for the final product and ratified by all the actors involved in the sprint.

Still, the application of RESCRUM in property development could not be achieved by simply using sprints and scrums; some organizational changes are necessary too:

- Different *roles*, such as the SCRUM-master, must be assigned to the actors involved; it is good to evaluate their assignment in scrums too.
- Next, a *mandate* is needed from the organizations involved to give sprints all the developing space they need. The RESCRUM-master needs enough mandates to determine priorities and organize several sprints (iterations) before formal evaluation by the organizations takes place.
- *Concrete measures and decision criteria* are needed and should be established beforehand so that the progress of a sprint and prototype can be determined, a prototype in each scrum can be evaluated, and the phase result between the phases can be assessed. Actors' goals should be recognizable in the criteria.
- *Compensation* structures should be built. Actors should be rewarded for their contribution to each phase.
- A shift of focus is needed to give more attention to the *early phases* of a project and create common project goals. By using RESCRUM from the preparation phase the effectiveness and efficiency of the process can be greatly improved. If RESCRUM is only used in the design phase there will already be too much complexity and several restrictions to the process will be present.

Uncertainty management with RESCRUM

In RESCRUM complexity can be managed according to SCRUM and certainties can be defined according to the traditional process. In this way informal controllability and predictability of SCRUM, with its intense collaboration and the adjustment of goals and means which is achieved during sprints, is combined with the formal controllability of the traditional process with its phasing and decision moments. Table 1 compares the different approaches.

Initial test of RESCRUM in practice

A second case study was conducted to test the practical application of RESCRUM: the development of a multi-use tower, the Gershwin project, at the 'Zuidas' in the southern part of Amsterdam (Figure 5). For the developments on cluster IV, a consortium was being set up. The Gershwin 14A project had a long history of studying the potentials and tuning the programme of requirements. After the start of the preliminary design phase, the process was halted because of changes in the environment of the project and the difficulties of adjusting the design to the needs. A new design brief was made and during the period of research a new concept design phase was started.

Uncertainties in the project

Before testing the RESCRUM method the uncertainties that the developer had to cope with at the moment that

Table 1 Comparison of traditional, SCRUM and RESCRUM processes for the management of uncertainty

	Topic	Traditional	SCRUM	RESCRUM
Organization	Phasing	Initiation, programme of requirements, preliminary design definitive design	Initiation phase, overall phase	Same as traditional
	Decision moments	At the end of each phase	Prototypes at the end of sprints	At the end of each phase and prototypes at the end of sprints
Cooperation	Adjustment of goals and means between actors	Actors involved: only related to activity of a phase; goal imposed by the developer	As from the start all (main) actors are involved; in sprints continuous adjustment	Same as SCRUM, but with the possibility of involving some actors later on or only in SCRUM
	Creating commitment	Normative communication, risks for strategic behaviour	Active and open communication due to the openness and intensity in sprints	Same as SCRUM, but normative communication as well in phase transitions
	Product flexibility	Dependent on the initiatives of the developer	Dependent on the initiatives of different actors; better possible due to close cooperation	Same as SCRUM
	Process flexibility	Limited; fixed and linear structure, limited input of desired changes, limited possibilities for implementation	Large; structural check of prototype with desired changes, sprint useful for implementing changes	Same as SCRUM, but limited due to decision documents in the structure of traditional phasing

the case study was started were analysed. A distinction was made according to the main source of uncertainty and five sources were found:

- Zuidas as a whole: unpredictable because the project realization depended on the overall Zuidas project.
- Consortium: uncontrollability regarding decision moments with parties in the consortium, and regarding receiving the property of the building and possibility for exploiting it.
- Municipality: unpredictability in how much the municipality will adhere to the urban plan and uncontrollability in changing the price of the parcel of land to be paid to the municipality.
- The market: uncontrollability in the evolution of, and specific demands made by, the market, which led to the complete halt of the project in the concept design phase.
- Lack of involvement of the architect and constructor early in the project: unpredictability because of a design brief whose feasibility was not checked in terms of fitness of functions of the available space and because of a lack of judgement of constructability, which was important given the demand for a flexible and high-value, mixed-use building.

Proposed development process with use of RESCRUM

The development of the Gershwin project was simulated using RESCRUM. The development process is organized with sprints, which involves the developer, the architect, the building costs advisor, a constructor and the municipality of Amsterdam. Sprints are organized in 30 days, with intense daily contact between the actors. The traditional phasing remains with clear decision documents, e.g. a tested design brief, a tested concept design, and a tested detailed design. The moments in between the sprints are used to present the results to the project team of the consortium; after each phase the results are presented to the direction of the consortium.

The organizational changes needed for RESCRUM are implemented as follows. The project leader from the developer takes the role of RESCRUM-master. The consortium needs to give a mandate for the sprints; the developer therefore needs to get some freedom. To determine measurement criteria, the different actors must first coordinate their different interests and then the criteria should be prioritized. The compensation of activities in the early phases should be paid for by the developer, and thus the consortium.

An important added value of the RESCRUM process is the check of the design brief and thus a more complete assignment for the concept design phase. Another main contribution to the management of uncertainties is the more intense involvement of the municipality and the

Figure 5 Artist's impression of the Gershwin area in Zuidas Amsterdam. Courtesy: CIIID/Cees van Giessen

market. By involving the municipality, better priorities and the financial framework of the project can be learned. By involving the market, a more adequate reaction can be given to the deteriorating economy by surveying the changing needs of the market.

Evaluation of RESCRUM in practice

In the workshop with the involved project actors, the uncertainties in the project were recognized and the relationship with process organization was found to be valid. The need for a better process organization was affirmed. It was emphasized that the preparation phase did not receive enough attention in the traditional process; the influence of the developer on the course of the project is largest in this phase. A change in the process around the preparation phase is therefore desirable.

From the workshop related to CASE B and the validating interview with another developer, it can be concluded that RESCRUM is useful to support the management of uncertainties because of the flexible generation of prototypes, the explicit coordination of goals and means during the alternation of sprints and scrums, the explicit coupling with the market, the intense process by which priorities are kept to the project and commitment stays high, and the focus on the preparation phase. RESCRUM has added value for all the main actors involved. The fictive application of RESCRUM also brought forward some restrictions for direct application in practice. The use of RESCRUM demands a cultural change in practice; this is not unthinkable, given widespread opinion that the traditional process is not optimal. The real application asks for a big show of confidence, for example for an openness of information and an intense commitment to the project.

Conclusions and recommendations

The main target of the research was to develop (1) a framework for uncertainty management and (2) a method for uncertainty management, both focusing on the early phases of complex RED projects. A theoretical framework for uncertainty management was developed. Uncertainty is characterized by unpredictability and uncontrollability. Organization of the development process and cooperation are seen as the basic concerns in uncertainty management. The new RESCRUM method can contribute to the improvement of the management of uncertainty in early phases of property development. RESCRUM entails not only a new organizational process, but also to be successful a new way of working from all the involved actors. In turn, this implies a cultural shift in property development is needed. The central position of the developer suggests this actor is best situated to initiate this change.

The main *scientific contribution* is the treatment of the gap in the literature on the management of uncertainty in property development. Most of the research on risk management focuses on quantitative or 'predictable' aspects. This research focuses on the management of uncertainty; moreover, it translates a design method (SCRUM) from a different sector (software development) and links it to new approaches for process organization in property development. The application of (RE)SCRUM can eventually lead to a better management of uncertainty, realizing a better basis for risk management and thereby more certainty about the return of a project.

The *limitations* of the research result mainly from its explorative nature. A theoretical viewpoint was chosen for the exploration of the use of new development process approaches in property development. The research focused on the theoretical basis of uncertainty, the management of uncertainty, and the backgrounds of SCRUM. Only two cases have been studied and RESCRUM was not really used in practice.

Further research is needed to fill in the gaps of this research. The framework was only applied to traditional processes, so further research needs to be done into whether this same framework is also useful in projects which are organized differently because of other procurement methods or other team settings. Further research should concentrate mostly on the adaptability of RESCRUM in practice, such as the content of a sprint and the criteria to judge the status of a prototype; the realization of open communication; the roles of different actors and the shift of budget to earlier phases to compensate for the early involved actors.

Recommendations based on what has been learned are that *developers* focus more on the management of uncertainties rather than only on the quantifiable risks. To make an inventory of the uncertainties and to cope with these uncertainties RESCRUM has proven to be a useful method. RESCRUM deals for the main part with soft factors like commitment, trust and prioritizing. To persuade parties to see the strengths of the method, experience with the method is needed and results need to be communicated to external parties.

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