New tools for risk management in early stages of PPP workplace projects

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Abstract

PPP project are everywhere. Many government organizations use this type of partnership to develop government and public buildings, road, bridges or other infrastructural works. One of the objectives is to contract those works or services for a long period, up to 30 years. This implies that organizational changes in society will affect the functional requirements of the artifact. Uncertainty and lack of information are entering the development process and need to be addressed. This article focuses on two instruments that were developed in the Netherlands to deal with uncertainty and risk in the early stages of the development of workplace projects. The PKM method (Product Knowledge Model) helps to understand, map and decide about the consequences of different assumptions on functions, the characteristics and interrelationships that usually appear in the brief or program of requirements. PKM helps to structure the discussion within the end user organization between general managers and those responsible for the workplace project. The other instrument is the PARAP model which is an advanced cost calculation model supporting decision making in the early stages. PARAP calculates the consequences of different choices in the initial, definition and early design phase. PARAO is a practical tool that structures the discussion between parties that are involved in PPP projects.

I Introduction

PPP projects are everywhere. They represent a neo-liberal political belief that some public tasks are better delivered through a long-term participation of the private sector. Usually governments give a verbally magnificent explanation of the possible positive outcomes at statement of this belief:

- Experimentation with new forms of contracting
- Supporting innovation and chain management: synergy
- Creation of knowledge
- End user can focus on his core business

Most scientists are rather skeptical because none of the recent PPP projects has been evaluated yet. PPP project seem to be large-scale scientific experiments without a proper research plan, method or data. It is like an adventure, a replica of the great discoveries not knowing where we go and what the consequences of the endeavor will be. Most of the time, PPP projects are complex because of its content and number of stakeholders involved. Complexity off course is an interesting theme for study but in real life decisions, they usually create a lot of risks, trouble or frustration.
The actual knowledge situation with PPP is best described with the slogan:

“There are a lot of stories but not many facts”.

The future will teach us whether PPP were a success in terms of the expectations, in terms of the economic development, the creation of jobs, the consequences for taxes and the leftovers for future generations (intergenerational solidarity). Yet, with this political reality of PPP projects, the hesitation about the risks and the challenge to develop new knowledge, tools and research in mind, it is good to have a look at the challenges in workplace projects. In this article, I will describe the characteristics of PPP workplace projects from the Dutch perspective: the need for knowledge and tools to support risky decisions that are made in early stages. I will zoom in on two instruments. One is the Product Knowledge Model for development and monitoring of the program of requirements. The second is PARAP, which is a cost model to support decision-making in the early design allowing the user to track the development of costs, based on advanced modeling techniques relating briefing and design decisions to a calculated reference building.

II Definitions and Characteristics

Definitions

PPP projects for workplace projects are integrated contracts between public and private contract partners. The extreme form is the DBFMO contract in which specified parts of design realization, management and exploitation are brought together and are contracted out from the public party to a private contract partner.

DBFMO stands for Design, Build, Finance, Maintain, Operate.

Some people like to talk about *integrated* contracts. The definition here is the “different activities in the different phases (sometimes including the financing) of an accommodation project are brought together and are contracted out to one party, that will be paid on the basis of delivered performance”. It is questionable what is the object of the contract: some say it is a building, some say it is a service (“guaranteed delivery of functional conditions”) that is contracted.

Characteristics

Here are some characteristics of integrated contracts:

1. The integration includes the different phase but also different actors with different core businesses /competences. Integration assumes interrelations or the understanding of the consequences of decisions, circumstances or occurrences made in one phase and has effects in the others. The chain is thought over back and forth.
2. The contracts cover a long period and huge amounts of money. When time and money are involved, financing parties want to be sure about the risks and returns. High-risk means high return rates.
3. Risk sharing: parties negotiate a reasonable risk share for each of the parties. Parties have to look into possible futures using scenario techniques. They have to develop strategies covering the occurrence of possible risks. Protocols for changes are to be negotiated in advance.

These problems are not new. In construction research, we are long familiar with the cost quality issues. Construction projects are step-by-step projects in which the available amount of information increase with the development of the project while at the same time, with all those decisions made, the opportunity to influence costs are reduced. We know that with respect to cost estimations in early stages, we are dependent on our knowledge about the effects of assumptions. This phenomenon is given in figure 1.

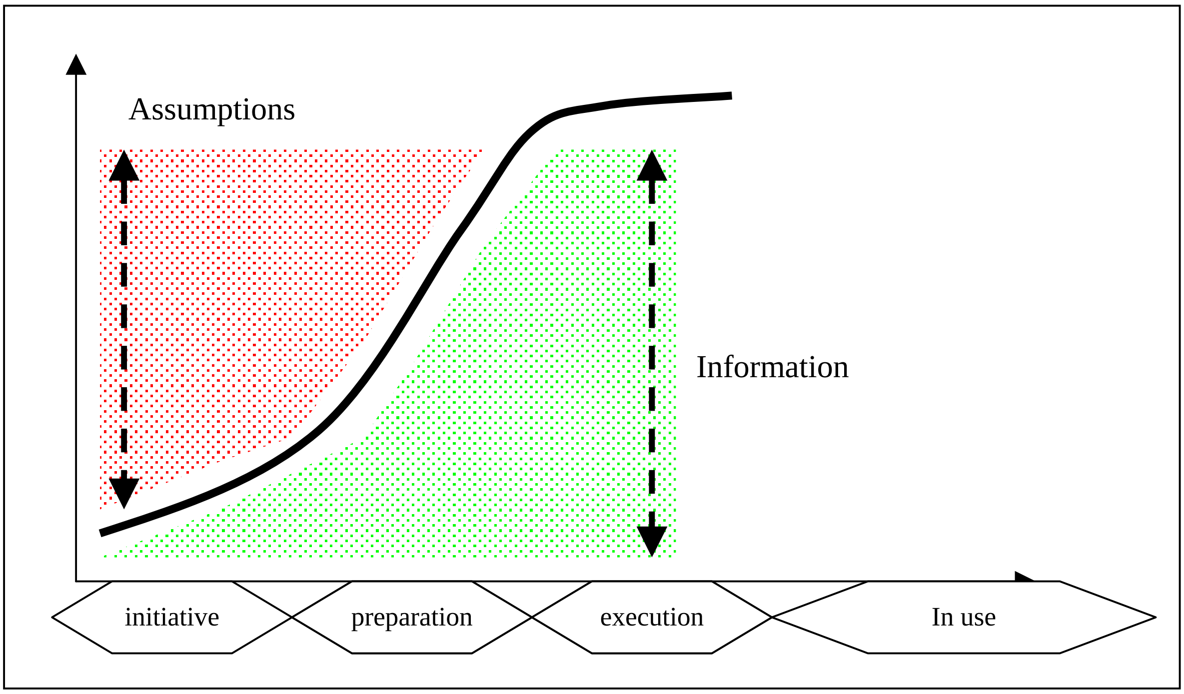

Figure 1 Information in early stages of a project

Problems and solutions
The early stages are full of problems that are well known in the briefing research.
Problems of traditional briefing include:

- Use of implicit requirements
- Inconsistent/incomplete description
- Unclear/messy testing
- Limited accessibility of underlying documents
- Solution-oriented

In order to solve the briefing problems in PPP projects where the pressure to produce explicit requirements, consistent description of demands and clarity on performance testing is high, we need new tools that allow us to browse through initial and intended, functions and requirement during the contract period. We need tools that allow us to describe output specifications as much as possible.
Two developments are interesting mentioning:

1 Following traditional cost quality research during the last 20 years a group of scientists and professional consultants started to develop models to bring more structured knowledge in the early stages (Gerritse, 2005). This resulted in the delivery of the PARAP model and in the PARAP research program (Dekker, 2005), now both part of the toolkit of the Center for People and Buildings.

4 A complete innovation for the construction industry was the PKM model, awarded 2005 with the Dutch Construction Innovation

Price. This model derived from existing modeling product design methods (ISO-Step, ECM, IOP- BIM, see www.pkmsolutions.com) was first applied in 2003/2004 in a workplace briefing project for the PPP based renovation of the Department of Finance in the Netherlands.

In the following paragraphs I will describe first the PKM model and secondly the PARAP model. The article will end with a sort discussion on the way forward.

III Product Knowledge Model (PKM)

Basics
PKM helps the end user to define requirements in a structured way. Common language, normally spoken the medium for communicating meaning in a client's brief is 'translated' into 'objects. Those objects are parts in a model that is based on three independent *dimensions* that can be interrelated (figure 2).

1 Design models for manageable information
The first dimension allows us to map information about all the aspects of a product separately. This allows us to discern between functional requirements, form requirements or specs on the use of a product. Discerning also means managing separately. Main ingredients for modeling are:

- Objects / functions
- Properties
- Relations

5 Life Cycles
The second dimension is about the different process phases where product information is generated. The meaning of information depends on the process phase. Product information can tell about:

- The requirements for the product as demanded
- The specifications for product as to design
- The specifications of the product as designed
- The specifications of the product as realized

Using this *life cycle*-as the meaning of information is guaranteed organizing the information in the order of the different phases. Central issue is the description of customer/end user information as the basis for all other information description.

6 Information levels
The third dimension offers the possibility to differentiate product information to abstract levels. Information can be part of the project, of a directorate, of a floor level, a purchasing process etc. This dimension allows creating libraries for different functions: space management, procurement, maintenance, materials etc.

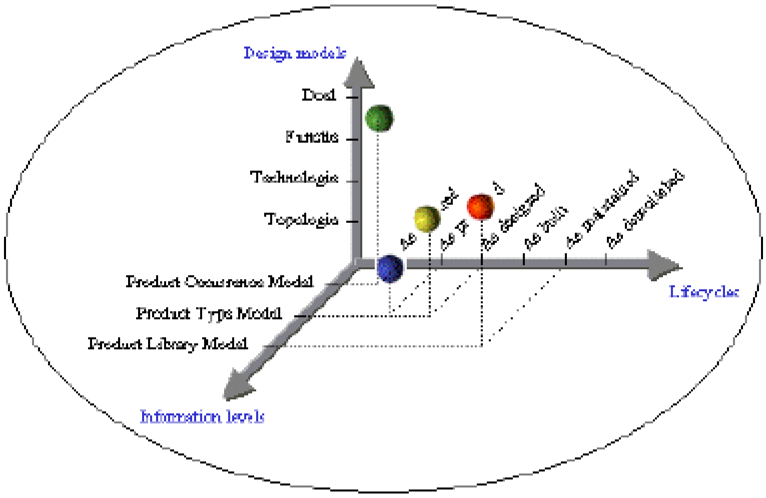

figure 2 The Three dimensions of PKM

Models
In the application for workplace modeling three basic models are used:

- Organizational model
- Building model
- Facility Management model

The Organizational model contains descriptions (properties and relations) of:

- Organizational objectives
- Activities
- Users

This model answers the question “Who is doing What and Why”. Completing this model requires explicit statements at board level about the organization, not yet the building. Often found requirements are like the following “improving communication, reducing costs, increasing efficiency, raising productivity”. Board members cannot escape from becoming more explicit when using this model. They need to be more specific because it is as with other models: ‘garbage in garbage out’. The organizational model is used for both defining requirements and for communicating them.

The Building model contains descriptions (properties and relations) of:

- Building or workplace concept
- Spaces
- Indoor climate
- Components

The Facility Management contains descriptions (properties and relations) of

- Services
- Staff

There are three support models: Definitions, Norms and Tests, each containing description that are equivalent to there names. The function is to protect from creating new semantics, or reinvent existing national standards or well functioning testing methods.

Relationships
The different models are interrelated by the description of their relationships:

- Realization relation (is realization of/is realized by)
- Requirements relation (has requirements for/holds requirements from)
- Support relation (is supported by/supports)
- Location relation (is located in/locates)
- Connection relation (is connected to/is connected to)
- Proximity relation (is in proximity of/is in proximity of)
- Assembly relation (is part of/is whole for)
- Control relation (is controlled by/controls)
- Accommodation relation (is accommodated in/accommodates

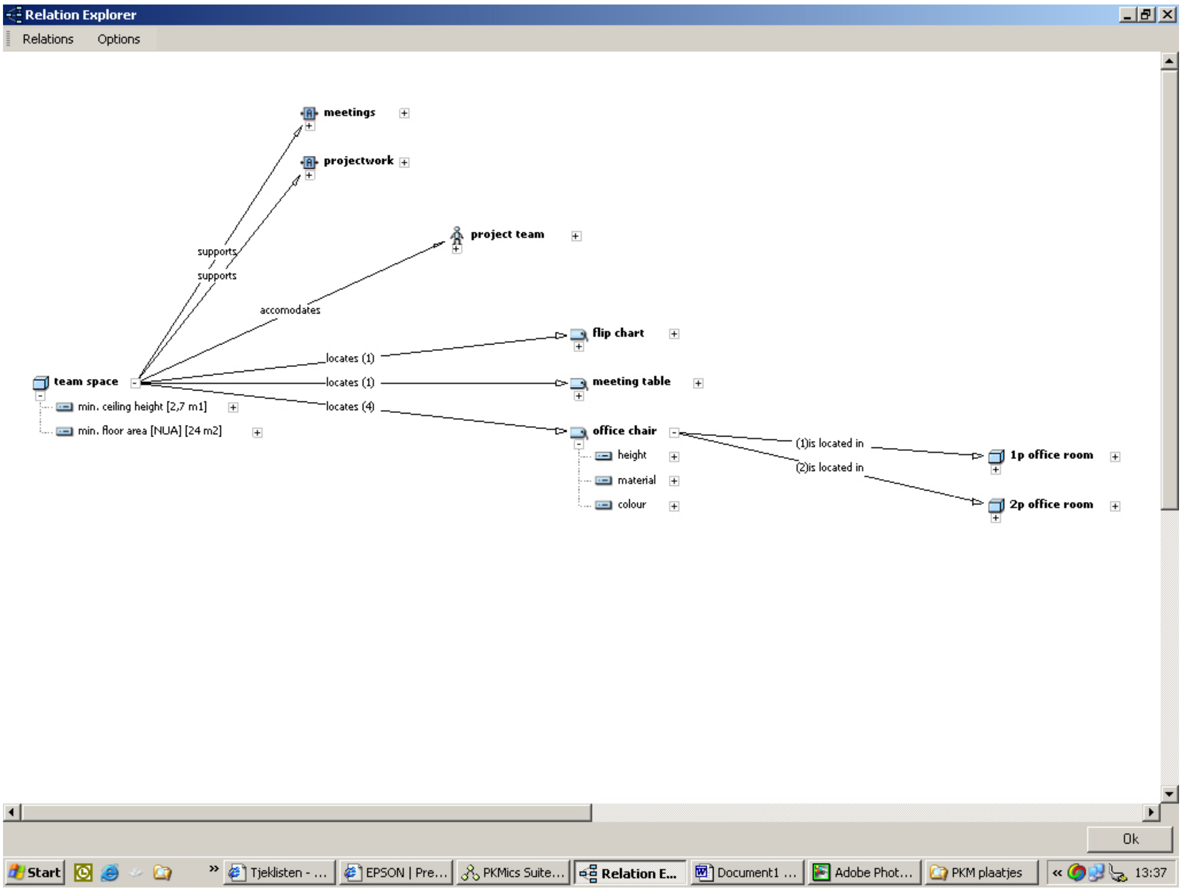

Figure 3 Example of relationships

Use of the model in practice
Using those basic dimensions and model we can start applying them in a workplace project. Here are some steps that have to be taken:

1 Defining requirements
2 Communicating requirements
3 Changing requirements

4 Testing requirements
5 Re-using requirements

De definition of performance requirements is placed somewhere between defining organizational objectives and showing reference solutions. The Nordic Five level structure gives a good understanding (figure 4)

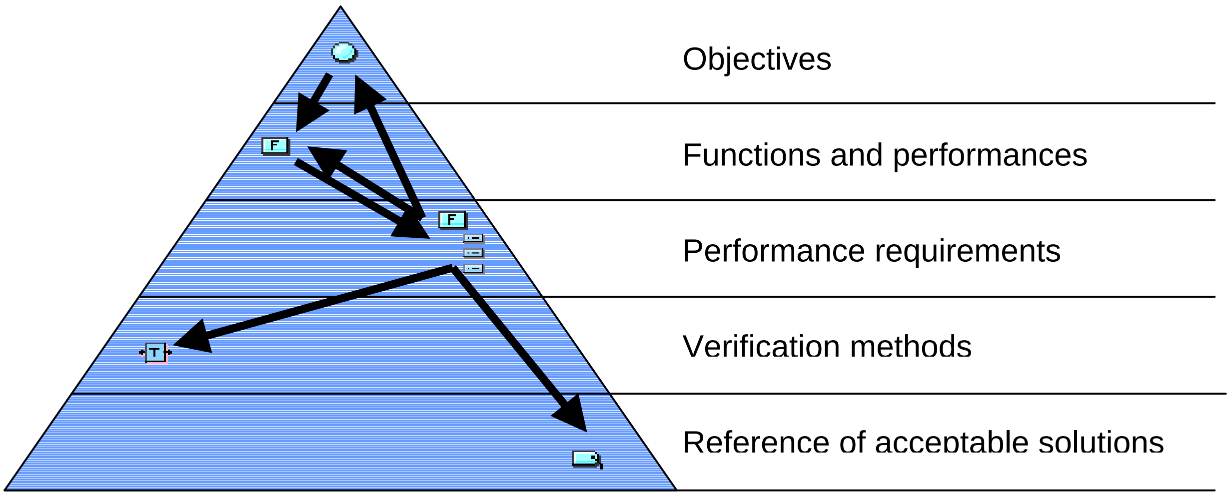

Figure 4 : Nordic Five Level Structure

Ad 1 Defining requirements;
Experience so far has taught that the input for defining requirements is usually a text document with some basic notions about requirements. Often there is no clear relationship with organizational objectives. Sometimes the objectives are vague, unspecified and not properly related to functional or technical requirements. Questions need to be asked like:

- Do all objectives have realization-relations?
- Are all specifications related to tests?
- Are all components related to functions or objectives?
- Are all spaces related to activities?
- Are all activities related to spaces?

In order to answer those questions three steps are taken

- Developing model structure (“object trees”)
- Identifying requirements (“properties”/”relations”)
- Rationalizing requirements (“validation”)

Ad 2 Communicating requirements
All information is collected in the model; the modeling techniques are digital so the communication is also through a website, accessible for those involved in the project (the client, the architect, consultants, technical support). Figure 5 shows an example:

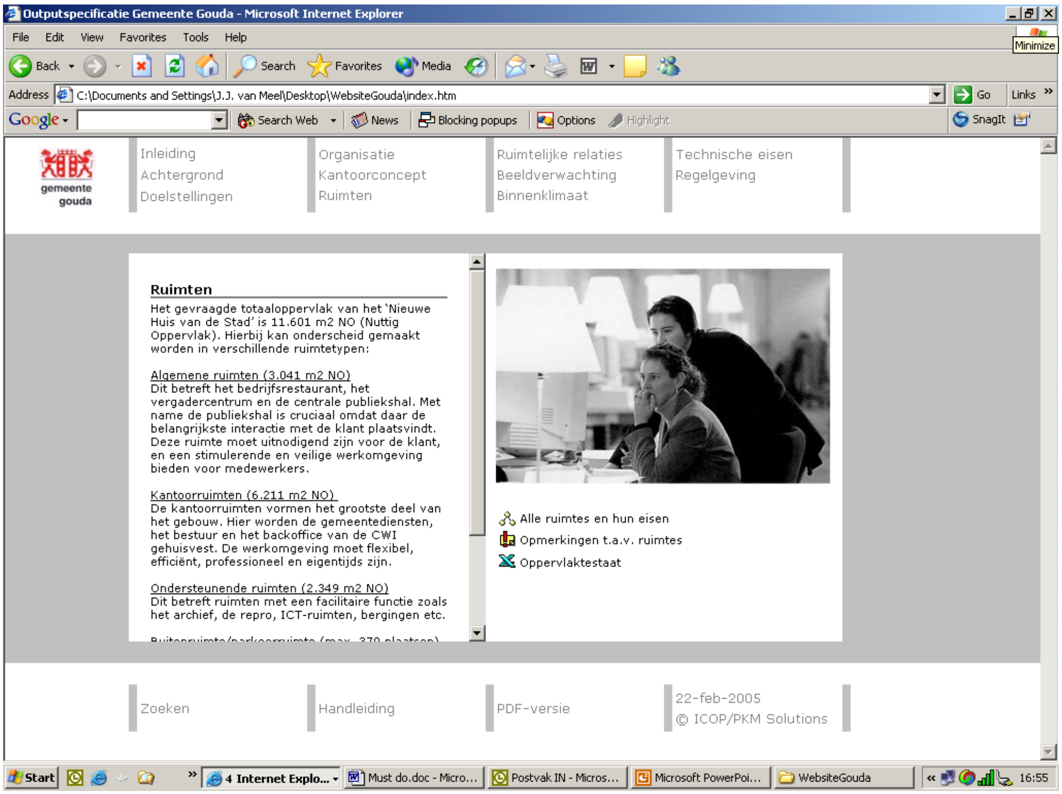

Figure 5 A dedicated project website (source ICOP, Rotterdam)

Ad 3 Changing requirements

Because life is dynamic, changes can be made in the model. We are able to Add new requirements because we want to be more detailed. We can change existing requirements. Sometimes that is necessary due to technological changes, new legislation, negotiations, …or we might want to leave out some requirements; we can use the delete function. This function is often applied during the rationalization of existing requirements.

ad 4 Testing requirements

Defining a consistent and coherent set of requirements is a important feature; but the proof of the pudding is in the eating. The client organisation needs to test wheter reuqirements are delivered.This can be done in four phases of the workplace development and eralization project:

- Tender assessment
- Design verification
- Construction verification
- Performance monitoring

Explicit testeing procedures are decribed in the support model Testing

Ad 5 Re-using requirements

From practice we know that there is a lot of copying of solutions. We might call that standardization. The knowledge gathered in the past can be reused in the future. Knowlede allwas us to build a library of standardized sets of requirements or specifications fro spatial or technical solutions. In the model those are described in a network of relations the user is always able to trace back how ‘solutions’ are derived from or linked to certain solutions.

Lessons and future developments
PKM is a new method. Therefore, it meets both enthusiasm and skepticism. Enthusiasm is based on experiences of the language problems between those who are involved in the network of actors. Thos people recognize the power of structured and coherent information, not just data. Some saying that the process to develop specifications requires too much time, show their skepticism. Another argument is that specifying requirement in this manner drives out creativity.

The second lesson is about the fear to be perfect. Since PKM is focusing on a more complete and consistent set of specifications the user might by trapped by the wish to be maximally complete in the first instance. Learning to deal with the dynamic character of the model requires sensitivity for what is going on the project context.

A third lesson is an obvious one: garbage in, garbage out. The model does not think, only a bit). It is in the discussion between users of the model that the real intelligence is shown.

PKM is using the latest digital tools; yet, people show a preference for paper. Care has to be taken on what becomes the legal base for the tendering process.

Everything can be related to everything. The questions however are what is relevant, is the knowledge available to develop more or deeper levels and finally more efforts is more time, more time is more money

Thus, the model becomes part of a cost benefit analysis in which the consideration of the trade offs is very important. The model does not make those decisions.

Future developments
PKM is introduced in the PPP projects of Dutch Government Buildings Agency. There has been pilot project with the Treasury building and now a start ha bee made with a number of new projects. In addition, individual organizations are discovering the qualities. It will take about three years to start with the cross case evaluation of the PKM model
In the mean time research will start on different questions:

- How can graphic language support the communication process without end users?
- How can lessons from end user evaluations (Post Occupancy Evaluations) enrich the development of the quality of specification or shift attention to other requirements than ever thought of before?

IV PARAP

PARAP is derived from PARAPLU (Umbrella). PARAP is a collection of cost calculation and analysis models that are placed in one system to support decision-making in the early briefing or design stages. It allows the user to track the development of costs, based on advanced modeling techniques relating briefing and design decisions to a calculated reference building. It helps to understand the influences and outcomes of different design options, varying the number of FTE to be accommodated in a building, the space plan and building structure, the quality levels of building materials used of installation types.
PARAP stands in a long tradition of building related cost quality studies in the Netherlands for office buildings, schools and correctional services (prisons). The cost model that calculates building investment costs is available, this model allows the user also to calculate the environmental costs. Under construction are two modules on life cycle costs and one on renovation.
.
The main reason for the development of the toolkit is the need to be able to guide the decision making process in early stages of a workplace project. The need to be able to study the outcomes of different decisions is part of a bigger argument in management. This is about the availability and reliability of information. Depending on the management perspective or the focus of the dialogue where the information is needed, the model should be able to provide the ‘correct language’ this could be either clear cut costs, or the effects on CO2 production, or the effects of choices for a certain occupancy rate or building quality as a part of HR policy. This should be so even when no architectural sketch is available. Having said this it is clear that some assumptions are made when creating and when using the model.

Background of the model
In early stages, the influence on cost outcomes is big. The available information is the only source for calculating cost-outcomes. If we want to manage costs, we need to manage qualities as well. Managing cost and qualities is done in the marketplace where prices differ from costs. One problem is that during the course of a project the different indicators are used e.g. functional indicators like cost per employee or per workstation, or cost per m2 or costs for materials, labor etc. To calculate building investment costs in early stage we do not have much information on amounts of materials available, actually none. Therefore, assumptions have to be made based on the evaluation of reference projects en model studies.

As said before, the PARAP model has its roots in a long tradition of cost quality studies. Benefits have been enormous. Model studies of prisons in the early nineties have reduced construction budgets per prison by 40% (Gerritse, 2005). The structured and systematic evaluation of numerous building taught what the major cost generating factors are:

- Space use: the amount of space in a building
- Building form: number of stories, number of interior spaces, percentage of inbuilt spaces
- Quality level of requirements

The knowledge of these factors and their interdependences formed the basis for the PARAP. Mathematical techniques are used in the modeling process to represent the relations between numerous independent and well-defined variables that make up the three cost generating factors.

The model
The model communicates with the user in an interface for input and output. Basic input parameters are five:

- Number of person expressed in FTE
- Location type (two different: (a) underground and (b) amount of space available for parking. A CBD location usually has limited parking space.
- Type of building: head office or regional office. In the reference values of a building type, this leads to different installation types.
- Basement: yes or no
- Number of stories. The model can calculate the number of stories base on the criterion of minimal costs

A differentiation in the number of FTE is possible: fulltime workers, part time workers and guest workers; also the amount of people that require an enclosed office can be put in. In order to enhance desk sharing a sharing factor can be added.
The input parameters lead to calculation of Net floor area for office space based on generic space standards. Additional functions for meeting rooms, space for filing, restaurant and storage (etc) are calculated by algorithms derived from national space standards and realized buildings. Refining of input is possible. There could be reasons why the user wants to leave out certain spaces e.g. the restaurant, or make change in the size of spaces: less archives and filing because of digital storage etc.

Building characteristics can be added or left out like transport areas, number of staircases. Based on geometrical algorithms the model calculates gross floor area, the m2 in the façade and in the roof, the amount of elevators and spaces for technical installations.

Base on the initial values for location factors the model suggests whether parking will be part of the building (basement of not), it makes a choice for a type of foundation. Again, changes to the calculated values can be made manually.

The first calculation for investment costs can be made using default values for the quality level. In the support model Construction of each of the building elements a unit prices is calculated bases on the costs for material, labor, equipment and the work which is necessary and done by subcontractors.

In the sub model, Installation prices are calculated for 9 different mechanical and electrical installation systems that might be part of the building.

The user is able to make detailed choices for the quality of the building by resetting the default value for building elements and the installations.

Fixed interior elements like those of sanitary spaces, and installations necessary for maintenance are separately calculated.

Now the values of basic input criteria are chosen the model Calculation generates an investment cost budget, which can be presented at three levels each according to (aggregated) definitions of the national standards:

- The building as a whole
- Clusters of elements (e.g. façade, construction, installations, roof
- Individual building elements (e.g. different load bearing elements.

How to use
Now being able to create output on the basic of decisions of input factors the model starts doing it's work: make studies of alternative options by picking different input factors that resemble the practical choices in the workplace project.

An example:
You are starting an inquiry for your organization to accommodate 280 FTE and you have a number of options:

- A secondary location in Delft that allows to built a construction in four stories.
- A CBD location in The Hague allowing to built12 stories
- There is also an existing building in Delft having 7 stories and 8700 m2 gross floor area.

You can calculate the difference in size of the building (4 story building: 8533 m2GFO, 12 story building 9096 m2 GFO and the existing 8700 m2GFO) and building investment costs.
However, you want to know more. What is the difference in investment costs when we choose to build a parking garage in the basement? Now the model can calculate the difference based on the knowledge of different underground causing higher cost for a soft underground.

The same applies to differentiation in the information about the organization. We know that out of the 280 FTE we have 180 fulltime jobs and 200 part-timers. This will cause an increase in the number of workstations by 10%. Floor area will go in GFO from 8533 to 9111m2. Considering the cost effects of this increase the decision makers may find the increase unacceptable and decide to introduce a desk sharing policy. To do so the number of one-person rooms is reduced leading to a workplace reduction of 14% and a GFO of 7410m2. As a compensation of desk sharing the decision maker expects an increase in the demand for meeting rooms, break out areas and a bigger library. All these changes can be added manually. The consequences for the GFO may differ depending on de amount of space added for those functions. Yet, we are still working in the model with the 4 floors.
All the effects of the changes in functional requirements can be shown as different outcomes for the building investment costs. In the same way, one can change building characteristics and technical quality levels.

In summary:
Based on input parameters the model pinpoints an organizational model and a building model. All dimensions that are necessary to calculate cost are interrelated and counted consistently. Depending on those dimensions the model calculates the budget.

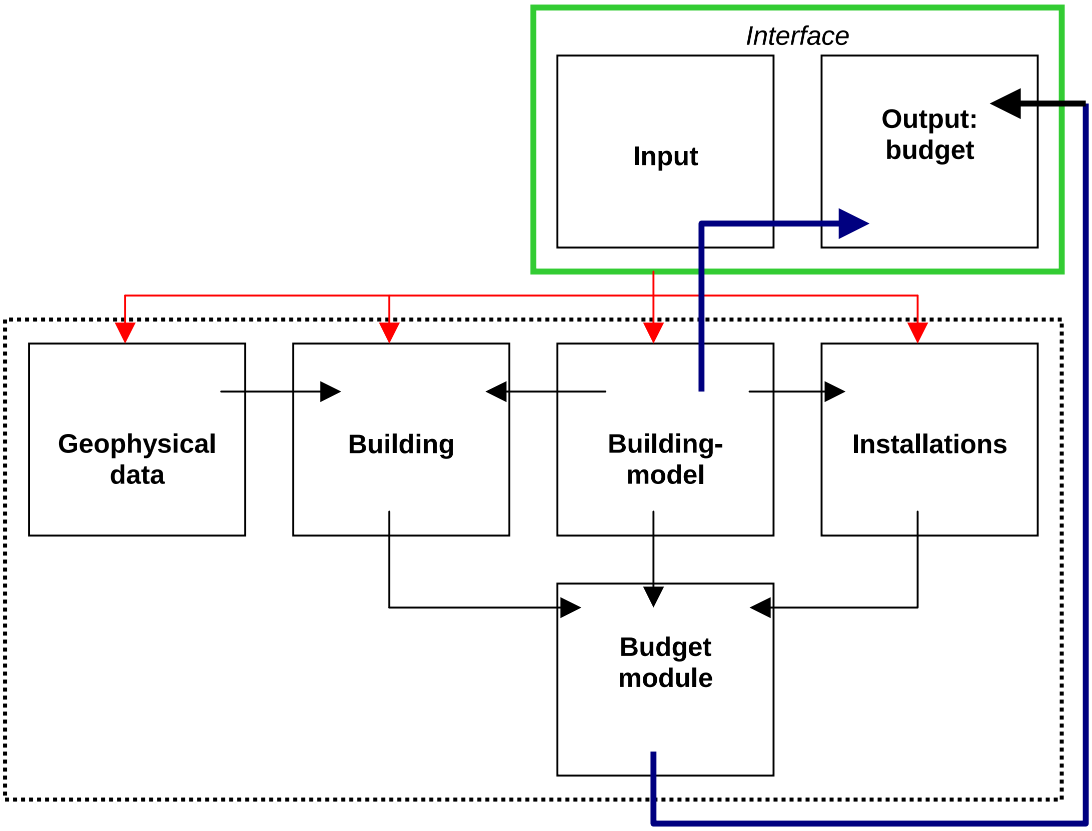

Figure 6 PARAP model

V Discussion

Decision-making under uncertainty is the central theme when we develop workplace projects with the PPP mechanism. The contract time is very long and no one knows what will happen. Usually decision makers deal with this by demanding flexibility, both in the building delivered as in the contracts. We adopt Volberda's definition (Volberda, 2004) on flexibility that is "the ability to deal with strategic surprises".
Methods and models can help. Either to create an *organizational memory*: "why did we decide for this, what were the underlying assumptions, what where the objectives, what were the organizational choices? Or as is characteristic to models "to *play* with different assumptions". Models still do not predict the future with a 100% result. The real flexibility is a human gift. It is in the mind of people to understand the input and to understand the output. To use the methods and models to its fullest extent decision makers need to

be aware of the traditional behavior when deciding in risky situations. In behavioral economics, a lot is research on these issues. Famous is the work done by Tversky and Kahnemann(1979), teaching us how people behave risk avers and what the importance is how the decision to be taken is formulated. Awareness of this behavior is a big gain. Dealing effectively requires a mind shift and a behavioral shift and it requires teaching and training. At Delft University future generation of construction, real estate and facilities managers are educated and trained using briefing methods and calculation model. However, when in business in practice, students seem to forget the value of applying of those models. With the long-term contract period of PPP projects in mind, it is interesting to see how the contracting parties are urgently looking for methods and models to prepare good contracts. The slogan “ if you fail to prepare, be prepared to fail” is applicable. Failure in the context of PPP can be described as the consequence for the taxpayer in the long term. The taxpayers of the future are our children. It is an obligation of intergenerational solidarity to them to make the proper decisions today.

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