A requirements specification of an information system to support planned and unplanned use of shared meeting rooms

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Master Thesis

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Management Summary

This report describes the research done for the school of Management and Governance at the University of Twente. The goal of this research is to provide recommendations for the key requirements specification of an information system that supports planned and unplanned use of the shared meeting rooms at the Ravelijn building, by employees and students of the school of Management and Governance. This report describes how the research has been performed as well as the results obtained.

Research lens choice

We have chosen to perform this research using Commons literature as a research lens. The reason for this choice is as follows: during the research setup we were discussing in which direction to take this research. The problem was that at that point in time, the school of management and Governance was still housed in the old building, where the way meeting rooms were shared was very different on two points: students were not allowed to use the rooms and employees had larger offices in which they could hold meetings. Therefore we assumed that the need for those rooms in the old building was simply less critical than in the new situation, where both students and employees use the rooms, and the building is designed in such a way (smaller offices) that use of the shared meeting rooms is promoted. This means that the new situation places different demands on the system than the old system. As we wanted the requirements for the new system to minimize pitfalls that might reduce the usability of the system, we started looking for best practices in literature. From this preliminary research we found an interesting set of theories: Commons theories. These theories provide insight in how shared resources can be successfully managed, and what typical processes occur in those successful settings. We reason that the Commons literature therefore can provide us with a useful context to deliver recommendations for requirements specifications for the information system.

The shared meeting rooms can be categorized as a Commons; they fulfill the a) low excludability and b) highly subtractability characteristics that define Common-pool resources. Firstly, the shared meeting rooms can be used by anyone; the policy of the school of Management and Governance is that the shared meeting rooms should be available to all students and employees to use (it is therefore hard to exclude an individual from using the rooms). Secondly, when an individual uses a shared meeting room, it is unavailable for another individual to use (high subtractability).

Current situation – Part I

There are different processes that are relevant for the information system: reservation, the process of actual use of the shared meeting rooms, and the management information related process of monitoring. The technology used to handle reservations is: a desktop computer at reception desk with Outlook installed, with a separate agenda for each room. The communication infrastructure consists of a telephone network, e-mail and face to face communication. Other technology related to room reservations, available at the University Twente is: ZBS, Planon and Syllabus Plus.

Problems identified

We have identified a number of problems in the current situation that need to be solved in order to let the current situation be able to support both planned and unplanned use of the shared meeting rooms. We have based these problems upon interviews with stakeholders, observations and problems found in Commons literature. We have identified four main categories of problems:

- Current role of the information system is not suitable to record both planned and unplanned use of the shared meeting rooms)
- Information in the reservation database is not up to date and not necessarily congruent with the real world
- Reservation process is cumbersome for employees
- Reduced efficiency in supply of resource

These problems are caused by the root problems, which can be seen in the table below:

- Cancellations are not communicated to reception
- Reservation swaps by secretaries are generally not communicated to Reception
- Contact information of the reservee is not consistently stored in the database
- Room designation changes are handled in such a way that reservations are lost.
- No-Shows are not recorded in the system
- Meetings that take extra time (or less time) are not recorded into the system
- Functional Beneficiaries can only access reservation information / room availability via reception, they cannot quickly access this information themselves
- No digital confirmation is sent to reservee of room
- Unplanned use of the shared meeting rooms is not recorded in the Outlook Agenda
- Functional Beneficiaries cannot reserve rooms in the Outlook system themselves
- Extra facilities for a meeting have to be reserved separately.
- Functional Beneficiary: Reception is not always available when trying to make a reservation
- Monitoring process is done not often enough to provide information that may help reduce collective action problems
- Ineffective institute to regulate behavior

Best practices

To solve the problems discussed above we have looked at Commons theories, best practices for relevant ICT system in the market and have interviewed stakeholders with regard to wishes for the future system.

Commons

Firstly, we have looked at Commons literature to identify three levels of analysis, operational, collective choice and constitutional choice. For each of these levels we have identified the elements that are relevant from an information system perspective: relevant actors, processes and artifacts.

The operational level is about the actions of individuals that directly affect the physical world. [Ost90] The collective choice level defines the rules that are used in the operational level; for example the do's and don'ts with regard to appropriation or provision). [Ost08] The constitutional choice level is about defining the rules for the collective choice level. [Ost08] These collective choice level rules then in turn help define the operational choice levels. What can be done at a higher level will depend on the capabilities and limits of the rules at that level and at a deeper level. [Ost08] We also have chosen to slightly deviate from the typology of the three levels of analysis as it allows for a more logical categorization of certain actor roles (monitor, enforcer, and arbiter). We use these actors, processes and artifacts as a basis for the processes our information system is going to support.

Secondly, we have discussed best practices for Commons, i.e. those factors that allow Commons to endure over longer periods of time. We have used the Design principles as proposed by Ostrom [Ost90]. These principles are: Clearly defined boundaries, Congruence between appropriation and local conditions, Collective choice arrangements, Monitoring, Graduated sanctions, Conflict-resolution mechanism, Minimal recognition of rights to organize, and for Common-pool resources that are part of larger systems: Nested Enterprises.

The design principles are relevant for our Information system in two ways, first of all any insights in new processes or actors or artifacts have been included in our analysis of the actors, processes and artifacts that we will use as a basis for the IT requirements. Secondly, the design principles make clear that organizational changes are required as well: the school of Management and Governance needs to think about the implementation of the collective choice arrangement and operational rules used.

Best practices ICT systems

To further improve our knowledge base for the desired information system, we have looked at best practices for relevant ICT systems in the market. We have studied three cases: Spitsmijden, Microsoft and ROC Friese Poort. The first case is Spitsmijden where we see a Commons situation that uses technology to monitor the use of appropriators in a Commons. The second case is ROC Friese Poort where we see the application of monitoring technology in a school of environment to handle the unplanned use of meeting rooms. The third case is Microsoft where we see how this company has arranged for its employees to reserve rooms in their office near Schiphol.

From Spitsmijden we have learned that ICT-enabled monitoring is useful for infrastructure Commons (the same Commons category as the shared meeting rooms at Ravelijn), even when there are high introduction costs involved, because the resource units are non-storable and mobile for Spitsmijden. Furthermore, Spitsmijden also has shown that rewards are useful to use to promote wanted behavior. This information can be used for the requirements of the information system as an addition to the graduated sanctions design principle from Ostrom [Ost90].

ROC Friese Poort has shown us that monitoring technology for unplanned use can consist of using the lighting system to identify whether someone is in a room or not. This allows the system to know whether a room is in use, without the user having to do anything. In turn, the accuracy with regard to room availability of the system improves, and makes the system more valuable for the people at the school.

Microsoft is the third case we have researched. The Microsoft room reservation system is part of a larger service called the hospitality team. The hospitality team takes care of all facilities for their employees and any guests they may have (ranging from Wi-Fi, to parking passes, to catering). Microsoft has decided to functionally split up rooms in two categories: rooms that can be reserved, and rooms that are meant for unplanned use. The rooms that can be reserved are reserved via the hospitality team, and are also meant for more formal meetings (hence the hospitality team). Each of those meeting rooms has a wall-mounted display near the room to show people the reservations for that day, Outlook and an exchange server is used to record the room reservations. The rooms for unplanned use have no dedicated information system; people have to physically walk by the room to see whether it is available.

Current situation Pt. 2

After we had researched the Commons best practices we needed to revisit the current situation, as a number of new processes were identified that we needed to further investigate, to get a better feel of the requirements for the new Information system.

We see that on an operational level the monitoring processes, enforcement processes and arbitration processes are at most informally available. This is understandable as there is no policy with regard to management of the resource as a Commons (that is to reduce problems of overuse or waste of resources). Therefore the first step for the school of Management and Governance should be to improve upon the first three Commons best practices: better define the boundaries of the resource, improve monitoring and then improve the congruence between appropriation and provision. In other words, management should first know what the resource is, and who the users are. Then the information system should support the monitoring of the usage of those users. Finally, while the right monitoring information is being generated, management of the school of Management and Governance should implement a collective choice arrangement to design better operational rules to reduce the problems of overuse and waste of resource.

Stakeholder wishes

We have interviewed various stakeholders as identified in chapter 3. During the interviews with the various stakeholders, reception desk, employees, students, and management, we also discussed the wishes each stakeholder has for the system. The main points from this analysis is that secretaries, employees and students all would like to be able to access the room reservations themselves, as well as be able to reserve rooms themselves. Interestingly, reception desk was satisfied with the way of working, and had no desires for the future. This may be because we have done this interview at the previous building, where only 250 employees used four rooms, instead of nearly 1,600 people using 30 rooms. The change in workload may have been hard to anticipate for reception desk.

Finally management is interested in getting better insight in the actual usage of rooms. He also finds it very important that the system should fit the way of working of the people at the faculty. He would rather have a lower occupancy rate and an improvement of the employee satisfaction than a lot of stress and a high absenteeism [Sch10]

Recommendations

Our study resulted in the following key requirements based on Commons theory, best practices ICT systems and stakeholder interviews. First of all the system consists of two parts: an organizational part and ICT part. For the organization we recommend that:

Organizational requirements

Org R1. School of Management and Governance must resolve differences between Facilitair Bedrijf' policy and internal Policy.
Org R2. Appropriation must be fair for the individuals involved
Org R3. The school of Management and Governance must implement a formal collective choice arrangement to prescribe, invoke, evaluate and apply the operational rules.
Org R4. the school of Management must improve monitoring
Org R5. Graduated Sanctions must be implemented to enforce operational rules
Org R6. Conflict resolution mechanism must be implemented

By following these requirements we expect that the school of Management and Governance can improve the efficiency in supply of the resource, in turn allowing for better planned and unplanned use of the shared meeting rooms. We also propose a set of operational rules to improve monitoring and reduction of waste of resources through no-shows, see table 14 and 15.

ICT requirements

We provide the requirements of the ICT system in the following form: functional requirements (what should the system do), nonfunctional requirements (warrant the usability of the system), suggested technology to support use of the system.

Functional requirements

For the actual ICT system we recommend that it should support the following functionality, which we provide in depth descriptions of in chapter 8.

ICT R1. View room availability
ICT R2. Check in (let the system know that you are using the room)
ICT R3. Reserve a room
ICT R4. Check out (free up the room in the system for other people to use)
ICT R5. Monitoring of usage (no-shows, record of no check in, record of no check out)
ICT R6. Enforcement of operational rules (notification of rule violation to enforcer)
ICT R7. Management information (usage, and information about the effectiveness of the operational

rules)
ICT R8. Report conflict by student or employee to reception desk

Additionally the system should support the following functionality:

ICT R9. An ICT administrator should be able to add, delete, remove users, and set user rights
ICT R10. The ICT system should support a link to Radius in order to let the UT wide user credentials to be used as log-in credentials for the ICT system.
ICT R11. The ICT system should support creation, editing and removal of an operational rule.

Suggested Technology

A. Wall Mounted tablet for each of the 36 shared meeting rooms, linked to the system, displaying room information, and supporting check-in functionality.
B. Movement sensor in each shared meeting room, linked to the reservation system to monitor actual usage of that room. This allows the system to detect the presence of possible free-riders
C. Support of mobile devices such as smart phones and tablets to reserve rooms. This makes it easier for people to reserve rooms.
D. A separate computer near reception for people to see which rooms are available, where their meeting is, and to reserve a room. This makes it easier for authorized appropriators without reservation rights, currently students, to see which rooms are available without having to ask reception desk. Reception desk can still have a degree of control, as they can see the computer and see which students make use of the computer.

Quality Requirements

Q R1. The system should contain up to date (within 5 minutes) information about the status of reservation rooms. This requirement ensures that the system is actually useable with regard to unplanned meetings, where it is important to be able to quickly find rooms. We have chosen to use a five minute window.
Q R2. The system should be available both during and outside office hours to people who want to reserve shared meeting rooms
Q R3. The system should be perceived as usable by MB employees and students

Preface

Without a doubt, performing this research and writing this thesis have made it to the number one spot of my top three of “most proud to have achieved” (the other two being, losing 30 kilograms of weight and having been part of development of the, unfortunately no longer existing, website i-dance.com). I wish to thank everyone who I met, worked with, and who has inspired me in the last three years. In no particular order:

Jos en Pascal, thank you for the opportunity to learn from you and the patience you have shown me throughout the project.

Frank, thank you for your critical insights. I did not always enjoy hearing them, but in retrospect they were just what I needed.

Ton, I have really enjoyed our talks and learning from you; always making sure to keep in mind that the subjectieve beleving is a positive one. Thank you!

Lucas, Robin and Esther, thank you for the great time in room 304. Lucas, thank you for helping me in capturing concepts that I found difficult to grasp alone.

To my family: Baaf, Birgitta, Annemiek and Reijer: thank you for always supporting me and helping me through the rough patches of this research!

To Zerko, man, a great big thanks to you. Let’s make sure we keep playing urban games for the rest of our lives.

To Chris, Oni, Chris2 and Rob, thank you for taking the time and providing me with insights, and nudging me in the right direction when it needed to be.

To Jeroen, thank you for the support you’ve given me and the effort you’ve spent reviewing my thesis.

To Bernadet, thank you for making me feel calm and in control during the more difficult parts of writing my thesis. I feel lucky to have made the last part of this journey together with you.

To everyone else, thank you for your insights with regard to the shared rooms and the time you’ve freed up to help with this research.

I hope you enjoy this thesis,

Matthijs

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1 Introduction

This report describes the research done for management of the school of Management and Governance at University of Twente. The goal of this research is to provide recommendations for the requirements specification of an information system that supports planned and unplanned use of the shared meeting rooms at the Ravelijn building by employees and students of the school of Management and Governance. This report describes how the research has been performed as well as the results obtained. [1]

Our report is structured as follows. In chapter 2 we discuss the goals and approach of the research itself. Chapter 3 provides a discussion of the stakeholder analysis. Chapter 4 discusses the current situation with regard to the shared meeting rooms. Chapter 5 discusses the problems experienced by stakeholders and found in literature. Chapter 6 discusses the desired components of a requirements system that aims to support dynamic use of shared meeting rooms, based upon best practices from experts and literature. In chapter 7 we present the second part of the current situation, where we approach the the school of Management and Governance from a Commons perspective. In chapter 8 we provide the stakeholder wishes and requirements specification, which is based upon the results in the previous chapters. Chapter 9 discusses the validation process and results of the design process and research. Finally, chapter 10 provides conclusions about the research performed, including limitations and suggestions for future research.

1.1 Faculty Management and Governance at University Twente

In this chapter we introduce the school of Management and Governance at University Twente, the organization for which our research has been performed. We also introduce the object of research: the faculty owned shared meeting rooms in the Ravelijn building at the University campus.

In 2009 the school of Management and Governance (MB) of University of Twente (UT) finalized the plans to move into a new building at the UT campus. After the fire in 2002 the faculty had been scattered throughout the campus, separating students from their professors. The new building, Ravelijn, brings the faculty together again; there is space allocated for both employees doing research as well as the education of the students. Ravelijn has been built with a specific philosophy in mind: a flexible organization in a flexible building; where people are motivated to meet each other and be part of a stimulating learn-, live- and work environment. [PvE06]

In order to realize this philosophy of flexibility, Ravelijn offers thirty six meeting rooms that are available to both employees and students, free of charge. The rationale behind this setup is that by having smaller offices, most of them without conference tables, employees are motivated to meet in meeting rooms rather than in their own offices. These shared meeting rooms can be divided up into several different types of rooms based upon size, shown below in Table 1.

[1] As a general note, to improve readability of the text we use the term him and he as an abbreviation of him or her and he or she respectively .

Type	Size (in persons)	Number of rooms	Other notable characteristics
Oval VIP Room	40	1	Can only be reserved for VIP worthy events
Meeting room A	16	2	One of these rooms has a video conferencing set up
Meeting room B	8	21	
Meeting room C	6	11	
Meeting room D	5	1	

Table 1 Specification of the shared meeting room pool at Ravelijn

Currently Outlook Calendar is used to record reservations of these shared meeting rooms; however management of the school of Management and Governance is not satisfied with the way this system currently works, they feel the system does not provide support for the desired organizational flexibility.

Unplanned or last-minute meetings are common practice at Ravelijn. For example, a student drops by a professor to seek advice, or, an employee uses a shared meeting room to make a phone call in a quieter environment. In both situations, a shared meeting with is a useful place to have such a meeting in. Generally the people using the shared meeting rooms for unplanned meetings do not reserve the room for that meeting via reception; they simply go sit in the room if it is available. The unplanned meetings are not monitored or recorded, resulting in a discrepancy between the information stored in the Outlook Calendar and the real world. Management wants an information system that supports both in-advance bookings and last-minute use of the meeting rooms, supporting the philosophy of a flexible organization in a flexible building.

At the time this research was started, no simple practical solution existed for the needs, as discussed above, of MB management. Therefore we have performed research to provide management with recommendations for a set of requirements for an information system that is able to better support the desired organizational flexibility of using the rooms in both planned and unplanned ways. In the next chapter we discuss the specific approach taken to this research.

2 Research approach

This chapter describes the details of the research performed. First of all we discuss the reasoning behind the chosen research lens. Next we discuss the objectives of the research. Thirdly, we provide the main research questions and the sub research questions that help to answer the main question. Fourthly, we discuss the approach taken to the research. Finally we provide the scope of this research.

2.1 Research Lens choice

We have chosen to perform this research using Commons literature as a research lens. The reason for this choice is as follows: during the research setup we were discussing in which direction to take this research. The problem was that at that point in time, the school of management and Governance was still housed in the old building, where the way the shared meeting rooms was very different on two points: students were not allowed to use the rooms and employees had larger offices in which they could hold meetings. Therefore we assumed that the need for those rooms in the old building was simply less critical than in the new situation, where both students and employees use the rooms, and the building is designed in such a way (smaller offices) that use of the shared meeting rooms is promoted. This means that the new situation places different demands on the system than the old system. Now as we wanted the requirements for the new system to minimize pitfalls that might reduce the usability of the system, we started looking for best practices in literature. From this preliminary research we found an interesting set of theories: Commons theories.

Commons theory stems from a classic problem discussed by Hardin, called the tragedy of the Commons. In a nutshell the tragedy of the Commons is about how a resource that is shared by a group of people is vulnerable to enclosure, overuse and social dilemmas. We discuss this classical problem in more detail in Chapter 6. The main issue in this dilemma as proposed by Hardin is that each individual is motivated to selfishly use the resource, as the gains are entirely for that individual, while the costs are shared between all the individuals who contribute to maintaining the resource. As these goods are easily accessible, it is difficult to exclude people from using that resource [Har68]. This leads to two problems: overuse and free-riders, as well as other collective action problems. We discuss the collective action problems in more detail in chapter 5. The point is that overuse, free-riders and other collective action problems can pose serious issues for the perceived usefulness (and sustainability) of Commons resources.

The shared meeting rooms at Ravelijn can be considered a Common good, as they possess two important characteristics: it is difficult to exclude people from using the shared meeting rooms, and the use of the shared meeting rooms is subtractable (when one person uses a room, it is no longer available to another individual to use). We discuss these two characteristics in more detail in chapter 6.

Therefore we approach the shared meeting rooms in Ravelijn as a Common good, which means that the resource is susceptible to the same kind of problems as the situation in the Tragedy of the Commons (and might actually already be under the influence of such problems). Therefore we have chosen to use Commons theory as a basis to find best practices in creating and maintaining Commons that minimize/solve the problems of enclosure, overuse and social dilemmas. Secondly, we apply the lessons learned from the Commons domain to our situation, and use these best practices as a basis for the

requirements of the desired information system by the management of the school of Management and Governance. By combining best practices, stakeholder wishes and insights from commons theory, our requirements will are likely to be able to handle the collective action problem of meeting room reservations.

2.2 Objectives

The objective of this research is to design key requirements of an information system that support both planned and unplanned use of the shared meeting rooms in Ravelijn. We have performed this research for the school of Management and Governance by making explicit the factors that currently limit planned and unplanned use of the shared meeting rooms, create insight in the desired components and confront the current and desired situation to create a set of key requirements for the information system.

To this purpose we perform a stakeholder analysis, study best practices in the market and analyze Commons literature.

This objective statement described above can be schematically seen in the research model, Figure 1. The approach discussed by Verschuren and Doorewaard to develop a research model has been used in this research. [Ver98] The benefit of a research model is that it gives a global oversight of the goal of the research and the steps needed to achieve that goal [Ver98]. The research model has been revisited several times during the research due to a better delineation of the scope.

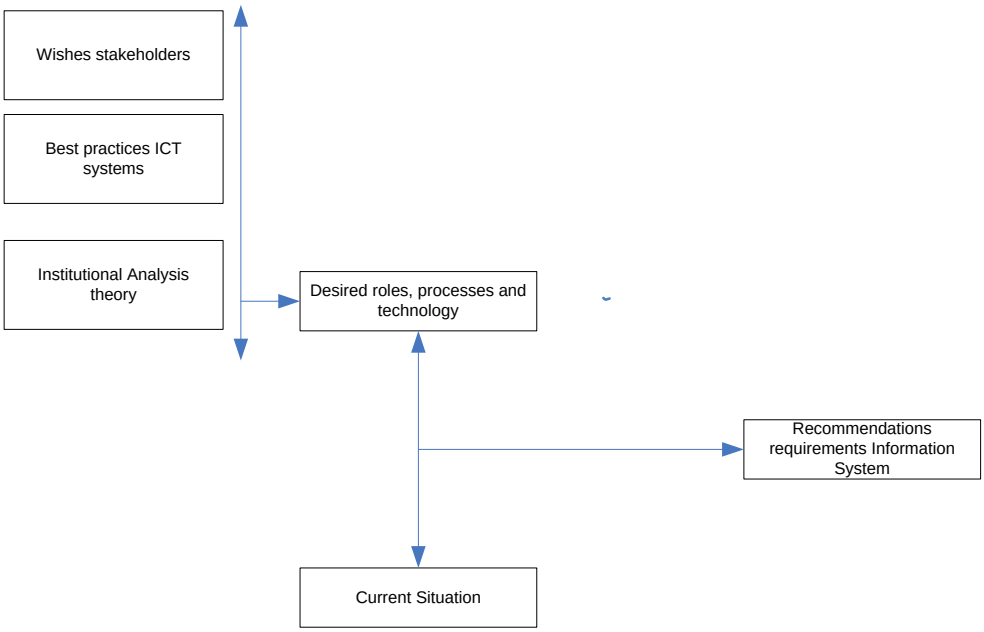

Figure 2 Research Model

For this research we have made the choice to approach the desired situation not purely as a computer-based information system, but rather take a broader approach, by investigating the requirements for an information system. The difference is that an information system is defined as interrelated components working together to collect, process, store, and disseminate information to support decision making, coordination, control, analysis and visualization in an organization [Lau02]. A computer-based information system (CBIS) is an information system that relies on computer hardware and software for processing and disseminating information [Lau02]. The difference is that an information system does not necessarily uses computers, while a CBIS system does. This means that our recommendations are not limited to an ICT system but includes other components, such as people roles and processes that need to be present in the organization as well. The reason is that we think that the desired situation of flexibility does not merely come from only a new ICT system, but needs changes in the way people currently interact with the rooms as well (organizational changes). We discuss these problems, their causes and consequences in more detail in chapter 5.

2.3 Research Questions

In this section we discuss the problem statement and the research questions. Based upon the objective discussed in the previous section the following problem statement has been defined:

What are the requirements for an information system to support planned and unplanned use of the MB owned shared meeting rooms in Ravelijn?

According to Wieringa and Heerkens this problem statement is a world problem as the purpose of this problem statement is to change the world. [HW06] That is, MB management is interested in a set of requirements to develop or buy (and implement) an IT system. The consequence of a problem being a world or a knowledge problem is the approach on how to solve the problem. Practical problems can be solved through the engineering cycle, while knowledge problems require research. [WH06]

In order to help solve the problem statement the following knowledge questions have been defined:

1. Who are the stakeholders for this project?
2. What is the current situation with regard to use and monitoring of usage of shared meeting rooms at MB?

3. What are the problems in the current situation that prevent the information system to support planned and unplanned use of the resource?
    a. What are the problems according to stakeholders?
    b. What are the problems found during observations?
    c. What problems can be found in institutional analysis literature?

4. What are the desired roles, processes and technology for an information system to support planned and unplanned use of the shared meeting rooms?
    a. What best practices for information systems to support use of a shared resource can be learned from Institutional analysis literature?
    b. What are the best practices in the market with regard to comparable information systems?
    c. What are the wishes of stakeholders with regard to use of shared meeting rooms?

5. What actors, processes and artifacts should be put in place within the current situation, taking the Commons framework as a reference?
6. How well does the organization in the current situation score with regard to current application of the identified best practices for Commons?

2.4 Research approach

There are three typical kinds of projects, each has a different approach [OF04], and these are: mathematical research project, a design research project and an empirical research project. A mathematical research project's goal is to define hypotheses and proving the theorems. A design research project's goal is to create a specification or prototype that can be tested, based on a problem definition, and has rigor through the used methodologies and theoretical foundations. An empirical research project's goal is to define a theoretical framework and formulating hypotheses, collecting test data, analyze and interpret the data and formulate conclusions and recommendations based on the data [OF04]. This research fits the design research project the most as the goal is to create a set of requirements, i.e. an artifact is created. Therefore we have used the framework to perform information systems research, as proposed by Hevner et al. [HMP04]. The authors provide guidelines on how to provide relevance and rigor to information systems research projects. Their research framework can be seen in Figure 3.

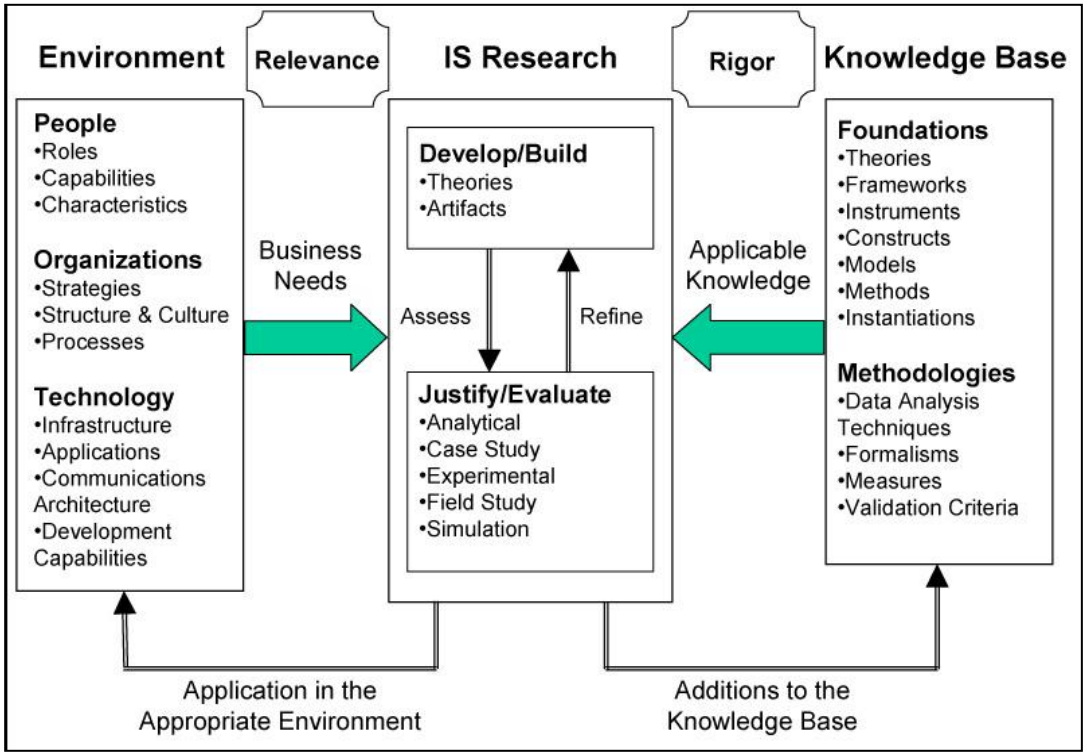

Figure 3 IS Research framework (Adopted from [HVP04])

Our application of the framework and the corresponding chapters in this report can be seen in Table 2 below.

Environment	Chapter 3: Stakeholder analysis Chapter 4: Current situation Chapter 5: Problem bundle Chapter 7: Current situation from Commons perspective
Knowledge Base	Chapter 6: Desired Components
Develop/build	Chapter 8: Requirements specification
Justify/evaluate	Chapter 9: validation

Table 2 Application of IS framework

Firstly we have researched the environment of our research. We have performed a stakeholder analysis, and interviewed relevant stakeholders, to make explicit the processes and technology in the current situation, as well as any problems the stakeholders currently experience with regard to the usage of the shared meeting rooms. Secondly, we have performed a literate study to make explicit the problems that management could reasonably expect from a Commons' theory perspective. Thirdly we have combined the insights of the stakeholder analysis, informal observations and the literature study into a problem bundle. This problem bundle provides us with causality between the problems found, and provides us with an ordering of the business needs with regard to the desired system. Chapter 3 provides the stakeholder analysis. Chapter 4 describes the current situation. Chapter 5 discusses the problem bundle.

Secondly, we have researched best practices in Commons situations by performing a literature study. We have investigated best practices in comparable ICT systems by holding interviews with experts in the market. This provides us with the knowledge base to provide recommendations for the desired system. Chapter 6 discusses the best practices found.

Thirdly, we have combined the insights from the business needs analysis and the knowledge base via a qualitative analysis into a set of key requirement for the desired system. The development/build step has consisted of using a requirements analysis method to transform the acquired knowledge, business and theories, into a domain level requirements specification. The reason for a domain level requirements specification is that it provides enough detail for management MB to see the effects of the knowledge base used, without locking them into a specific vendor. This gives management the freedom to develop the solution in-house, start negotiations with software houses, or investigate whether there are now software packages that might comply with the suggested requirements. Chapter 8 provides the requirements specification of the system as well as an analysis of the desires of the stakeholders.

Fourthly, we have evaluated the requirements specification. Firstly, a walk-through validation process has been applied to evaluate the practical validity of the requirements specification; it discusses how the stakeholders perceive the solution. Secondly, the validity of the research itself is discusses, following the guidelines discussed in the IS research framework. Chapter 9 discusses the results of the validation step.

Finally, we provide the conclusions including the limitations of this research and suggestions for future research.

2.5 Scope

In order to keep the project manageable it is important to define what will and will not be investigated. This section discusses the scope of the research.

Firstly, this research focuses only on the MB owned meeting rooms; all other types of rooms at Ravelijn and the campus of Twente University are outside the scope of this research.

Secondly, this research only aims to change and improve upon problems in the operational world. We acknowledge that the collective and constitutional world are influenced by the operational world, but consider these worlds to be a given, rather than a variable. Specifically the choice and possible optimal configuration of the collective choice arrangement is outside the scope of this research. You can find a more in depth discussion of the three worlds in chapter 6.

Thirdly, this research will not go deep into specific technical aspects such as what programming patterns to be used in case MB decides to develop a system for room-reservations. Rather a set of domain level requirements will be provided describing what kind of functionality should be available in the system. The resulting requirements will be a start for a package solution or detailed design of a custom developed system.

Fourthly, this research will not research what type of implementation strategy would be best to use. The focus is on how people make use rooms and how IT could help them to enable a sustainable situation.

3 Stakeholder analysis

The first step in the problem analysis is to define the relevant stakeholders for this project. This allows us to know which persons we need to interview to identify the problems experienced with regard to the current situation.

In this research we use the onion model approach as proposed by Alexander and Robertson [AR04]. The reason for this approach is that the onion model takes into account a very broad definition of the term stakeholder. In the onion model a stakeholder is not simply an end-user of the system; as Alexander and Robertson put it: "a stakeholder is someone who gains or loses something as a result of the project" [AR04]. Therefore by using this approach to modeling stakeholders, we are able to get a more comprehensive view on the problems and wishes, of the stakeholders, present in the school of Management and Governance.

Firstly we present the default onion model as proposed by Alexander and Robertson. Secondly we apply this general model to the shared meeting room system situation at Ravelijn for the school of Management and Governance.

3.1 Default Onion Model

The default onion model can be seen in Figure 4 below.

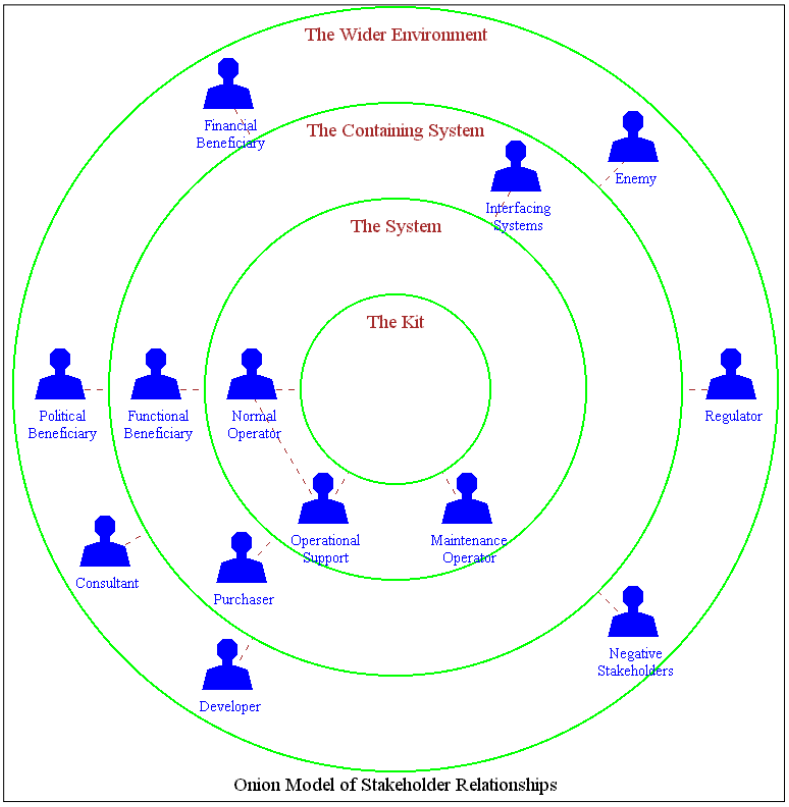

Figure 4 Onion Model (Adopted from [AR04])

The model consists of four layers; the kit, the system, the containing system and the wider environment. The further away a layer is from "The Kit", the less the stakeholders in that layer are involved with the daily operations relevant to the system. *The Kit* is the center of the model and represents the system under development. *The System* layer consists of *The Kit* and its human operators and the standard operating procedures or rules governing its operation. *The containing system* consists of *The System* and any human beneficiaries. The *wider environment* consists of the *Containing System* and any other stakeholders [AR04]. Alexander and Roberts discuss that the default onion model can be adjusted to the specific situation. Not every stakeholder role has been modeled, only those that generally exist in a project [AR04]. The figure below, Figure 5, gives a short description of each of the stakeholder roles.

The System

- **Normal Operator**: this stakeholder gives routine commands and monitors outputs from the product.
- **Operational Support**: the stakeholder role that advises the normal operator on how to use the system.
- **Maintenance Operator**: this stakeholder role involves the people who maintain the product, diagnose and fix faults.

The containing system

- **Functional Beneficiary**: this stakeholder role benefits from the result or output created by the system.
- **Purchaser**: the stakeholder role that is responsible for having the system developed.
- **Interfacing System**: stakeholder roles responsible for neighboring systems that have electronic or other interfaces to the product.
- **Product Champion**: role responsible for initiating development of the Product, for obtaining funding for it, and for protecting the development from 'political' pressures and funding cuts. The role requires positional power within the purchasing organization (e.g. the company creating a mass-market product).

The Wider Environment

- **Financial Beneficiary:** any role that can benefit financially from the product.
- **Hostile Agent**: any stakeholder role that actively seeks to hinder or harm the product.
- **Regulator**: any role responsible for regulating the quality, safety, cost or other aspects of the Product. For example, aviation authorities, health and safety executives, rail regulators, radio regulators, financial service authorities
- **Negative Stakeholders:** any stakeholder role that could be harmed by the product, physically, financially or legally.
- **Developer:** any of the roles directly involved in the development of the product e.g. , engineer, tester, analyst

- **Consultant**: any of the many roles (marketing expert, software expert, business analyst, management specialist, etc.) involved in supporting some aspect of Product development, characteristically from outside the development organization. Internal consultancy is possible but problematic, as it is hard to speak out in the face of 'political' pressure within the organization
- **Political Beneficiary:** any role that can benefit in terms of power or prestige from the development of the product.

Figure 5 Standard Onion stakeholder roles (Adopted from [AR04] and [AL05])

3.2 Stakeholders at School of Management and Governance

In this section we discuss the instantiated version of the onion stakeholder model, as introduced in section 4.1. The approach to finding the stakeholders for this project has been as follows; based upon initial discussions with the project supervisors, we have identified stakeholder roles and which people fulfill these roles at the school of Management and Governance. This process has been iterative in nature, combining new insights in stakeholders and their experienced problems with the development of the problem description (which is discussed in chapter 5). During each interview we explicitly asked the interviewee whether he or she could think of another person who should be included in this project. Some people who were interviewed could provide us with new person's names, allowing us to better fill in the default onion model. The next section discusses the identified stakeholder roles, and corresponding functions within the organization in detail. For the readers' convenience we first present the identified stakeholder roles in their entirety in Table 3. In the next sections we discuss each layer separately in more detail.

The System

Onion Model Stakeholder role	Role at Ravelijn
Normal Operator	• Current: Reception desk • Future: employees, students
Operational Support	• Reception
Maintenance Operator	• ICTS

The Containing System

Onion Model Stakeholder role	Role at Ravelijn
Functional beneficiary	• Employees • Students • Management
Purchaser	• Management school of Management and Governance
Product champion	• Management MB
Interfacing Systems	• ICTS

The wider environment

Onion Model Stakeholder role	Role at Ravelijn
Financial Beneficiary	• Management School Management and Governance
Negative Stakeholder	• Possibly FB
Regulator	• Information Management UT
Developer	• ICTS or to be determined
Consultant	• Researcher
Political Beneficiary	• Management School of Management and Governance • Director of Studies

Table 3 Stakeholders for the information system under development

3.2.1 The system layer

On *the system* level the following stakeholder roles from the Onion model have been identified: normal Operators, Operational Support and Maintenance Operators. The corresponding roles at Ravelijn can be seen in Table 4.

Onion Model Stakeholder role	Role at Ravelijn
Normal operator	• Current: Reception • Future: employees, students
Operational Support	• Current: Reception
Maintenance operator	• ICTS

Table 4 the system layer stakeholders

In the current situation there is one role at Ravelijn that falls under the Normal Operator role, and that is the reception. This party has exclusive access to the system to make reservations and view availability of the rooms. However, in the future situation it is possible that the roles that fall under the Functional Beneficiary role may become Normal Operators. Therefore we have made the choice to include employees and students as Normal Operators as well.

The second stakeholder role is Operational Support, which is currently represented at Ravelijn by reception. When a new person joins the team of receptionists, the more experienced employees provide training to that person in how to work with the system. As a side note, should employees and students become Normal Operators in the future situation, the instantiation of this stakeholder role at Ravelijn should be re-evaluated. It may be undesirable to have the receptionist provide support to every individual in Ravelijn.

The third role at the system layer is that of Maintenance Operator. This role is filled at Ravelijn by ICTS. ICTS is a central organization of University Twente that provides IT facilities and support. It has a department at Ravelijn to provide IT support, which includes the support needed to keep the current room reservation system running.

3.2.2 Containing System

In the containing system layer we have identified roles at Ravelijn for each of the four default Onion model stakeholder roles. No additional stakeholder roles in the containing system layer have been found. The results of the analysis can be seen in Table 5.

Onion Model Stakeholder role	Role at Ravelijn
Functional Beneficiary	• Employees • Students • Management
Purchaser	• Management School of Management and Governance
Product Champion	• Director of Studies school of Management and Governance
Interfacing Systems	• ICTS

Table 5 Stakeholders Containing System

The Functional Beneficiary is represented at Ravelijn by two different roles: employees and students. The term employee is a collection for all the different types of employees that are present at Ravelijn. From a system perspective there is an important distinction to make in the following three types of employees:

- Secretaries: who reserve rooms for other people
- Other reserving employees: people who only reserve rooms for themselves. The school of Management and Governance has two types of employees, depending on the nature of their work: supporting and managerial personnel and scientific personnel.
- Management: employees who do not necessarily reserve rooms themselves, but are interested in management information about the usage of the shared meeting rooms.

The difference between these three types of employees is first of all the type of information they need. Secretaries need to be able to reserve rooms for other people, while the other reserving employees only need to be able to reserve rooms for meetings they are themselves included in. Thus these two types of employees need information that allows them to make a reservation decision. The third type, management, is more interested in aggregated information about the shared meeting rooms, for example occupancy.

The second role at Ravelijn of Functional Beneficiaries is students, who can currently make use of the rooms, but cannot reserve the rooms in advance at all. Students can claim a room by going to reception and check whether there is a room available at that point in time, if so, they can claim it.

The Purchaser role is represented at Ravelijn by Management School of Management and Governance. Management decides whether the faculty will invest in a new system and makes arrangements for payment.

The Product Champion role is represented at Ravelijn by one of the directors of studies of the school of Management and Governance. The assignment to research requirements for a new system has been issued by one of the director of studies and he has been the person to provide initial scoping for the project.

The Interfacing Systems role is represented at Ravelijn by ICTS. ICTS is responsible for making sure that the necessary IT components can work with each other to provide the IT services as requested by the faculty.

3.3 Wider environment

In the wider environment layer the following Onion Model stakeholder roles have been identified: Financial Beneficiary, Negative Stakeholders, Regulator, Developer, Consultant and Political Beneficiary. The corresponding roles at Ravelijn can be found in Table 6.

Onion Model Stakeholder role	Role at Ravelijn
Financial Beneficiary	• Management School

	Management and Governance
Negative Stakeholder	• Possibly FB
Regulator	• Information Management UT
Developer	• ICTS or to be determined
Consultant	• Researcher
Political Beneficiary	• Management School of Management and Governance • Director of Studies

Table 6 Stakeholders Wider Environment

The first role to discuss is that of Financial Beneficiary. It is hard to define who might benefit financially from this system, due to the nature of the system. The system is going to support daily activities; in itself the system does not generate profit. However, the system does provide indirect benefits by being able to support a more efficient and/or effective way of working. This in turn might be able to provide better information with regard to demand for the resource, and may enable management to more cost efficiently manage the use of the rooms. Therefore we have defined management as the financial beneficiary of this project.

The negative stakeholder may be represented in this project by Facilitair Bedrijf. Facilitair Bedrijf is an organization at University Twente which has received the responsibility from College van Bestuur to provide all facility related services. These services range from catering to logistics to being involved with the building of new buildings and renting buildings to faculties. Facilitair Bedrijf also develops plans to accommodate expected future demand for infrastructures at University Twente. During this research Facilitair Bedrijf proposed a new plan to College van Bestuur to create a university wide pool of rooms, which would include the shared meeting rooms at Ravelijn [Fb09]. From this plan it became clear that the current way the rooms are used, may change in the future. These changes would be University wide, making rooms in buildings accessible for each faculty, which is currently not the case. Thus the current policies with regard to how and by whom rooms can be used may change significantly, which in turn may change the requirements for an information system. However, in this research the choice has been made to take the current policies as a given, although noting that this may change in the future. Now, this does not make Facilitair Bedrijf necessarily a negative stakeholder, but it does increase the likelihood as the scope of this system may not match the desired future policies as proposed by Facilitair Bedrijf.

The Regulator role is represented in the current situation by the department of Information Management. This organization is responsible for making sure that existing and new strategies are supported through ICT at University of Twente. This includes that the organization wants to make sure that new ICT developments fit well into the existing ICT infrastructure.

The Developer role is currently undecided, it depends on whether a system will be developed in house or not. In case it will be developed in house, ICTS is the likely partner. Otherwise management of the

school of Management and Governance will contract an external party to perform the development of the new system.

The Consultant role for this project is the researcher who is performing this research project.

The Political Beneficiary role is in this case the director of Studies at the school of Management and Governance as he was the person to initiate the project. Management School of Management and Governance is also a party that is likely to benefit in terms of power or prestige, as a well working system could be used as a success story to motivate other faculties to use a similar system.

3.4 Conclusion Stakeholder Analysis

In the previous sections we have discussed the different stakeholders we have found that are present for this project. All default roles as proposed by the Onion model have been found present for this research, and have been specified. This analysis provides us with the roles of people at Ravelijn, whom we can consult in order to gain the knowledge necessary to provide answers to the research questions.

4 Current situation

This chapter provides an answer to the second sub question “What is the current situation with regard to use and monitoring of usage of shared meeting rooms at MB?” We have interviewed the following stakeholders from The System layer: normal operators and operational support. We have also interviewed stakeholders from the containing system layer: functional beneficiaries, product champions and interfacing systems. The results of these interviews can be found in Appendix F. These interviews have been held to gain a better understanding of the current situation: the people, processes and technology, with regard to the MB owned shared meeting rooms in Ravelijn.

4.1 Shared meeting rooms in context

Before we discuss the processes with regard to the reservation of shared meeting rooms, we first provide an overview of the shared meeting rooms from a UT wide view. On the University Campus there are many types of spaces, each with its own purpose. College van Bestuur delegates responsibility for the execution of the determined policies of new infrastructure to Vastgoed Drienerlo (VGD) and the maintenance of the infrastructure to Facilitair Bedrijf. Facilitair Bedrijf in turn rents parts of this infrastructure, i.e. buildings, to faculties. Other parts of the UT wide spaces are designated as UT pooled rooms, these are rooms that can be rented by any individual at the University (and in some cases externally as well). The shared meeting rooms at Ravelijn are part of the faculty rented space. As we can see in Figure 6, this means that only the processes related to the bottom line “provides spaces free of charge to” between School of Management and Governance and Employees and Students MB are relevant for the system under development. Those processes, the processes that deal with how and when employees and students use the shared meeting rooms are specifically of interest to this research.

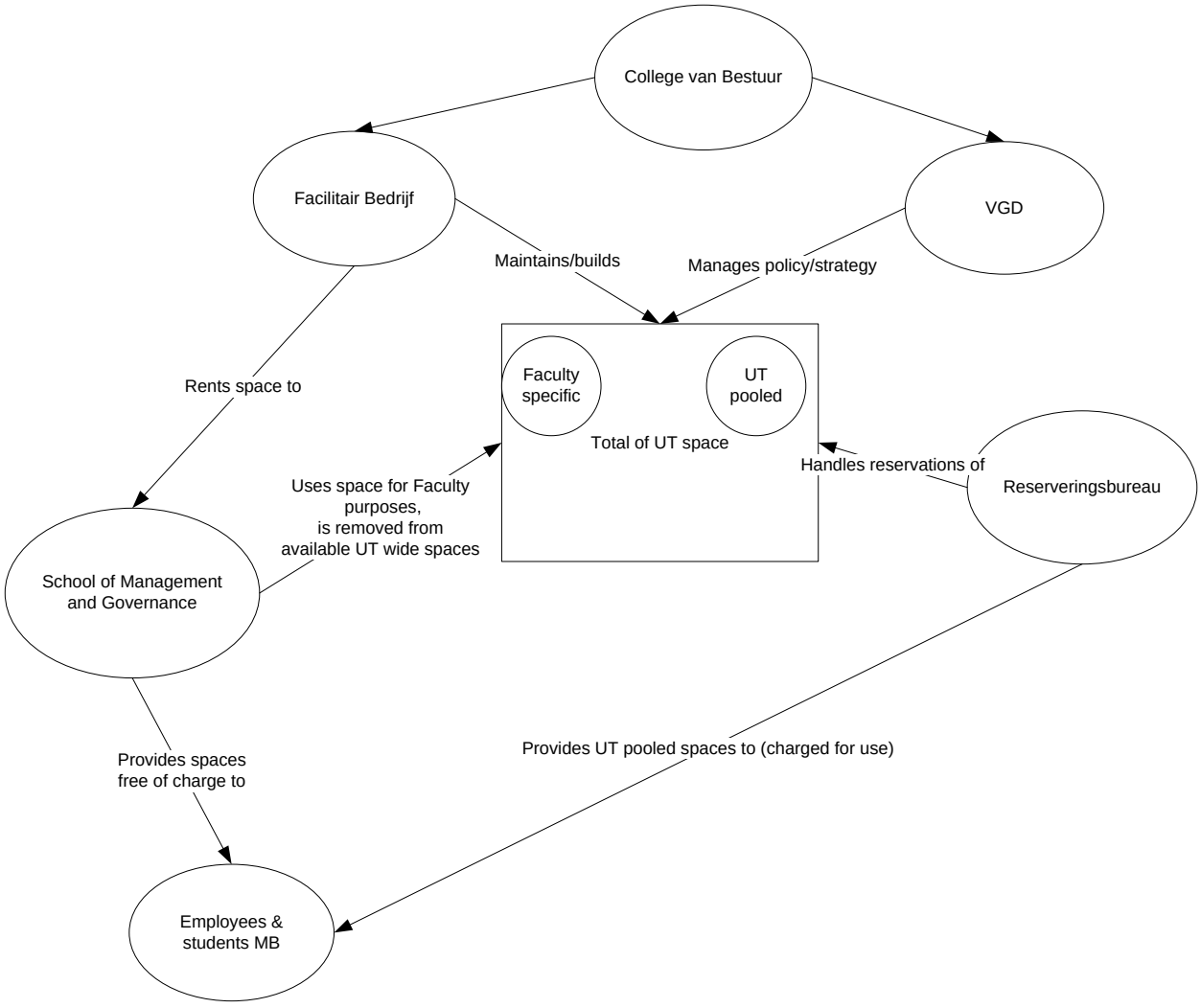

Figure 6 UT Infrastructure, involved parties and responsibilities

4.2 Processes

We have found five different processes with regard to the reservation and use of the shared meeting rooms: reservation of a room, unplanned use of a room, planned use of a room, cancel reservation, swap reservation and monitoring of room occupancy. Next we discuss these processes in detail, including who performs these processes, and finally we provide an overview of the technology used in these processes.

Please note that the processes discussed in this chapter are modeled using the activity diagrams technique. Activity diagrams show the steps performed in a process and also what data comes in and out of each function or activity [Lau02]. By using this technique we get a better understanding of how each process is performed at Ravelijn, as well as getting a better understanding of what information is

used in each step. A black circle is the start point or trigger of the activity. A rounded square denotes a specific activity performed. A square is an information object and shows which information is sent to another party/object. A horizontal black bar is a wait sign for inputs to have arrived before the next activity can be undertaken. A Black circle with another circle around it is the end point of the entire activity. A grey vertical bar is a swim lane to make clear that there are multiple people/roles performing steps. A dotted line is to indicate that an information object or step is going across swim lanes to another role. A filled line is to indicate the flow of steps. An hourglass indicates an event triggered by the occurrence of a date/ time.

4.2.1 An employee reserves a room him/herself

The first process we discuss is the most simple reservation process that is performed at Ravelijn: In this process the employee makes reservations for shared meeting rooms himself, see Figure 7 below.

In this process an employee has direct contact with reception desk. The employee contacts the reception via e-mail, telephone or physically walks to the reception desk at the entrance of Ravelijn. The employee communicates the wishes for the reservation; reception checks whether there is a room available. If so, the room is booked by reception into the Outlook calendar. Otherwise the employee might change his/her wishes, or look for another room at the campus. When the reservation is made, the employee may write the reservation down in his/her own agenda. This is the end of the reservation process.

The second part of this process occurs when the employee is going to use the room at the reserved time slot. The room may or may not be locked (key is available at reception or secretary). Assuming the room has been left by any previous users of the room, the employee can walk to the room with the people he has a meeting with. They enter the room and have their meeting. After the meeting is done, they leave the room.

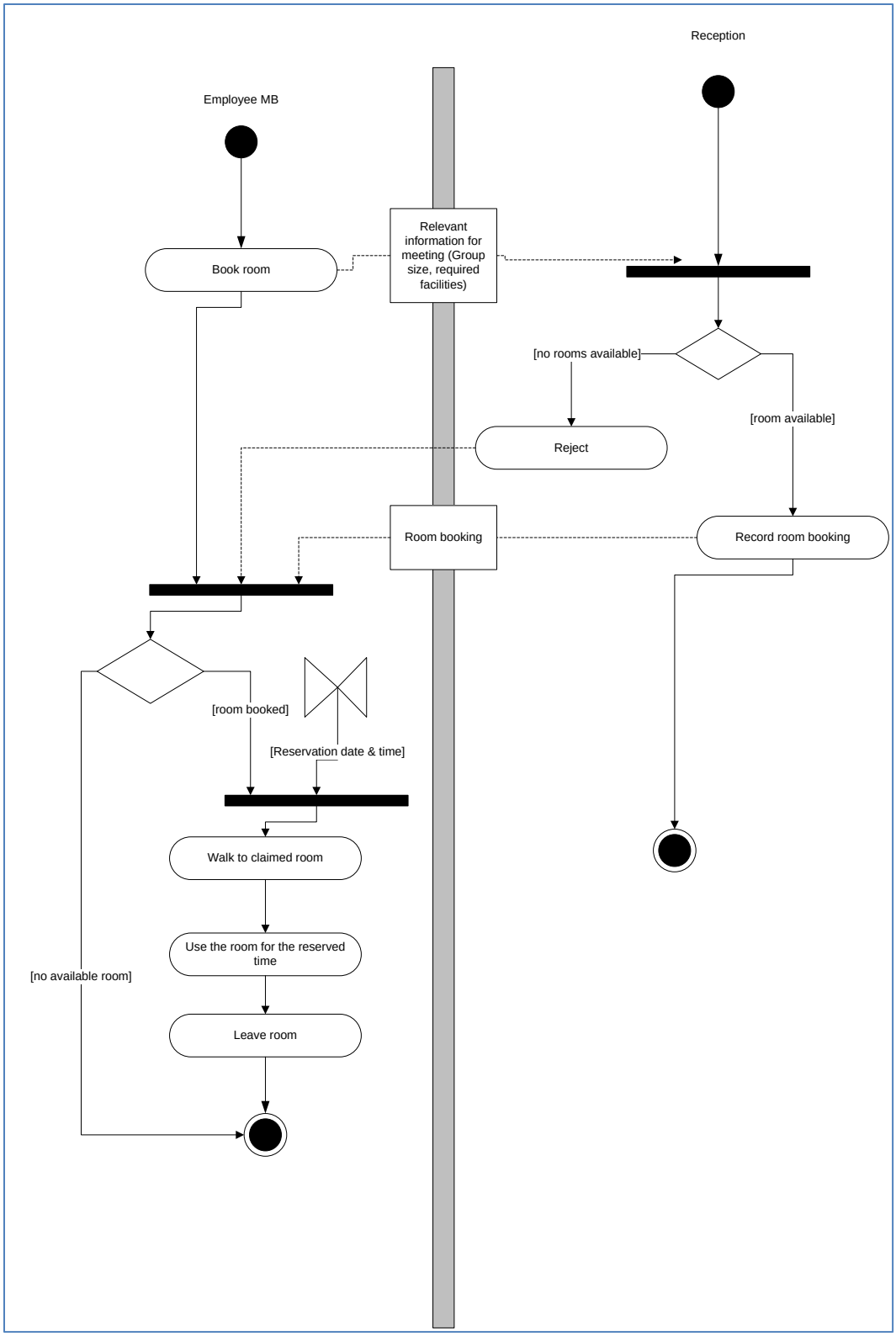

Figure 7 Employee reserves shared meeting room

4.2.2 An employee reserves a room via a secretary

This process is the second reservation process that typically occurs at Ravelijn. In this process, an employee has a secretary who handles room reservations for that employee, see Figure 8 below.

There are three parties involved in this process: an employee who wants to use the shared meeting room, a secretary who makes the reservation on behalf of that employee and reception who books the reservation. The employee sends an e-mail, gives a call or walks to the secretary to communicate the wishes for the room reservation. The secretary writes down any specific wishes, such as date, room size, facilities and/or location. Then the secretary sends an e-mail, calls or walks to reception to make the reservation for the room. As with the previous process, reception checks whether a room is available that satisfies the reservation demands, and if so makes the reservation. The secretary then notifies the employee whether a reservation has been made.

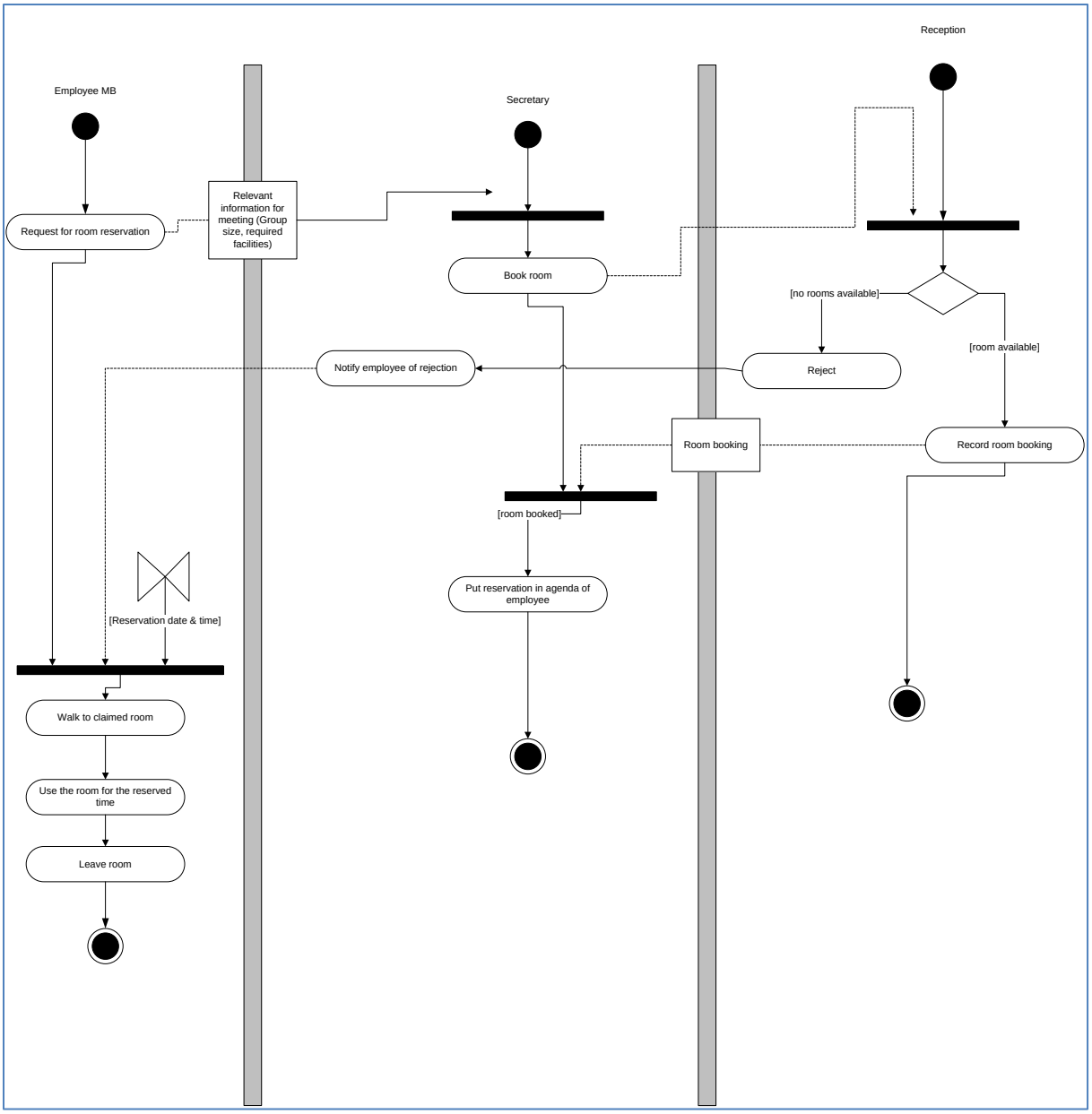

Figure 8 Secretary reserves room for employee

4.2.3 Student reserves a shared meeting room via reception

The third process is about how students use the shared meeting rooms, see Figure 9 below. A student is allowed to use the shared meeting rooms, but cannot reserve the rooms in advance. Students are only allowed to use rooms that are available at that moment in time. The student can reserve the room as follows.

The student goes to reception to see whether there are shared meeting rooms available. Reception checks on the desktop computer whether a room is available that satisfies the needs the student might have (room size, facilities such as beamer). If there is a room available, the student can reserve that room (to be used immediately). Officially this room use should be recorded in Outlook, but reception

desk does not consistently record the usage. After the room has been claimed for the student, he/she can walk to the room and use it.

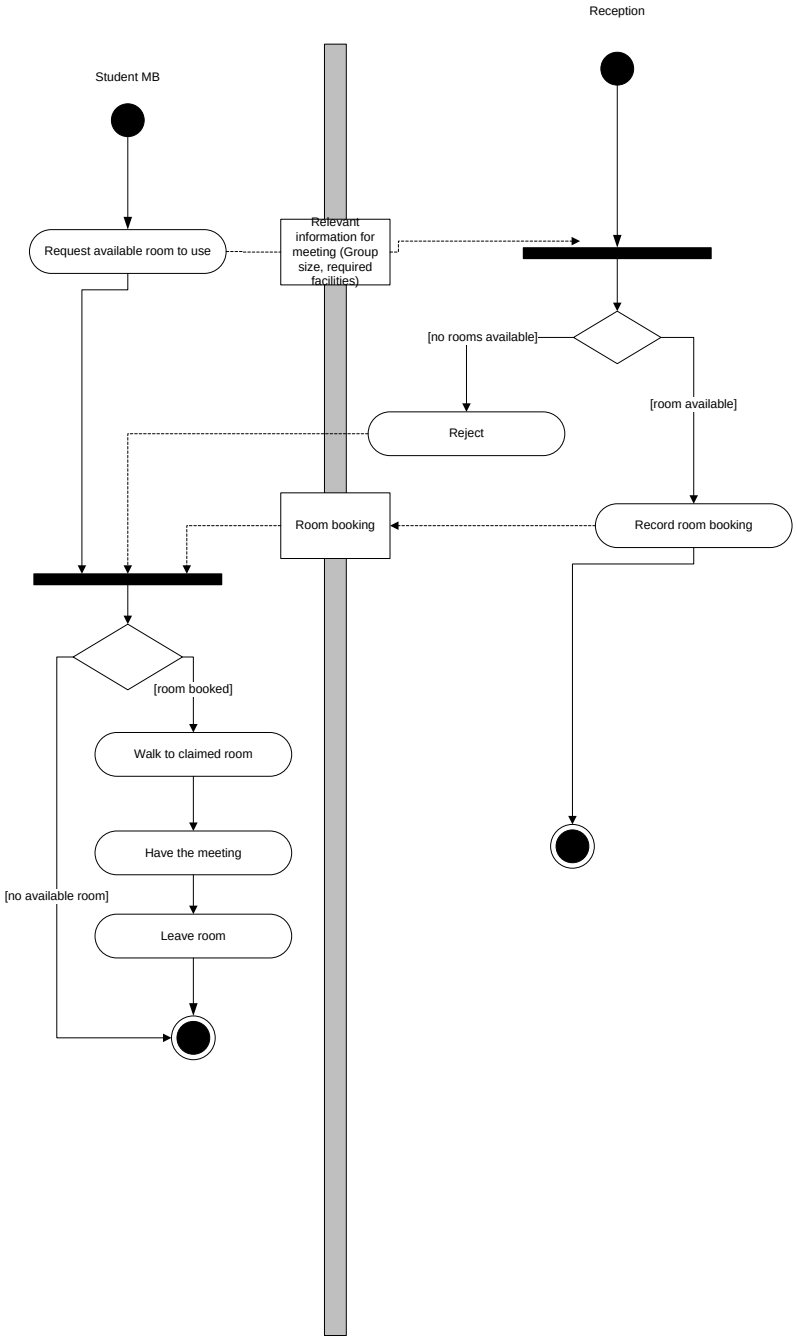

Figure 9 Student has a meeting in a shared meeting room

4.2.4 Unplanned use of room

This process entails the unplanned use of a room. In this case an individual circumvents reception entirely and simply checks whether there is a room available, if a room is available, he goes to sit there and use the room. Examples of triggers for this process include ad hoc meetings of professors with students, telephone calls that need to be made in a quiet environment or individuals who simply ignore the formal procedure of reserving a room via reception. As can be seen, no record is made of this type of use in the Outlook system at the reception desk.

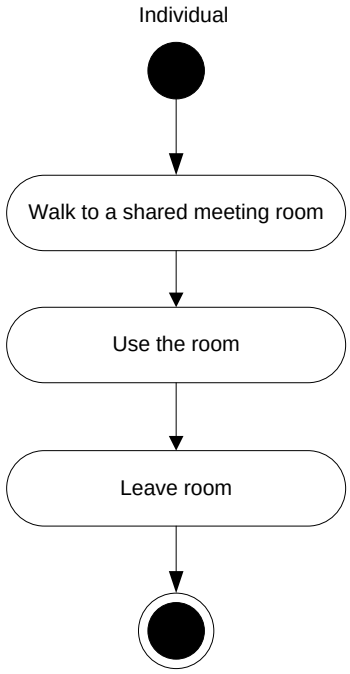

Figure 10 Unplanned use of room

4.2.5 Swap reservation

During interviews with the secretaries we found that secretaries swap reservations with other secretaries. This process can be schematically seen in Figure 11 below.

The starting point of this process is that a secretary wants to reserve a room for an employee that is already reserved by another secretary. The secretary contacts the person (usually another secretary), and checks whether the reservation can be swapped. If it is possible, the reservation is informally changed, usually this is not mentioned to reception. If it is not possible to swap the reservation, the secretary either keeps on looking for another date, or another location for the meeting. As a side note, although it is called trading a reservation, usually the person who gives up the reservation, has to make a new reservation, making it not a real swap, but is more like a favor one secretary does for another.

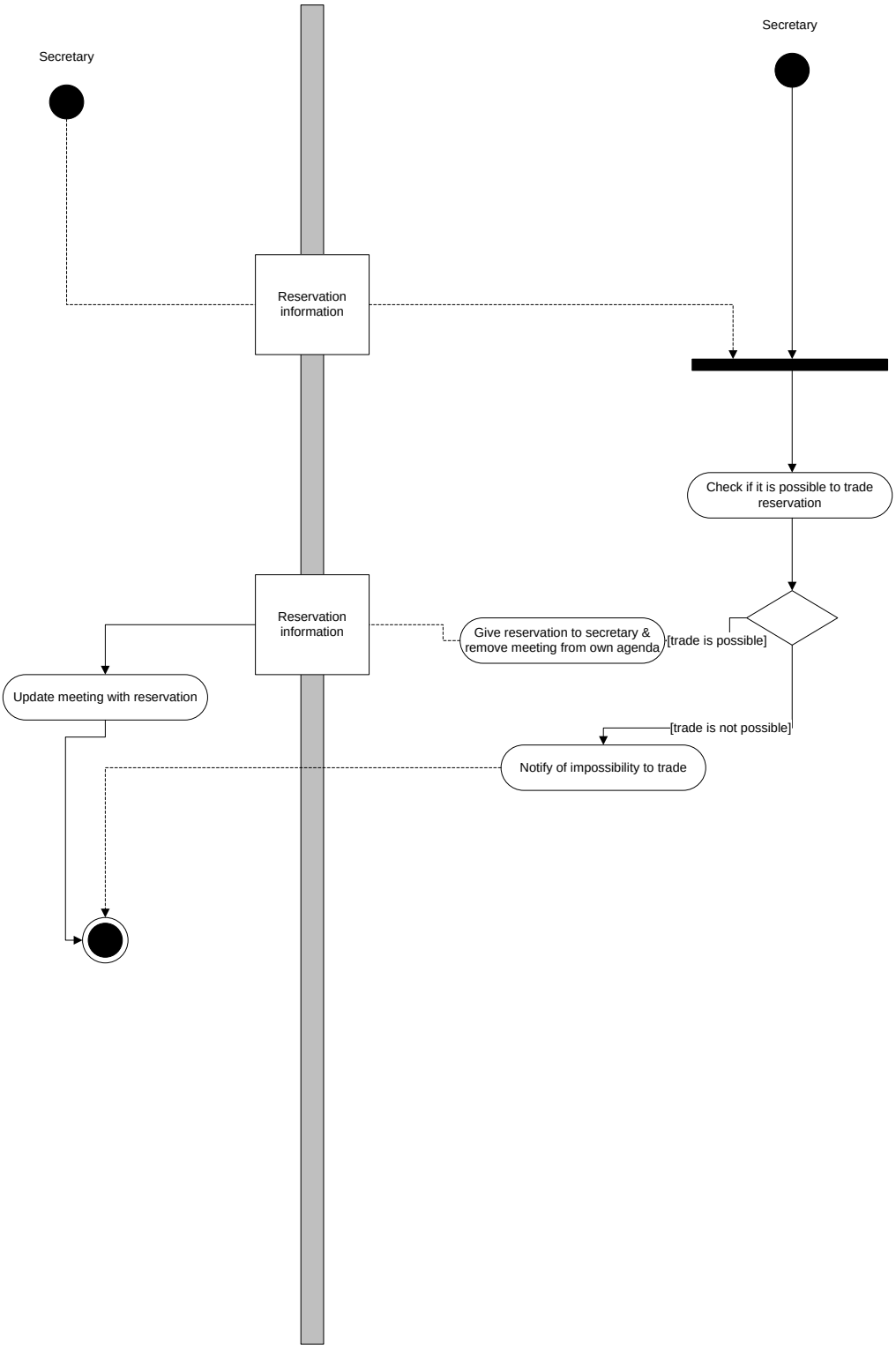

Figure 11 Secretary swaps reservation

4.2.6 Cancel reservation

It may occur that a person who has made a reservation is not able to make use of that reservation, for example, the meeting was cancelled, traffic issues or illnesses. Some people inform reception when such an event occurs, to cancel the reservation which has been made. Reception can then remove the reservation from the system, freeing up the room for someone else to use. During interviews it was mentioned that this act of courtesy is very easy to forget. Not reporting cancellations results in the Outlook calendar not being congruent with the real world; consequently reception may think a room is reserved, when it is actually free to be used.

4.2.7 Monitoring

Management is interested in the occupancy rate of the building. In the current situation this rate is measured periodically. Every once in a while a student is hired to walk by each shared meeting room, to record whether the room is in use at that point in time.

4.3 Technology shared meeting Rooms

In this section we discuss the technology employed with regard to the usage and monitoring of the shared meeting rooms at Ravelijn. Firstly we discuss the hardware used in the technical infrastructure section. Secondly, we discuss the communication structure and thirdly we provide a brief overview of other related technology available at University Twente.

4.3.1 Technical Infrastructure

The technical infrastructure with regard to the reservation system is as follows: a desktop computer is physically located at the reception desk. This desktop computer runs Microsoft Outlook software. In Outlook a user profile has been made for each shared meeting room. Reception employees enter reservations into Outlook Agenda to record that the room has been reserved. The appointment information is currently only accessible at the reception desktop computer. The reception desk also has a desktop phone to receive incoming calls and is accessible via e-mail.

With regard to monitoring of the use of the shared meeting rooms, the technology used is low-tech: a piece of paper and a pen is used to write down which rooms are in use.

4.3.2 Communication Structure

The communication structure with regard to reservation of the shared meeting rooms can be seen in Figure 12. The employees of the school of management and Governance have three options to contact either a secretary or the reception to make a reservation: use a mobile or desk phone, send an e-mail or physically walk by (face to face communication). Secretaries have the same options as the other employees, but typically only use their desk phones to make reservations. Students can only claim rooms when they are physically present at the reception desk, therefore only face to face communication is available to this user group.

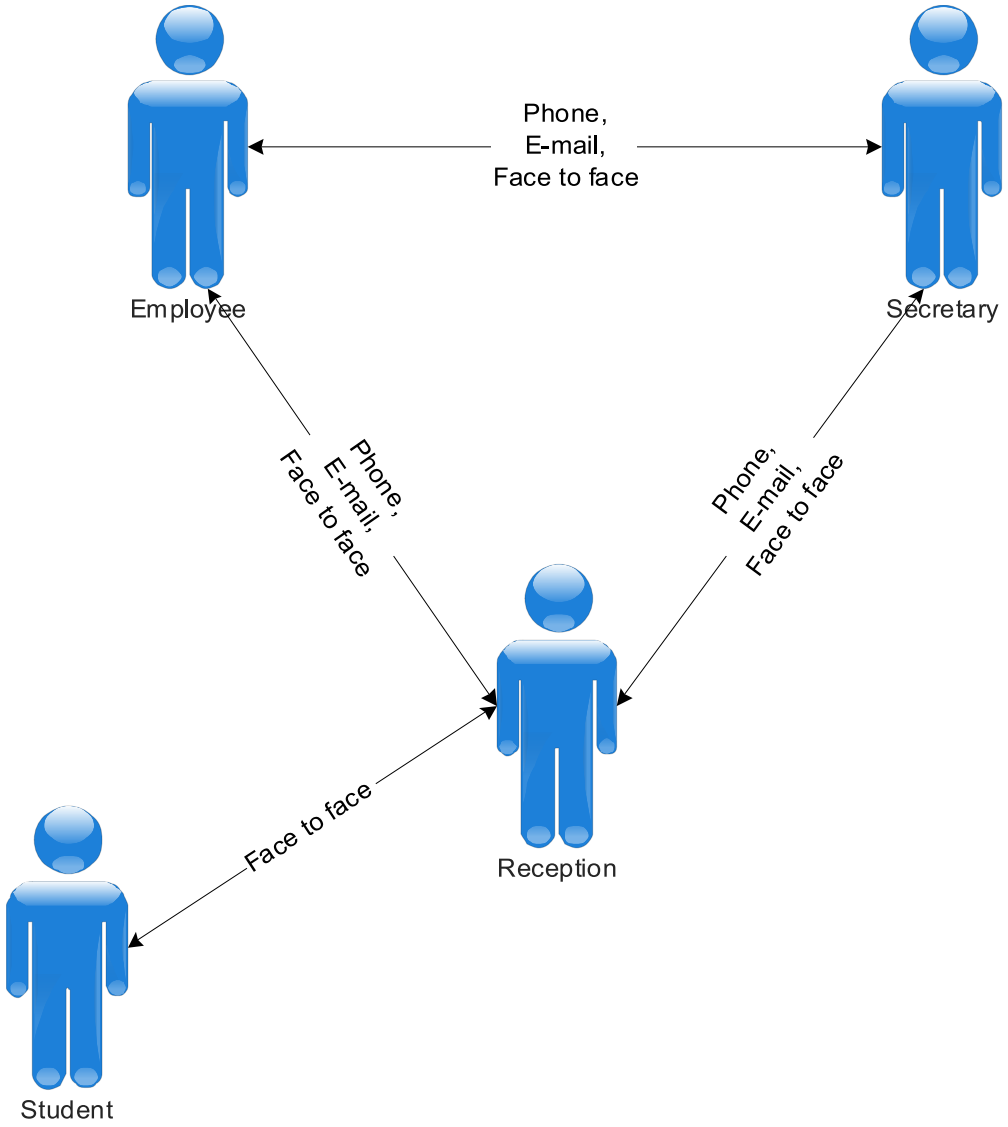

Figure 12 Reservation related communication structure

During the interviews we were interested in the reasons for choosing a particular communication method. Depending on the location of the reservee, either reserving via phone or face to face was the most popular option. People who work near the reception desk said they find it enjoyable to walk by reception to reserve a room. The least popular option is e-mail, mainly because of the cumbersome process it creates when a room is not available at the requested time; a phone call was found to be easier to quickly reserve a room.

4.3.3 Technology UT

Reserveringsbureau is the department that handles reservations of all pooled rooms on the university campus: for example lecture halls, congress rooms and other rooms that are shared by all faculties on the university. Reserveringsbureau uses a program called ZBS to record reservations of lecture halls. The department uses another software package called Planon to handle all maintenance calls, and reservations of pooled non lecture halls (congress rooms, pooled meeting rooms). Reserveringsbureau is in the process of replacing ZBS with Syllabus Plus, which features better roster functionality.

ZBS has a database as lecture rooms, while Planon has a database of all pooled rooms that exist on University Twente, including the lecture rooms in ZBS. However, there is no coupling of information between ZBS and Planon. When Reserveringsbureau needs information about the availability of lecture rooms, they need to access ZBS; this cannot be done in Planon.

Furthermore, each faculty, like MB, has rooms that are only available to that specific faculty. These rooms are managed by each faculty separately, with each faculty using separate software. In this research we have not investigated which software each other faculty specifically uses. None of these systems are currently coupled with each other. If you would want to reserve a faculty owned room at a faculty, you would need to contact reception for that specific building. If you want to reserve a pooled room, such as a lecture hall, you would need to contact Reserveringsbureau. To conclude, the availability Information about all the rooms on the UT is stored in several places, depending on what type of room it is, it is either recorded at Reserveringsbureau or at a faculty proprietary system.

4.4 Conclusion

In this chapter we have discussed the five different processes with regard to the reservation, the process of actual use of the shared meeting rooms, and the management information related process of monitoring. We have also discussed the technology used to handle reservations, which is a desktop computer at reception desk. The communication infrastructure consists of a telephone network, e-mail and face to face communication. Finally, we have discussed other technology related to room reservations, available at the University Twente: ZBS, Planon and Syllabus Plus are available software packages.

5 Problem description

In this chapter we answer the question, *what are the problems in the current situation that prevent the information system to support planned and unplanned use of the resource?* To answer this question we have investigated three sub questions: a) what are the problems according to stakeholders? B) What are the problems found during observations? C) What problems can be found in institutional analysis literature? We discuss the answers to these three sub questions first. Finally, we combine the problems found into one problem bundle. We use a problem bundle to identify the causal relationships between the problems. The problem bundle therefore allows us to identify the root problems that need to be solved in the new information system, in order to be able to support planned and unplanned use of the shared meeting rooms.

5.1 Problems as experienced by stakeholders

This section answers the sub question: *What are the problems in the current situation according to the stakeholders?* To answer this question we have interviewed people who fulfill the stakeholder roles in The System and containing system layer of the Onion Stakeholder Model, as discussed in chapter 3. We have limited the interviews to stakeholders within The System layer and Containing System layer as we are interested in problems directly related to the functionality of the system.

The first step in the process of uncovering the experienced problems was to find which people fulfill the relevant stakeholder roles and what problems they typically encounter with regard to using the shared meeting rooms. We have performed interviews with normal operators, functional beneficiaries, and the product champion to find out what problems these people experience. This has provided us with the typical issues of people who either use the system, or are dependent on the outcomes of the system. The answers to the interviews can be found in Appendix D. The next step has been to map out the problems encountered by the stakeholders to identify a single set of problems. The result of this step is a stakeholder versus encountered problem table, which can be found in Appendix E**.** We present this set of problems in Figure 13 below. Next we discuss each encountered problem in more detail; we provide why it is a problem and what the consequences of this issue are.

a) No digital confirmation of reservation is sent to reservee.

b) Cancellations of reservations are not reported to Reception.

c) Reception gets calls from people re-checking reservation information.

d) Contact information of the reservee is not consistently stored in the database.

e) Functional Beneficiaries can only access reservation information / room availability via reception desk; they cannot quickly access this information themselves.

f) Functional Beneficiaries cannot reserve rooms in the Outlook system themselves.

g) Ratio between students and employees using the shared meeting rooms may be skewed.

h) Extra facilities for a meeting have to be reserved separately.

i) Functional Beneficiary: Reception is not always available when trying to make a reservation.

j) Room designation changes are handled in such a way that reservations are lost.

k) Current monitoring process is a snapshot of the situation, which is not necessarily a correct representation of the actual occupancy rate.

l) Possible wasteful use, in the form of: no-shows, longer than required booking of rooms, small groups using large rooms.

m) Swaps are not communicated to reception desk

Figure 13 List of problems as encountered by stakeholders

a) No digital confirmation of reservation is sent to reservee.

Currently no digital confirmation of a reservation is sent to people who reserve rooms. This may lead to people calling reception to recheck reservation data; just to be sure the room has been reserved.

b) Cancellations of reservations are not reported to Reception.

Sometimes people simply cannot make their reservations, this can be due to all kinds of reasons, traffic, illness, or re-scheduling of the meeting. In most of these cases reception does not get a phone call from the reservee to cancel the meeting. This leads to the following problem: we cannot be sure that the reservations in the database are correct. The consequence is that a room might be reserved in the system, while in reality the reservation has been cancelled, and is therefore again available for reservation.

c) Reception gets calls from people re-checking reservation information.

Reception told us that they regularly receive phone calls from people who made a reservation, with the question of when they have a reservation. Reception would like to minimize the calls they get about re-checking reservations, as this takes up their time that could be spent otherwise.

d) Contact information of the reservee is not consistently stored in the database

This is a problem mentioned both by a person in the normal operator role and functional beneficiary role. The contact information of the reservee is not always consistently stored in the database, this leads to ghost reservations, where a reservation is made, but is unknown who made this reservation. If the reservee has forgotten to write down the reservation as well, it may lead to a situation where the room is reserved, but will not be used at that reservation time, as no one knows who has reserved the room.

e) Functional Beneficiaries can only access reservation information and room availability via reception

This is an issue that was reported by functional beneficiaries; they find it frustrating that they cannot quickly access reservation information or room availability themselves; they can only get access to this information by calling, e-mailing or walking by reception. There are at least three negative

consequences of this issue. Firstly, it can lead to people calling reception to recheck reservation information, as they cannot access the outlook agendas themselves. This takes up time from reception, which might be spent otherwise. Secondly, it creates a dependency of the reservee to the availability of reception. The reservee can only check the reservation database if reception is available, therefore making it impossible to do reservation related work outside of office hours or when there is no one at the reception desk.

Thirdly, the reservee can get into a very cumbersome process of having to contact reception over and over again, if a room is not available at a certain time. As room information can only be gotten from reception, the reservee has to check each time whether a room is available at that time with reception. Especially when other people with busy schedules are involved, this can become quite a complex process to manage for the reservee.

f) Functional Beneficiaries cannot reserve rooms in the Outlook system themselves.

This is also a problem we have frequently heard about, functional beneficiaries would appreciate it if they can reserve rooms themselves in the Outlook system, rather than having to call or e-mail or walk by reception each time they need to make a reservation. This is an extension of the previous issue of not being able to view information, as functional beneficiaries would like to be able to reserve rooms in the Outlook Agenda themselves as well. We hypothesize that the consequence of this problem, is that there it is too much effort for people to communicate to reception that they are using a room for an unplanned meeting.

g) Ratio between students and employees using the shared meeting rooms

One of the functional beneficiaries was worried that students will take up too much time in the shared meeting rooms, leaving the employees with possibly too little time slots to use the shared meeting rooms. This could lead to employees not being able to do their jobs as well, as an infrastructure that should be available to them, is not. The lack of monitoring information, discussed in detail below, makes it hard whether this is currently the issue. However, during talks with employees, we have informally heard complaints about students using too much time in the meeting rooms.

h) Extra facilities for a meeting have to be reserved separately

Some functional beneficiaries reserve extra facilities such as coffee, lunch or beamers for their meetings. They would like it if these services would be integrated into the system, rather than having to be reserved separately.

i) Functional Beneficiary: Reception is not always available when trying to make a reservation

We have already discusses that this is an issues when a functional beneficiary wants to view reservation information; logically it is also an issue when a functional beneficiary wants to reserve a room. Reservations of rooms cannot be done outside of office hours or when there is no one at reception for another reason. However, from a flexible organization in a flexible building point of view, it may be

desirable that it is possible for functional beneficiaries to be able to make reservations in a quicker more agile way.

j) Room designation changes are handled in such a way that reservations are lost.

This was brought to us by one of the secretaries. It may happen that over time a shared meeting room is changed in designation; in this case room 1238 became a temporary office instead of a meeting room. At that point in time, reservations were already made for that office. These reservations were simply removed from the Outlook Agenda, without notifying any reservee. This led to people thinking they had a reservation, while in reality they no longer had one.

k) Current monitoring process is a snapshot of the situation, which is not necessarily a correct representation of the actual occupancy rate.

We have described the current way of monitoring in section 4.2.7, which consists of periodical walks by a student through Ravelijn, writing down whether a room is in use at that point in time. Now, this does give management some information about the occupancy rate. However, management does not know whether that single measurement is a reasonably accurate representation of the real world. It might be that a student measured during a popular meeting time, leading to a higher measured occupancy rate. Or it could be that a student measured during a low-usage time of the week, leading to a much lower occupancy rate. Therefore the current monitoring process is not suitable to provide the information management actually needs to manage the shared meeting rooms.

l) Possible wasteful use of the shared meeting rooms

This issue was provided to us by the product champion for this project. It is possible that currently wasteful use of the shared meeting rooms is occurring. Possible causes of wasteful shared meeting rooms are: no-shows, longer than required booking of rooms, and small groups using large rooms. No-shows are people who simply do not show up for a reservation they made. This is a problem as it is space wasted, that could be used by other people. The second cause may be *longer than required bookings*, where for example people reserve a meeting room for four hours, while the meeting only takes two hours. In the current situation this would lead to a room being empty for two hours, while it could be used by other people. The third cause is people using larger than required facilities, for example a small group of people using a large meeting room. Alternatively it could also be that a group of people have a meeting in a room with video conferencing facilities, while they do not need those facilities.

Unfortunately, we do not know how often this wasteful use occurs. The current monitoring process is not adequate enough to provide this level of detail. The reservation information in the Outlook Agenda can also not be used, as it only records reservations made, not any cancellations or no-shows, or meetings that end early.

In the next section we discuss the issues that were found during observations of how people use the shared meeting rooms.

m) Swaps are not communicated to reception desk

Secretaries sometimes swap reservations with each other. These swaps are generally not mentioned to reception desk, but changed informally. This means that contact details for a certain reservation might not necessarily be correct, thus lowering the expected correctness of the information in the outlook agendas.

5.2 Observations

During our interviews people were not yet able to use the rooms in Ravelijn. After the Ravelijn opened, we have had the opportunity to informally observe how people use these rooms. From these experiences we have noticed a few issues that need to be solved in the new system. These observations have provided insights regarding unplanned use that otherwise could have been lost on us, as unplanned use was less important in the previous building of the school of Management and Governance.

n) Finding out room availability for unplanned use can take up a lot of time

As the offices of employees have become smaller and are generally shared, the need for unplanned use of the shared meeting rooms has become greater. Employees use the rooms to have unplanned meetings with students, or have a phone call as to not disturb their colleagues in the same room. However, they cannot quickly find out which rooms are available to use at that time. They have two alternatives: a) contact reception to find out whether a room is available b) walk around in the building until a free room has been found. As the desire of management is to have a flexible organization in a flexible building, one can imagine that this is not an optimal way of working.

o) Actual unplanned use of the shared meeting rooms is not recorded in the Outlook Agenda

Actual unplanned use of the shared meeting room is not recorded by reception. Generally a person, who needs to quickly use a shared meeting room, finds an available room by walking around in the building until he finds one. There is usually no communication between that person and reception, to reserve the room. Therefore in the system the room is still available, but in reality it no longer is. This creates a difference in the real world and the digital representation of the shared meeting rooms. As the new way of working has likely increased the amount of unplanned use, this could create big differences in actual and virtual room availability. In order to improve the usefulness of using a room reservation system, this difference needs to be minimized.

5.3 Problems with Commons reported in literature

In general, humans using resources of this type [Common-pool resources] face at least two incentive problems: overuse and free-riders [OST90]. Ostrom uses the term incentive problem to describe problems that are caused by people making a (conscious) decision to exhibit a certain unwanted behavior. This behavior results from an internal decision between the expected costs and benefits of exhibiting that behavior [OST90].

Harvesting from a common-pool resource has one structure of incentives that can lead to overuse [NRC02]. Providing rules to govern a common-pool resource has a second set of incentives that tempts participants to free ride on the time and effort required to craft effective rules because they will benefit from the adoption of such rules whether they contribute or not [NRC02]. The two sets of incentives work together to make the problem of avoiding overuse a real challenge [NRC02].

The degree, in which these two problems are present in a Common-pool resource, can have serious consequences. In the most negative case: if problems associated with the harvesting or sub tractable resource units become severe, local appropriators may refuse to undertake provision activities [Ost90]. Without a fair, orderly, and efficient method of allocating resource units, local appropriators have little motivation to the continued provision of the resource system [Ost90]. This means that when overuse and free-ridership are heavily present, not only the resource itself is in danger, but also management of the resource becomes doubted, and may be disregarded by those people. To give a specific example of this effect: in the case of the shared meeting rooms at Ravelijn, this principle of usefulness could mean that if employees cannot reasonably use the shared meeting rooms for unplanned meetings, they start to display opportunistic behavior and reserve a room for an entire week for a specific department. This is behavior we want to avoid, as it would further reduce the possibility for other people to use the rooms for unplanned meetings. We discuss the problems of overuse and free-rider in the next section.

p) Overuse

The overuse problem follows from the subtractability characteristic of common-resource pools. [OST90] Subtractability is the degree in which when one person uses the good, it is not available to others [McG00]. For example, take a highway; only one car can drive at a certain location at a certain time on the highway, other cars cannot occupy that exact spot. This characteristic of Common-pool resources leads to the possibility of demand for the resource being equal or greater than the amount of resource units produced by the resource. When demand is equal or greater to the number of resource units available, the resource can become congested, overharvested, degraded or even destroyed [NRC02]. Take our highway example, when the total demand at a certain time is higher than the available space on the highway offers, traffic jams occur. Depending on certain qualities of the specific Common-resource pool overuse can be utterly destructive, or merely lead to congestion. Take for example fisheries [OST90]. When too much fish is caught by fishermen, the population of fish has no chance to renew. In this case the ecological system can actually be destroyed through overuse, as there are simply no more fish left in the fishery to repopulate. In the example of the highway overuse will more likely lead to congestion, as the highway is immediately available for use after a car has left the infrastructure. However, the basic principle behind this problem remains the same: when people demand more of the resource than it can deliver, overuse is occurring, and it will have negative consequences for the resource.

Frischman discusses the subtractability characteristic as another term: rivalrousness of consumption [Fri06]. He defines rivalrousness as a function of capacity and the degree to which one person's consumption of a resource affects the potential of the resource to meet the demands of others. He proposes that many partially (non)rival resources are sometimes nonrivalrously consumed and

sometimes rivalrously consumed, depending upon the number of users and available capacity at a particular time [Fri06].Frischman takes Highways as an example. During off-peak hours, consumption of these resources is often nonrivalrous. At these times, users do not impose costs on other users and the marginal cost of allowing an additional person to use the resource is zero [Fri06]. At some point, however, nonrivalrous consumption turns rivalrous and congestion problems arise. The importance of this partial non-rivalrous attribute is that overuse can be avoided in infrastructures, by expanding the size of the infrastructure itself [Fri06].

We now know that overuse is the result of supply versus demand during a certain point in time. If the supply of the resource is too low to meet the demand at that point of time, congestion occurs.

Now, there may be two possible causes if the supply is considered too low in the situation of the shared meeting rooms. First of all, the infrastructure may simply be too small in size to realistically expect that demand can be adequately handled. One of the solutions to this problem, increasing the size of the infrastructure, is outside the scope of this research. The size of the infrastructure is a given; the shared meeting rooms of Ravelijn constitute the total infrastructure.

Secondly, the problem of overuse can also occur simply because people do not know which rooms are available. There is an example that this lack of information can make perceived congestion greater [Sch09]. This is not truly overuse, but rather a lack of information about availability that perhaps makes people default to nearby rooms, rather than rooms that are available on other floors.

Information on these two factors: size of the infrastructure and room availability information is not available or unreliable in the current situation. The size of the infrastructure is a given. Room availability information can negatively affect the perceptions of the users with regard to the amount of rooms that are available. The smaller the perceived supply, with demand being equal, the quicker congestion will occur (or the feeling that there is congestion).

Demand side is where the classical Commons theories come in. In Hardin's classic example, overuse occurred because a) people seek to maximize their gain and b) there was no regulation in how people use the resource [Har68]. Ostrom discusses that Hardin's scenario is valid, but only under extreme circumstances. [OST90][NRC02] When resource users cannot communicate and have no way of developing trust in each other or in the management regime, they will tend to overuse or destroy their resource as Hardin's model predicts. [NRC02] Under more typical, when people can communicate with each other, circumstances of resource use, however, users can communicate and have ways of developing trust. Under these conditions it is possible, though by no means certain, that they will agree on a set of rules to govern their use patterns so as to sustain the resource and their own economic returns from it. [NRC02] These arrangements are called institutions. A Commons institution can be defined as a set of rules governing the number of decision makers, allowable actions & strategies, authorized results, transformations internal to decision situations, and linkages among decision situations. [MCG00] In other words, it provides the doe's and don'ts in a commons situation. [NRC02] Therefore an effective institution should reduce the likeliness of overuse. Therefore, we assume that

overuse is more likely to occur when there is no or no effective institution in place to regulate individual's behavior.

We discuss how institutions can help reduce incentive problems, such as overuse, in the 'desired components' chapter. For now it is enough to know that from a supply side there are two factors increasing the likeliness of overuse: physically too small infrastructure for the demand, and perceived too small infrastructure for demand due to lack of availability information. From the demand side, we see that overuse is caused by a) people who seek to maximize their gain from using the resource and b) the institution that regulates behavior of individuals is either nonexistent or ineffective.

q) Free-riders

The second incentive problem is the free-rider problem. This problem stems from the cost or difficulty of excluding individuals from the benefits generated by the resource [NRC02]. The benefits of maintaining and enforcing rules of access and exclusion go to all users, regardless whether they have paid a fair share of the costs. [NRC02] As it is hard to exclude people from using the resource, it becomes more interesting for people to use the resource without contributing to the costs of maintaining that resource. In this research, the excludability factor can be influenced. The rooms at Ravelijn can theoretically be locked with a key, although this is currently not the policy from a flexibility standpoint. Therefore we assume in this research that it is hard to exclude people from using the shared meeting rooms. Currently, we do not exactly know whether free-riding is occurring, and in which degree.

The consequence of free-riders is firstly that the limit of the resource system is reached more quickly. For example, we have a demand of X hours in the shared meeting rooms which are created by the employees of MB. Now let us assume that there are people outside the faculty, who do not directly contribute to the costs of providing and maintaining Ravelijn, who use the resource for Y hours. Total demand is now X + Y hours, rather than X alone. If X + Y are equal or greater to the total supply, congestion will occur. The larger Y becomes, compared to X, the greater the problem of free-riding becomes. Secondly, when free-riding occurs on a regular basis over longer periods of time, people will lose their faith in the institution. [NRC02] Therefore, it is important to know whether free-riding is occurring, and how serious it is, in order to make sure that the institution is capable of dealing with the incentive problems that pose serious issues within that specific common-pool resource.

Other incentive problems

We have seen in the first part of this chapter that stakeholders have defined problems which can be classified as incentive problems. Wasteful use of the resource, due to no-shows, longer than required booking of rooms, and small groups using large rooms, can all be considered incentive problems. If we are able to influence the costs and benefits people expect by performing certain behavior, we may be able to positively influence the chance that desired behavior is exhibited, rather than undesired behavior.

5.4 Problem bundle

We have combined the problems discussed in the previous sections into one problem bundle, see Figure 14 (A larger version of this problem bundle can be seen in Appendix K). This problem bundle shows each problem, and its relationship with the other problems. The result is that we now know which problems are at the root of the problem, and which need to be solved first, in order to be able to solve the other problems.

As we can see the problem in the middle is the problem in the bright green block:" Current situation does not support both planned and unplanned use of the shared meeting rooms". We have mapped all problems discussed in the previous sections to this problem. We have categorized these problems into the following categories (dark green blocks in the problem bundle):

- Current role of the information system is not suitable to record both planned and unplanned use of the shared meeting rooms)
- Information in the reservation database is not up to date and not necessarily congruent with the real world
- Reservation process is cumbersome for employees
- Reduced efficiency in supply of resource

From this problem bundle we have identified the following root problems, Figure 15, that need to be solved in the new situation in order to be able to provide planned and unplanned use of the shared meeting rooms.

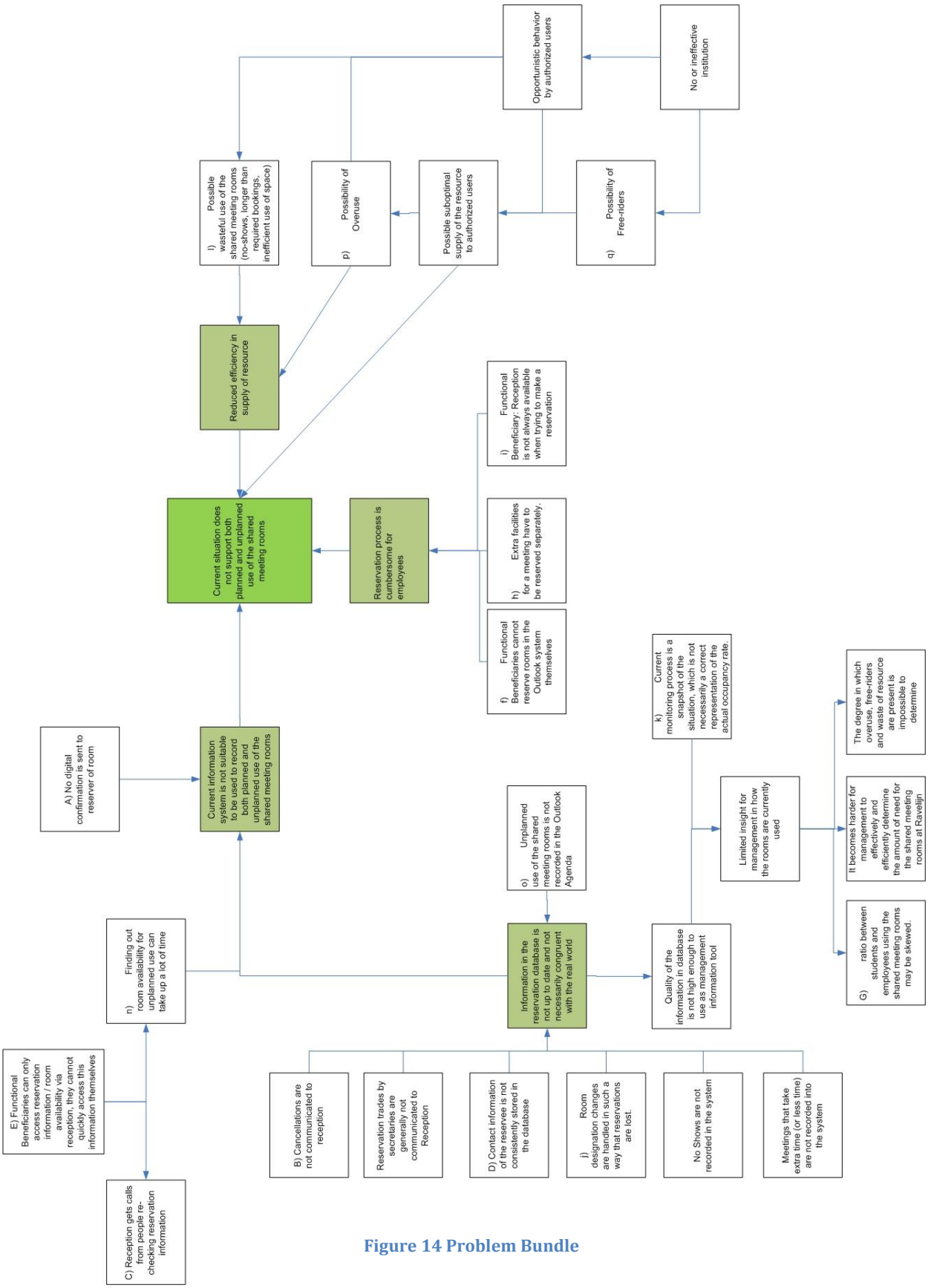

Figure 14 Problem Bundle

- Cancellations are not communicated to reception
- Reservation swaps between secretaries are generally not communicated to Reception
- Contact information of the reservee is not consistently stored in the database
- Room designation changes are handled in such a way that reservations are lost.
- No-shows are not recorded in the system
- Meetings that take extra time (or less time) are not recorded into the system
- Functional Beneficiaries can only access reservation information / room availability via reception, they cannot quickly access this information themselves
- No digital confirmation is sent to reservee of room
- Unplanned use of the shared meeting rooms is not recorded in the Outlook Agenda
- Functional Beneficiaries cannot reserve rooms in the Outlook system themselves
- Extra facilities for a meeting have to be reserved separately.
- Functional Beneficiary: Reception is not always available when trying to make a reservation
- Monitoring process is done not often enough to provide information that may help reduce collective action problems
- Ineffective Institution to regulate behavior and prevent overuse and free-riders

Figure 15 Root Problems

5.5 Conclusion

In this chapter we have answered the two sub research questions, which have given us insight into the current experienced problems by stakeholders, and relevant problems from Commons theories. We have related these issues to each other into a problem bundle, and have defined the root problems that need to be solved in the new situation in order for the school of management and governance to be able to use the shared meeting rooms in both a planned and unplanned fashion.

6 Desired Components

In this chapter we provide an answer to: “What are the desired roles, processes and technology for an information system to support planned and unplanned use of the shared meeting rooms?” We answer this question by providing answers to the following three sub questions: a) what best practices for information systems can be learned from Institutional analysis literature to support use of a shared resource? b) What are the best practices in the market with regard to comparable information systems? c) What are the wishes of stakeholders with regard to use of shared meeting rooms?

The first part of this chapter discusses Commons. Firstly we provide an introduction into the domain of Commons by giving an introduction into the background, governance and analysis. Secondly we provide an analysis of the actors, processes and artifacts in a Commons. We provide this analysis on three different levels: operational, collective choice and constitutional choice. Thirdly we discuss the best practices for Commons, with regard to the ability to deal with collective action problems (such as those described in chapter 5).

The second part of this chapter discusses the best practices we have learned from IT field studies. We have used the identified Commons processes as well as those identified for Ravelijn to find out how other situations can be related to this. We discuss one Commons situation (Spitsmijden), and two shared meeting room systems (ROC Friese Poort and Microsoft)

The third part of this chapter discusses the stakeholder wishes we have found during our interviews with the various stakeholders at Ravelijn (please see chapter 3 for an overview of identified the stakeholder roles).

6.1 Commons introduction

In this section we give an introduction into Commons. Firstly we provide a background to the Commons origins. Secondly we discuss closely related definitions of Commons, Common-pool Resource and Common-property. Thirdly, we provide a discussion of the two characteristics that defines a resource as a Common-pool resource. Fourthly we provide an introduction to Commons Governance, which will be further expanded on in the collective choice level and constitutional choice level sections. Finally we provide the method for Commons analysis we apply at the operational level, collective choice level and constitutional choice level sections to find out the relevant actors, processes and artifacts.

6.1.1 Commons origins

In 1968 Hardin had a paper published called “The tragedy of the commons”. In this paper he describes the issues he perceives with regard to the usage and sustenance of common-property resources (commons).

Hardin sets a scenario where a pasture is open to all herdsmen to let their herds graze. No regulation exists with regard to how many cattle each herdsman may keep on this pasture. Hardin proposes that as a rational being, each herdsman seeks to maximize his gain. The cost of adding an extra animal for each herdsman is shared between all herdsmen, while the gains are almost exclusively for the herdsman. Therefore it is financially interesting for the individual herdsman to keep adding cattle to the pasture. [Har68] However, the reasoning of adding animals is valid for each herdsman and this is where the

tragedy happens: exhaustion or even destruction of the publicly available resource because of overuse. [Har68]

Hardin's answer to this problem was to regulate use through governments or privatization of the resource, as he perceived that individuals were not able to overcome the problem of overuse themselves. Since then the view on these types of shared resource can be managed has changed. Ostrom discusses that Hardin's scenario is valid, but only under extreme circumstances. [OST90][NRC02] When resource users cannot communicate and have no way of developing trust in each other or in the management regime, they will tend to overuse or destroy their resource as Hardin's model predicts. [NRC02] Under more typical circumstances of resource use, however, users can communicate and have ways of developing trust. Under these conditions it is possible, though by no means certain, that they will agree on a set of rules to govern their use patterns so as to sustain the resource and their own economic returns from it. [NRC02]

6.1.2 Commons defined

There are multiple definitions of Commons, and even different terms that overlap in meaning. In this section, an overview is given of these different terms, how they relate to each other and why the term Commons is used in this research to define the situation of using and managing the use of a shared resource.

The first definition of a Commons comes from Hardin: he defines a Commons as an unregulated resource that is shared between people, who then make use of that resource [Har68]. Thus this definition focuses on the resource itself. Hardin discusses that the answer to the problem of overuse is regulation through government or privatization of the resource.

Ostrom coined the term *Common-pool resource* as a term to further define what Hardin called a Commons. She defines a common-pool resource as a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use [Ost90]. In her work she focuses on the social problems that occur within fisheries and harvesting wood of rainforests: one of the main challenges in these situations is how to keep the resource sustainable by reducing overuse. Ostrom came to the conclusion that government intervention and privatization are not the only answers to a sustainable common-pool resource: people who use the shared resource can organize themselves in order to reduce or solve overuse (and other collective-action problems) [Ost90].

The term *Common-property* has also been used to describe the same resource as Hardin describes with the term *Commons*. However, the preferred term for resources from which it is hard to exclude users is *common-pool resource*. The term common-pool focuses on the characteristics of the resource rather than on the human arrangements used to manage it [NRC02]. Therefore, this research uses the term common-pool resource to refer to the resource itself.

Hess redefines the term Commons as follows: A commons is a resource shared by a group where the resource is vulnerable to enclosure, overuse and social dilemmas. Unlike a public good, it requires management and protection in order to sustain it. [Hes08]

In this research the term *common-pool resource* is used to refer to the shared resource itself, as a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use. [Ost90] The term *Commons* is used to refer to the shared resource and the property rights system through which the use of the resource is managed. The method of management will be discussed in detail later on in this chapter.

6.1.3 Characteristics Commons

As defined in the previous paragraph a Common-pool resource is the actual resource itself. In this section we discuss the characteristics that categorize a resource as a Common-pool resource.

Ostrom discusses that in order to designate a resource as a common-pool resource it should at least have the following two characteristics: *non-excludability* and *subtractability*. Non-excludability means that it is costly or even impossible to exclude people from the resource pool. [OST90] Subtractability means that when one group or individual extracts or harvests resource units into the resource, these are not available to others. [OST90] Based on these two characteristics four types of goods can be distinguished, as can be seen in Table 7 below. [MCG00]

Exclusion	Highly subtractable	Less subtractable
Low Cost	Private goods: bread, milk, automobiles, haircuts	Toll goods: theaters, night clubs, telephone service, library
High Cost	Common-pool resources: water pumped from a ground water basin, freeways, fish taken from an ocean	Public goods: peace and security, national defense

Table 7 Jointness of consumption (Adapted from [MCG00])

6.1.4 Commons Governance

In this paragraph we provide an introduction to the governance of Commons. Specifically, how individuals in Commons deal with the problems that endanger the sustainability of their resource.

As we have seen people create arrangements that allow them to deal with the problems that are caused by the actions of others. These arrangements are called institutions. Broadly defined, institutions are the prescriptions that humans use to organize all forms of repetitive and structured interactions including those within families, neighborhoods, markets, firms, sports leagues, churches, private associations, and governments at all scales.[Ost08] Individuals interacting within rule-structured situations face choices regarding the actions and strategies they take, leading to consequences for themselves and for others. [Ost08] A Commons institution can be defined as a set of rules governing the number of decision makers, allowable actions & strategies, authorized results, transformations internal to decision situations, and linkages among decision situations. [MCG00] In other words, it provides the doe's and don'ts in a commons situation. [NRC02]

In Commons the goal of an institution is generally to either solve or reduce the likeliness of certain collective action problems, such as overuse, free-riders (poachers). [Ost90][Ost08] The institution can also be used to achieve a certain efficiency or effectiveness with regard to the use of the resource, or to make sure that the benefits of the specific Commons are distributed in an equitable way. [NRC02]

Therefore if we want to solve the problems in the problem bundle as discussed in chapter 5, Commons theory tells us that we need to look at the arrangement of how people deal with unwanted behavior in the Commons. To make this analysis structured we describe the chosen method for Commons analysis in the next section.

6.1.5 Commons Analysis

We use the Institutional Analysis and Development framework to analyze Commons situations. The goal of the IAD framework is to explain the patterns of human action and results that occur in interdependent choice-making situations. [McG00] The IAD uses three levels of analysis which are helpful to identify the typical processes in a Commons situation: operational, collective choice and constitutional choice. The operational level is about the actions of individuals that directly affect the physical world. [Ost90] The collective choice level defines the rules that are used in the operational level; for example the do's and don'ts with regard to appropriation or provision). [Ost08] The constitutional choice level is about defining the rules for the collective choice level. [Ost08] These collective choice level rules then in turn help define the operational choice levels. What can be done at a higher level will depend on the capabilities and limits of the rules at that level and at a deeper level. [Ost08]

For most practical applications, these three levels are enough. [Ost08] However Ostrom has hypothesized a fourth level called the meta-constitutional level, which defines the rules for the constitutional level. [Ost08] In this research the first three levels are used. The three levels influence each other, which are modeled as feedback paths. [McG00] These feedback paths can be quite complex, depending on the channel of feedback. [McG00]. The three levels of analysis and their interactions have been displayed, in simple form, in Table 8 below.

We use this framework as a basis to find out which artifacts are present on each level, which actors (types of individuals) exist and which processes they partake in. We also have chosen to slightly deviate from the typology of the three levels of analysis as it allows for a more logical categorization of certain actor roles (monitor, enforcer, arbiter), which we discuss next.

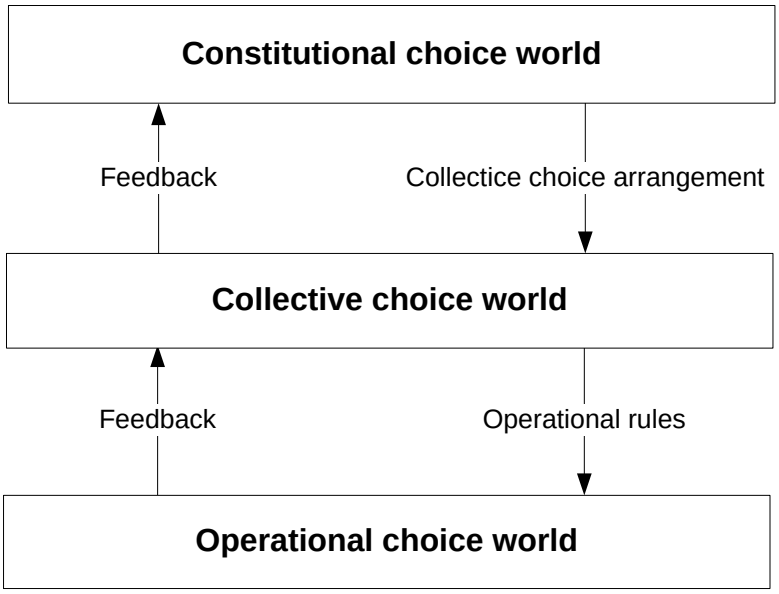

Table 8 Three levels of analysis

The next section provides a discussion on the processes that occur within each level of analysis and which actors perform these processes. Please note that an individual may have more than one role simultaneously, including multiple roles on multiple levels of analysis.

6.2 Commons - Operational level

In this section we discuss the actors, processes and artifacts we have identified on the operational choice level. We have used the descriptions of Commons from multiple authors and have combined these into the resulting Figure 16 below.

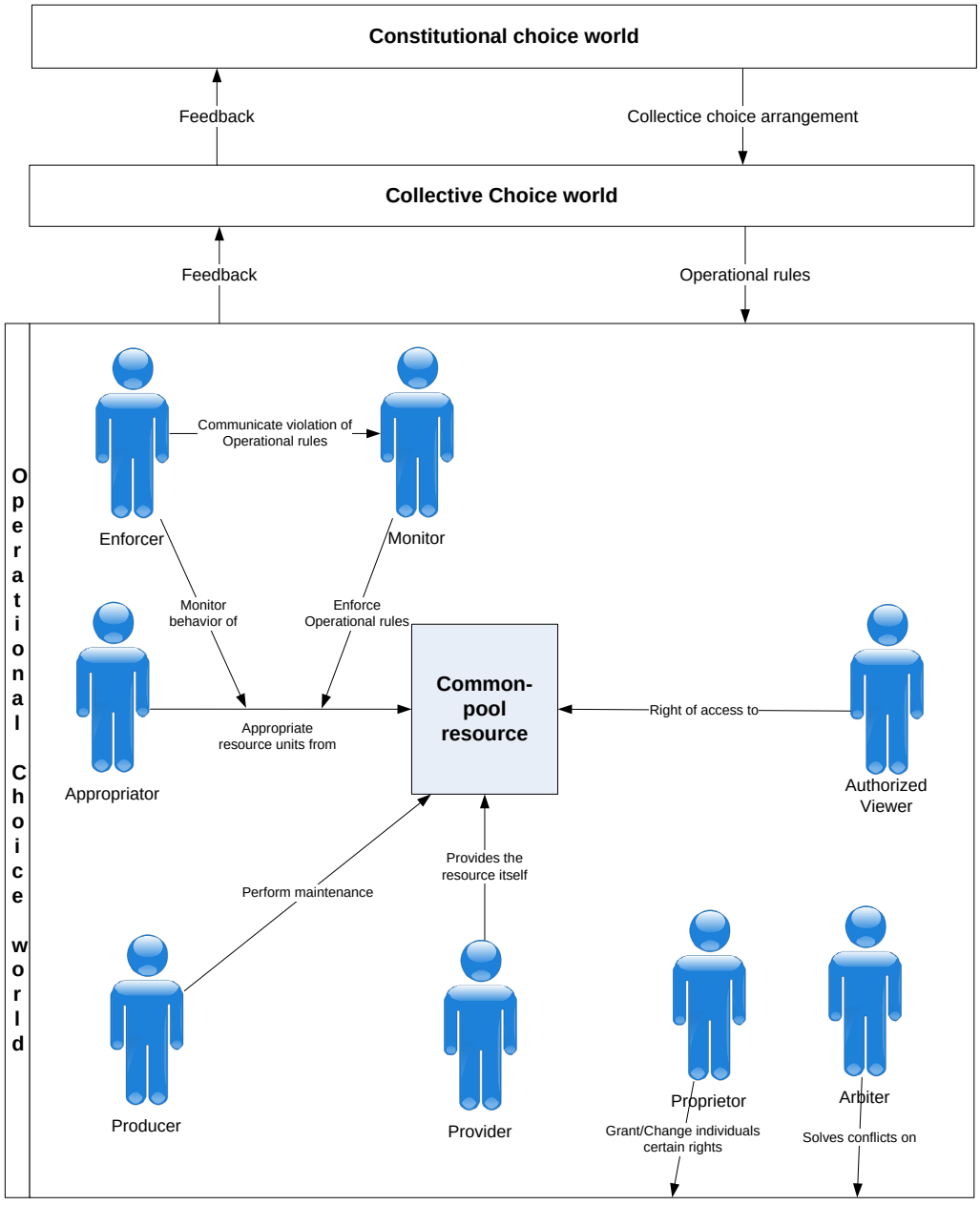

Figure 16 Actors, processes and artifacts on the Operational Choice Level

6.2.1 Actors

In this section we discuss the types of actors in a Commons on the operational level. As can be seen in Figure 16 we have identified the following actors: appropriator, producer, provider, monitor, enforcer, proprietor, arbiter and the authorized viewer. We discuss each actor role in more detail below.

According to Ostrom the actions of individuals on the operational choice level should directly affect the physical world. [Ost08] We take a slightly larger view on this level, because it allows for a more logical integration of the monitor, enforcer, arbiter and proprietor roles

Ostrom defines in her early work four different types of individuals who interact with the common-pool resource: the appropriator, provider, producer and monitor [Ost90]. We have taken this categorization as our basis. An *Appropriator* is any individual who withdraws resource units from the resource system. A provider is a person who arranges for the provision of a Common Pool Resource. A *producer* is an individual or organization who constructs, repairs, or takes actions that ensure the long-term sustenance of the resource system itself [Ost90]. To make a clear difference between provider and producer: A *provider* might be a national government that provides an irrigation system in the sense of arranging for its financing and design. It may then arrange with local farmers to produce and maintain it. Thus the farmers are the producers in this case. If local farmers are given the authority to arrange for maintenance, then they become both the providers and the producers of maintenance activities related to a common-pool resource [Ost90]. The *monitor* observes actions of individuals in a Commons. Ostrom is unclear about which processes or outcomes of processes the monitor usually observes. It depends on what the people who use the monitoring results need to know; one can imagine that information about the number of appropriated resource units, or the number of produced resource units might be valuable information for the institution. Therefore the monitor actor has currently been modeled as an actor that monitors usage of the Common-pool resource, as this is the most common use.

The *enforcer* role has been inferred from the enforcement process [OST90]. We use this role to identify any individual who may enforce the operational rules (discussed in the Collective Choice level section) in the operational level. This means that this individual may reward or punish other individuals.

In later work Ostrom continues to make a categorization of types of individuals based on the property rights they have in a Commons setting [Ost08]. Five rights have been found in operational resource systems in the field: access, withdrawal, management, exclusion and alienation [Ost08]. *Access* is the right to enter a defined physical property. *Withdrawal* is the right to harvest the products of a resource such as timber, water, or food for pastoral animals. *Management* is the right to regulate the use patterns of other harvesters and to transform a resource system by building improvements. *Exclusion* is the right to determine who else will have the right of access to a resource and whether that right can be transferred. Alienation is the right to sell or lease any of the above for rights. These five rights have been linked to five different types of individuals: authorized viewer, authorized user, claimant, proprietor and owner [Ost08]. An overview of the types of individuals linked to the property right they have can be seen in Table 9.

Right / Type of individual	Access	Withdrawal	Management	Exclusion	Alienation
Authorized viewer	✓				
Authorized user	✓	✓			
Claimant	✓	✓	✓		
Proprietor	✓	✓	✓	✓	
Owner	✓	✓	✓	✓	✓

Table 9 Property rights linked to actor roles (Adopted from [Ost08])

Compared to the first four roles: appropriator, producer, provider and monitor we see that three new roles exist: the authorized viewer, claimant and proprietor. The owner correlates to the provider and the authorized user is a synonym for appropriator. In our research the *authorized viewer* is an individual who may access the resource, but does not have any other rights.

From this categorization we have included the *Proprietor* role in a reduced form. In our research the proprietor has the right to determine who else has the right of access to a resource. The reason is that in our research an individual can have more than one role at the same time, thus by making an individual an authorized user, producer (synonym for claimant) and proprietor in our categorization, that individual has the same rights as the proprietor role definition by Ostrom [OST08]

There is one final role, the arbiter role. This role has been identified from the design principles [Ost90]. The design principles are discussed in the Commons Best practices. The arbiter is the individual responsible for making sure that conflicts are resolved [OST90].

6.2.2 Processes

We have identified the following processes: access to the common-pool resource, appropriation, monitoring, communication of rule violations, enforcement of operational rules, maintenance to the common-pool resource, provision of the resource itself, grant individuals certain rights and finally conflict resolvement. Between the operational choice level and the collective choice level are two processes as well: feedback and communication of the operational rules. We discuss these two processes in this section as well.

Access to the common-pool resource is the process that authorized viewers may undertake. This is the right to enter a defined physical property [Ost08]. In our research it is the right to a common-pool resource. *Appropriation* is to withdraw a (number of) resource unit(s) from the resource system [Ost90]. For example, an individual takes an apple from a tree; he appropriates that apple. *Monitoring* deals with the measurement of the actions of others, such as knowing how much resource units are appropriated, and who appropriates those units [Ost90]. Usually this is done to check whether people are following the operational rules.

Communication of rule violations [Ost90]. Between the monitor and enforcer there is a process that makes sure the enforcer knows that enforcement has to be done. The monitor and enforcer roles are not necessarily embodied by the same person, and therefore the enforcer needs to be aware of rule violations. *Enforcement* of operational rules is the process of making sure that the consequences (rewards or punishment) of either adhering or ignoring the operational rules are carried out consistently [Ost90]. The operational rules are formed on the Collective Choice level, the enforcer on the operational level takes these rules as a given and applies them based upon the monitoring information he receives. *Maintenance to the common-pool resource.* This is the *production* process as defined by Ostrom [Ost90]. It is the process of making sure the Common-pool resource is able to produce resource units on an operational level [Ost90]. *Provision of the resource* itself in terms of arranging for its' financing and design [Ost90]. This means that the resource itself is made available for appropriation to individuals. *Grant/Change individual certain rights*. The proprietor is responsible for giving individuals on the operational world the right to fulfill any of the roles defined in the operational choice level [Ost90]. This means he can choose whether someone will have view rights, may be an appropriator, monitor, enforcer, arbiter, etc. (or a combination of each of these actor roles). This is also called Distribution [Ost90]. We have modeled this process with an arrow to the side of the operational world to indicate that the responsibilities of the proprietor affect all actor roles within the operational world.

Conflict resolvement is the process of resolving conflicts between appropriators or between appropriators and officials [Ost90]. This process comes from the design principles as proposed by Ostrom [Ost90]. It is therefore not a process that is present by default, but has been found in those Commons that are successful over longer periods of time [Ost90]. Conflict resolvement entails that appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts [Ost90]. We have modeled this process with an arrow to the side of the operational world to indicate that the conflicts occur within the operational world, to be clear they can occur between all actor roles in the operational world.

Between the operational and collective choice level there are two processes: information feedback process and the operational rules communication. *Information feedback process* is the process that provides information about the operational situation to the collective choice situation and the constitutional level [McG00]. This information can be results from the monitoring process, but also explicit feedback from people on how they perceive the effectiveness of the operational rules. [NRC02] This information is used by the other levels to better make decisions about the operational rules and the instantiation of the collective choice arrangement. The second process between the operational and collective choice level is that of *communication of the operational rules*. [McG00] The people who decide upon the collective choice rules need to communicate those rules to the individuals in the operational choice level [McG00], both for the appropriators to know their rights and responsibilities, the monitors to know what to monitor and the enforcers to know which rules to enforce [McG00].

6.2.3 Common-pool resource

On the operational choice level there is one artifact: the Common-pool resource. In this research a common-pool resource is a natural or man-made shared resource. A common-pool resource consists of a resource system and the resource units produced by the resource system. [OST90] This distinction is

important to make because it helps to understand the processes of organizing and governing common-pool resources. [OST90] Therefore the discussion of the elements starts with the resource system and resource units.

Below in

Figure 17 the basic relationship between these the resource system and resource units can be seen. A discussion of these two elements is given next.

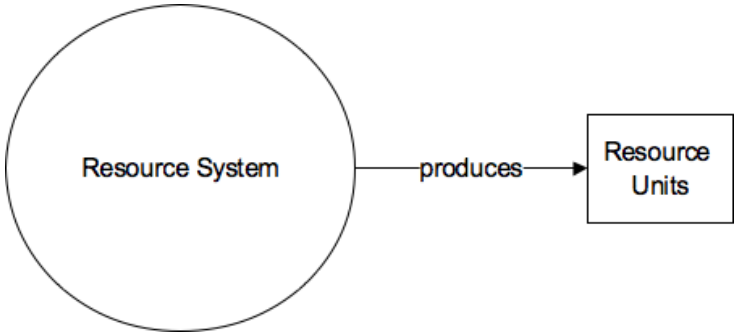

Figure 17 Relationship between Resource system and resource units

6.2.3.1 Resource system

Resource systems are best thought of as stock variables that are under favorable conditions capable of producing a maximum quantity of a flow variable (resource units) without harming the stock or the resource system itself. [OST90] For example, an ecological resource system in a Commons could be a shared apple tree. The tree grows apples each year. The apples can then be harvested by people. The same principles of resource system and resource units can be applied to other types of Commons, such as free-ways. Freeways can be seen as resource systems that produces time/space slots for people to use their motor vehicle to transport themselves from point A to B. This example hints at some relevant characteristics of the Common-pool resource, such as the time it takes to grow another harvestable batch of apples or time/space slots; these characteristics will be discussed in more detail further in this chapter.

6.2.3.2 Resource units

Resource units are those objects that can be appropriated by individuals. [Ost90] Appropriation is used by Ostrom as an abstract term for extracting, harvesting of an object, or using that object to dump something else into. Resource units are not subject to joint use or appropriation. [OST90] This means that only one person (or group of persons) can use a resource unit at a time; other (groups of) persons are then not able to use that resource unit at that time for another purpose. For example: suppose we have the apple tree from the previous example; the tree is the resource system and the apples it produces are the resource units. You harvest an apple from the apple tree. You have now appropriated one apple from that tree; another person can no longer harvest that same apple. However, a resource unit can be used by more than one person at a time, while still being subtractable. In our highway example from the previous paragraph, it is possible that multiple persons are driving together in one

car. This is still considered to be a subtractable good, as it is impossible for two cars to occupy the same time/space slot. It doesn't matter whether there is only one person in the car or multiple people, as all these people are contained in a single vehicle.

6.2.3.3 Common-pool resource characteristics

According to Dietz et al. costly exclusion and subtractability are the two defining attributes of common-pool resources. [NRC02] Dietz et al. describe three attributes of resources that may have a major impact on the incentives that individuals face (with regard to behavior that enables and supports the sustainability of the resource): renewability, scale and cost of measurement. [NRC02]

Renewability

Renewability relates to the rate at which resource units that are extracted (or used as a sink) replace themselves over time. The replacement rate over time can take any value between zero (nonrenewable) and one (instantly renewable).

A resource system in a Commons is usually defined as nonrenewable when no replacement of the resource unit is generated within a human time frame, for example the extraction of minerals or oils. [NRC02] An example of instantly renewable resource system is shared Wi-Fi internet access bandwidth via a certain access point. Once a person stops using the bandwidth, it becomes immediately available to other users. A resource system with a moderate renewability could be an apple tree, once each year apples can be harvested from the tree. An overview of the range of renewability for resource systems is given below in Figure 18. Please note that the range of moderately renewable is quite wide, denoting any resource system that is neither instantly or nonrenewable. A faster renewing resource system is placed more toward the right, while a slower renewing resource system is place more toward the left.

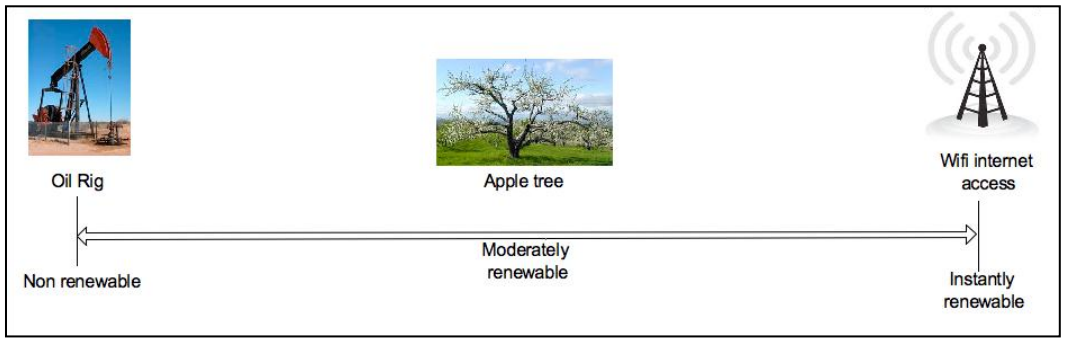

Figure 18 Range of renewability for resource systems

The effect of the renewal rate becomes clear in the types of rules used to govern the common-resource pool. For nonrenewable resources the key problem faced in regulating nonrenewable resources is finding the optimal path toward efficient mining of the resource [NRC02]. The rules therefore should focus on providing a sustainable solution to this problem [NRC02]. Renewable resources on the other hand have a renewal rate within a human time frame, for example fishing areas. In order to make a fishery common-pool resource sustainable there should at least be rules that limit the number of users;

limit the technology, timing, quantity, or location of extraction; and protect the habitat of the species [NRC02]. Thus the rules here to keep the common-pool resource sustainable are focused on achieving a resource withdrawal rate that is smaller or equal to the renewal rate [NRC02].

Instantly renewable resources have a renewal rate of 1, the resource is immediately available after a person has stopped using the resource.

Scale

Resource systems can vary in scale, from small pastries to large wild-life reservations, see Figure 19 Scale of resource systems.

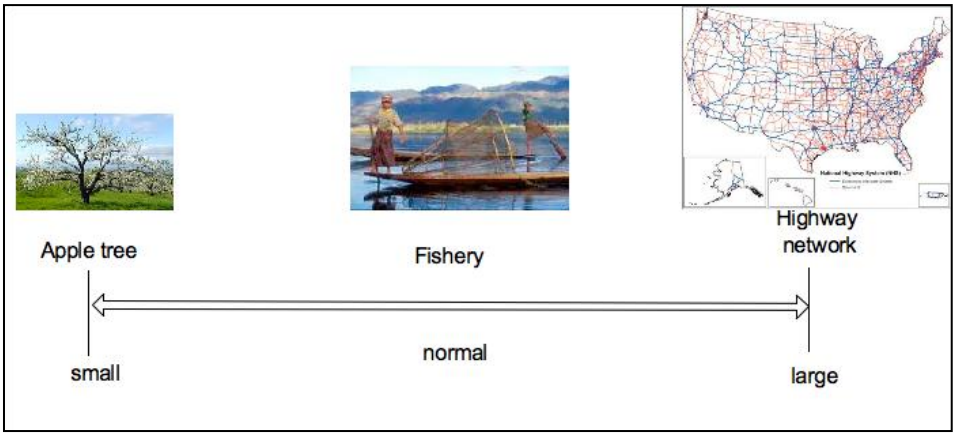

Figure 19 Scale of resource systems

Many important similarities exist between local and global common-pool resources but there are obvious differences. The first difference between small and large resource systems is the extent of the resource and thus the costs involved in monitoring use patterns at widely diverse locations. The second difference is the number of actors involved; in larger scale common-pool resources this number is obviously higher. The third difference is that the heterogeneity of these actors is likely to be higher in large scale common-pool resources when compared to small scale common-pool resources. [NRC02]

These three factors can affect the level of cooperation likely to be achieved in designing and complying with rules. The literature on local common-pool resources suggests that a greater number of resource users does not necessarily impede cooperation [OST90]. These three differences in large scale versus small scale common-pool resources may increase costs of devising, monitoring, and enforcing the rules. [NRC02] Furthermore in designing large scale Common-pool resources nested institutions can become necessary to make the common-pool resource sustainable [OST90]. Nested institutions will be discussed more in depth in the design principles for Common-pool resources.

Cost of measurement

The cost of measurement or monitoring of a common-pool resource depends mainly on two factors: *storage* and *mobility* [NRC02]. These two characteristics influence easily the usage of the resource units

are monitored. The assumption is that the more difficult it is to measure the appropriation of resource units, the more costly it is. [NRC02] *Storage* determines whether the produced resource units can be set aside to be used at a later time. Examples of storable resource units include apples plucked from an apple tree or water held with a dam. Non-storable resource units are resource units that are fleeing in nature: these resource units need to be used directly after production, else they are lost. Examples of these types of resource units are internet access bandwidth or time/space slots on roads. Storable resource units allow humans to measure the stock of a resource and provide information about what stock is currently available.[NRC02] The more storable a resource, the easier it is to measure the stock. [NRC02] *Mobility* determines the degree to which a resource unit can move from place to place. Mobile resource units, such as unpolluted air, or undammed river water, are much harder to measure than more static resources, such as forests and pasture lands. [NRC02] Thus the more mobile a resource is, the harder it is to keep track of. This means that more costs are introduced if the people who manage the resource do want to keep track of the resource units available in the common-pool resource.

6.3 Commons - Collective choice level

In this section we discuss the second level of analysis for Commons. This is the collective choice level. On this level individuals in the Commons decide the rules that enforcer use to regulate behavior of appropriators on the operational level. Collective decisions are made by officials to determine, enforce, continue or alter actions authorized within institutional arrangements. Collective decisions are plans for future action. Collective decisions are enforceable against nonconforming individuals by either punishment or rewards. [McG00] To put it more concise: in this level the operational rules are thought out, implemented, evaluated and revised. For our information system we are interested in the actors, processes and artifacts that are relevant at this level of analysis. In Figure 20 below the relationships between the actors, processes and artifacts for this level can be seen. We discuss each of them in more detail in the paragraphs below.

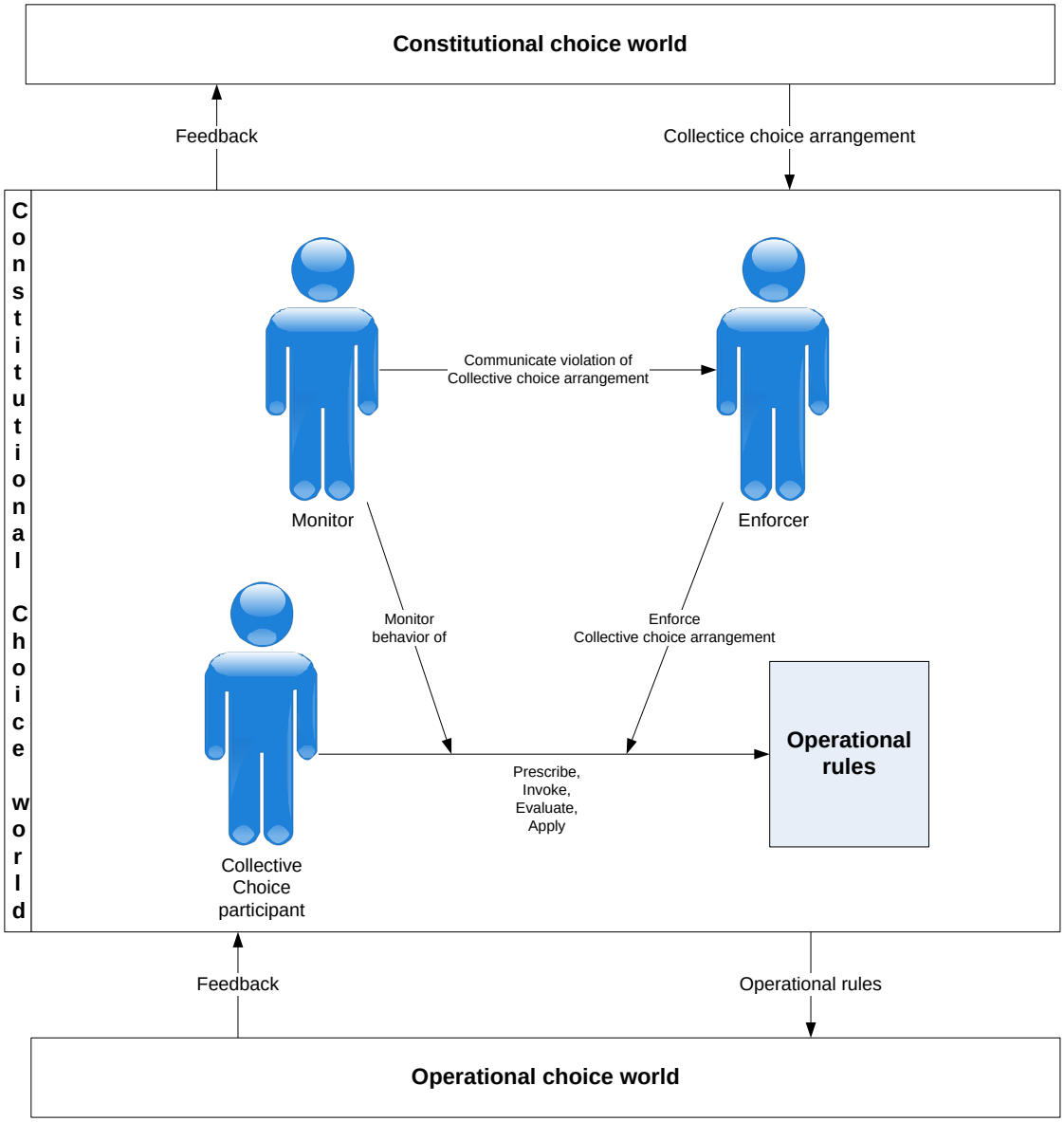

Figure 20 Collective choice world actors, processes and artifacts

6.3.1 Actors

We have identified three relevant actors at the collective choice level: the collective choice participant, the monitor and the enforcer (collective choice) [Ost08][NRC02]. The collective choice participant is defined as an individual who is responsible for the management of the operational rules. This is part of the responsibility of what Ostrom calls 'Management' rights, the right to regulate the use patterns of other harvesters and to transform a resource by building improvements. [Ost08] However in order to keep the roles for our Information system clear, we have decided to split up the management rights into three different roles (based upon in which level of analysis they perform activities): collective choice participants, producer and enforcer (operational level). A collective choice participant is responsible for creating the rules at the collective choice level. The producer and enforcer (operational) roles have already been discussed at the operational choice level.

The second role is that of monitor. On this level the monitor monitors the way people come to the resulting operational rules. The monitor monitors whether the collective choice arrangement that has been decided upon in the constitutional choice level is adhered to at the collective choice level. [McG00] Depending on the nature of the collective choice arrangement a monitor can be both a formal or informal role (See collective choice arrangements in the constitutional level discussion).

The third role is that of enforcer. The enforcer enforces that the collective choice arrangement as has been decided upon in the constitutional choice level is being followed on the collective choice level. [McG00] As with the monitor, the enforcer can be both a formal or informal role (See collective choice arrangements in the constitutional level discussion).

6.3.2 Processes

By combining several sources of Commons literature we arrive at the following processes at the collective choice level: prescription, invocation, evaluation and application of the operational rules, and monitoring, communication of violation and enforcement of collective choice arrangement. Between the collective choice level and constitutional choice level there are two processes: the feedback loop and application of the constitutional choice level. We discuss these processes in detail.

Prescribing rules is the process of defining operational rules [Ost08]. Depending on the form of the collective choice arrangement the collective choice participants (CCP) collaborate to define new operational rules. We describe operational rules in depth in the next section. *Invocation of rules* is the process of requesting for a revision of current rules or creation of new rules [Ost08]. Based upon feedback from the operational choice level CCP's decide whether it's necessary to change the current rules to better reduce of solve any unwanted collective choice problems. *Evaluation of current operational rules* [NRC02]. This process is the trigger for invocation of new rules [NRC02]. CCP evaluate the effectiveness of current rules based upon monitoring and enforcement information on the operational choice level. *Application of rules* is the process where, after operational rules have been decided upon, are implemented for use in the collective choice level [Ost08]. This means that the rules are communicated throughout the Commons.

Monitoring on the collective choice level is done by monitors who are interested in seeing whether the collective choice arrangement is followed correctly [McG00]. Basically the constitutional choice participants want to know whether the current collective choice arrangement allows the individuals to create effective rules to govern the operational choice level. *Communication of violation* of collective choice arrangement is the process between the monitor and enforcer that makes sure that the enforcer knows when to apply punishments or rewards based upon the collective choice arrangement guidelines [Ost90]. *Enforcement* is the process of applying punishments or rewards with regard to adherence to the collective choice arrangement by the collective choice participants [Ost90].

As on the operational choice level there are also two processes between levels: providing feedback to the constitutional choice level and communication of the collective choice arrangement to the collective choice level [McG00]. Firstly, we discuss the process of *providing feedback to the constitutional choice level*. On this level feedback can be communicated both formally and informally to the constitutional

choice level; monitoring information can be used by constitutional choice participants to determine the effectiveness of the collective choice arrangement. Secondly, provision of the collective choice arrangement to the collective choice level. The collective choice arrangement that has been decided upon in the constitutional choice level is implemented and updated via this process to the collective choice level, for our purposes this is done by the constitutional choice participants.

6.3.3 Operational rules

The collective choice world has one goal, to create a set of operational rules that solves or reduces collective action problems. The terms collective action problems and incentive problems are used as synonyms in Commons literature, both these terms are used to categorize problems that occur as a consequence of individuals behavior within a Commons context.

In this section we discuss the operational rules in more detail. Rules are used to govern/manage the behavior of individuals to reach certain goals. Rules influence the structures of a situation in which actions are selected [McG00]. In other words, rules shape the outcomes (the costs and benefits) for the actions an individual may take within a Commons; assuming that the institution that enforces the rules is credible. Rules specify sets of action on sets of outcomes in three ways [McG00]:

- A rule states that some particular action or outcome is forbidden. The remaining physically possible or attainable actions and outcomes are then permitted. For example, a park has a rule where it is forbidden for dogs to walk unleashed.
- A rule defines the upper and lower bounds of permitted actions, and forbid those not specifically included. For example, a parking zone has a rule where parking is only allowed between certain hours of the day.
- A rule requires a particular action or outcome. This last rule is used much less frequently to structure situations than the first two. An example of this rule type is that a judge should be present to resolve a conflict.

It is recommended to focus on those rules that can directly affect the structure of an action situation [McG00]. This leads to a classification of seven broad types of rules [McG00]:

a) **Position rules**: specify a set of positions and how many participants hold each position and how many participants hold each position [MCG00]. A position is a role a participant in a Commons may have, for example appropriator, enforcer, monitor, collective choice participant, etc.

b) **Boundary Rules**: specify how participants are chosen to hold the positions discussed in the first category and how participants leave these positions [McG00]. For example, under which condition can an individual hold a position that allows him to reserve shared meeting rooms at Ravelijn.

c) **Scope rules**: specify the set of outcomes that may be affected and the external inducements and/or costs assigned to each of these outcomes [McG00]. The scope rules define the allowable actions and allowable outcomes from interaction within organizations as well as those actions that the institution wants to discourage [McG00].

d) **Authority rules**: specify the set of actions assigned to a position at a particular node. In other words, the authority rules define which actions an individual holding a certain position may undertake in a certain action situation [McG00]. For example, an enforcer has the right to enforce the punishment upon detection of a rule infraction by an individual.
e) **Aggregation rules**: these rules specify the decision function to be used at a particular node to map actions into intermediate or final outcomes [McG00]. For example, these rules would define what happens to a repeated free-rider after he has again been caught in a Commons situation.
f) **Information rules**: these rules authorize channels of communication among participants in positions and specify the language and form in which communication will take place [McG00]. In other words they define what an individual should know in a certain action situation, with regard to that decision.
g) **Pay off rules**: these rules prescribe how benefits and costs are to be distributed to participants in positions. For example, they determine how the costs for maintaining the shared meeting rooms are distributed among which participants.

When analyzing rules [in a Commons] it is important to note that the rules in place should be considered as configuration of rules, rather than single rules [McG00]. The reason is that rules can fulfill different roles, as discussed above, and therefore a certain combination of rules may be necessary to complete the desired affection of an action situation.

Unfortunately, given the large number of possible combinations of specific rules, it is unlikely to have a complete theory of institutions. Therefore any particular application of the framework will need to make particular assumptions about the six rules for that specific context. [McG00] The IAD framework provides very little information about whether every type of rule should be in place, and what the effect is of different types of rules. As a general note, the trade-off between cruelty and effectiveness must be evaluated in any case involving punishment. [GRG07]

6.4 Commons - Constitutional Choice level

The third level in Commons analysis is the world of constitutional choice. Constitutional decisions are collective choices about rules governing future collective decisions to authorize actions. [McG00] In other words, they are the decisions about how to go about running things on the collective choice level. Constitutional choice also continues beyond the initial organizing period, for as individuals react to consequences of earlier rules for collective decision making, participants may change the rules to improve result. [McG00] In this section we discuss the relevant actors, processes and artifact.

With regard to information system functionality the constitutional choice level (and metaconstitutional choice level) is outside the scope of this research. Changes in the constitutional choice level may make entire systems obsolete, and therefore a system to support the constitutional choice level should be separate of those systems that support the operational and collective choice world. We do however include a discussion of the constitutional choice level to create a better understanding of how the collective choice arrangement is formed. For a more in depth discussion of the constitutional and

metaconstitutional choice levels we refer you to the book by Michael D. McGinnis [McG00]. See Figure 21 for an overview of the actors, processes and artifact on the constitutional choice level.

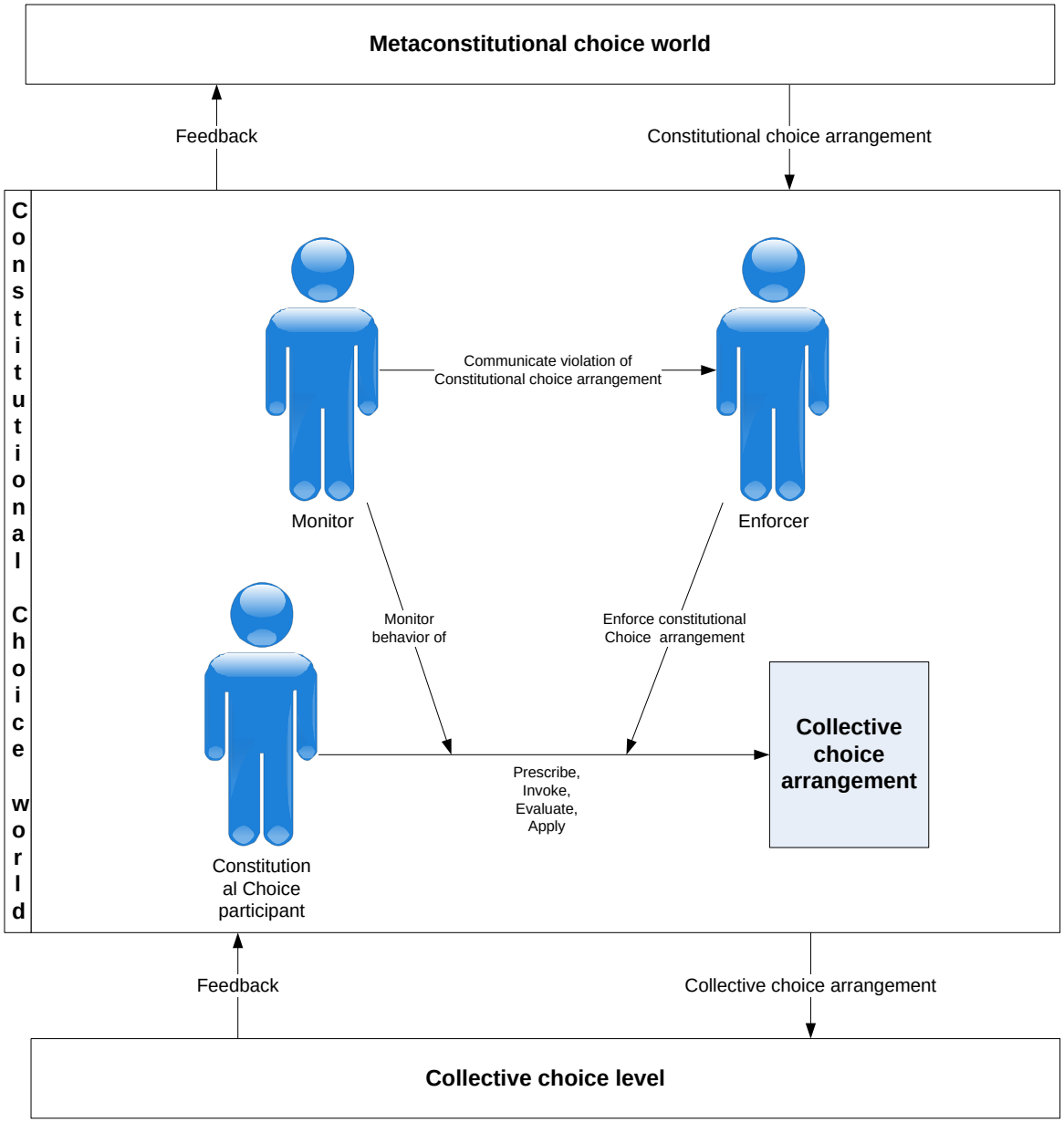

Figure 21 Constitutional choice level

6.4.1 Actors

On the constitutional choice level we have also identified three relevant actors. With regard to the type of responsibilities they have, they are the same type of actors as the collective choice level actors, only they are responsible for the constitutional choice level outcomes. The constitutional choice participant is therefore defined as an individual who is responsible for the creation and management of the collective choice arrangement [McG00][Ost90][Ost08]. This means that (a group of) constitutional choice participant(s) decide(s) upon how people on the collective choice level will come to operational rules.

The second role is that of monitor. On this level the monitor monitors the way people come to the resulting collective choice arrangement. The monitor monitors whether the constitutional choice arrangement that has been decided upon in the metaconstitutional choice level is adhered to at the constitutional choice level. [McG00] Depending on the nature of the constitutional choice arrangement a monitor can be both a formal or informal role. The monitor is most likely not the same individual as those on the operational choice level or collective choice level.

The third role is that of enforcer. The enforcer enforces that the constitutional choice arrangement as has been decided upon in the metaconstitutional choice level is being followed on the collective choice level. [McG00] As with the monitor, the enforcer can be both a formal or informal role.

6.4.2 Processes

As with the collective choice level we have combined several sources of Commons literature which result in the following processes on the constitutional choice level: prescription, invocation, evaluation and application of the collective choice arrangement, and monitoring, communication of violation and enforcement of constitutional choice arrangement. Between the constitutional choice level and metaconstitutional choice level there are two processes: the feedback loop and application of the constitutional choice level. We discuss these processes in detail.

Prescribing rules is the process of defining the collective choice arrangement [McG00]. *Invocation of collective choice arrangement* is the process of requesting for a revision of the current arrangement or new arrangement [Ost08]. As you may imagine, this process is rather involved as the change it has on the other levels is profound. To put it in perspective a change in the collective choice arrangement is a University wide policy change. For example, the planned change in how the faculty specific rooms may become university wide pool rooms is a change on a collective choice arrangement level. These changes can span multiple years before application.

Evaluation of current collective choice arrangement [NRC02]. This process is the trigger for invocation of a new collective choice arrangement [NRC02]. Based upon feedback from the collective choice level changes may be made in the collective choice arrangement, but again, this is an extensive change in the Commons.

Application of the collective choice arrangement is the process where, after the constitutional choice participants have decided upon a change or new collective choice arrangement, the new collective choice arrangement is implemented. Again, this is a big change for a Commons, depending on the size of the Commons it may be a huge undertaking. For example, the Dutch government decides that freeways will be financed through toll booths rather than be financed through taxes.

Monitoring on the constitutional choice level is done by monitors who are interested in seeing whether the constitutional choice arrangement is adhered to [McG00]. The metaconstitutional choice participants want to know whether the current constitutional choice arrangement allows the individuals on the constitutional choice level to manage a collective choice arrangement that is beneficial for the creation of the operational rules to solve problems in the operational choice level.

Communication of violation of constitutional choice arrangement is the process between the monitor and enforcer that makes sure that the enforcer knows when to apply punishments or rewards based upon the constitutional choice arrangement that is in effect [Ost90].

Enforcement is the process of applying punishments or rewards with regard to adherence to the constitutional choice arrangement by the constitutional choice participants [Ost90]. However, at this level it is more likely that we are talking about legal conflicts, gatekeeper organizations that sue organizations for the benefit of the Commons, rather than individuals applying a slap on the wrist to each other.

As on the other levels there are also two processes between levels: providing feedback to the metaconstitutional choice level and instantiation of the constitutional choice arrangement to the constitutional choice level [McG00]. P*roviding feedback to the metaconstitutional choice level* is the process where performance of the constitutional choice level is communicated to the metaconstitutional choice level. Instantiation of the constitutional choice arrangement is the process where the constitutional choice arrangement is implemented. In our research this would mean that the government will decide upon changes in how the University is run, which in turn would influence how the faculties are run, which in turn would influence how the buildings are managed, and the shared meeting rooms as well. In other words, these two processes are much too abstract for our purposes to go into deeply.

6.4.3 Collective choice arrangement

In this paragraph we discuss the typical forms of the collective choice arrangement that exist for Commons. Feeny has identified four broad classes of institutions for governing use of the resource: private property, common property, government property and open access. [Fee90] These four categories are ideal analytic types; in practice much overlapping occurs. [Fee90] However, these classifications provide some insight as to who determines how the common-pool resource is managed on an operational level.

Private property: the rights to exclude others from using the resource and to regulate the use of the resource are vested in an individual, or group of individuals such as a corporation. [Fee90]

Communal property, also called group property: the resource is held by an identifiable community of interdependent user [Fee90]. These users exclude outsiders while regulating use by members of the local community. Within the community, rights to the resource are unlikely to be either exclusive or transferable: they are often rights of equal access and use. These communal properties arrangements can be both formal and informal in nature, depending on the size [Ost90].

State property (or state governance): rights to the resource are vested exclusively in government which in turn makes decisions concerning access to the resource and the level and nature of exploitation. The difference between community and state property is that in state property, people who not necessarily use the resource determine the institutional rules.

Open access: the absence of well-defined property rights [Fee90]. This is where situations such as described in Hardin's Tragedy of the commons occur [Har69].

Unfortunately, currently there is no consensus on which type of institution is best suited for a certain common-pool resource situation. Furthermore the best available knowledge strongly suggests that the search for a single best strategy will be futile. The best tool for sustainable management of a common-pool resource depends on the characteristics of the resource and of the users [NRC02].

6.5 Commons - Best practices

In this section we discuss the principles we have found that are shared between successful Commons. Ostrom has analyzed several common-pool resource situations and found eight criteria that successful institutions share [Ost90]. We discuss the eight criteria and their relevance in this section.

6.5.1 Design principles sustainable Commons

We have used the eight design principles from the research as proposed by Ostrom [Ost90]. Ostrom defines successful institutions as those institutions that enable sustained use of the common-pool resource itself. [Ost90] The seven design principles for Commons are based on analysis of robust small scale common-pool resource institutions and an eight principle used in larger, complex cases. [OST90] Ostrom defines a design principle as an essential element or condition that helps to account for the success of these institutions in sustaining common-pool resource and gaining the compliance of generation after generation of appropriators to the rules in use. [OST90]

Ostrom discusses that these principles are still quite speculative and need theoretical and empirical works is needed before a strong assertion of necessity can be made. [OST90] In later work it is discussed that these principles have been accepted as a reasonable base design principle framework.[NRC02][Ost02][Ost08] However, it is still uncertain whether all these principles should be present, as in some cases of successful commons only a subset of these principles were found. [Ost08]

The eight principles are: clearly defined boundaries, congruence between appropriation, collective choice arrangements, monitoring, graduated sanctions, conflict-resolution mechanism, minimal recognition of rights to organize, and nested enterprises. [OST90][NRC02][OST02][Ost08] The overview can be seen in Figure 22. We discuss each principle in detail below.

Commons Design Principles

1. Clearly defined boundaries
2. Congruence between appropriation and local conditions
3. Collective choice arrangements
4. Monitoring
5. Graduated sanctions
6. Conflict-resolution mechanism
7. Minimal recognition of rights to organize

For Common-pool resources that are part of larger systems:

8. Nested Enterprises

Figure 22 Common-pool resource system design principles (Adopted from [OST02])

Clearly defined boundaries

This principle dictates that individuals or households who have rights to withdraw resource units from the common-pool resource must be clearly defined, as must the boundaries of the common-pool resource itself. [OST90] Agrawal suggests that this design principle should be split up into two parts: clearly defined boundaries of the resource itself and clearly defined boundaries with regard to membership to the group. [NRC02] This means that the resource itself should be well delineated, as well as who may use the resource. By defining those boundaries, the people in the Commons will be able to develop better rules and more effective institutions, as they better understand the limits of their Commons.

Congruence between appropriation and provision and local conditions

Ostrom defines this design principle as follows. First of all, the distribution of benefits from appropriation rules should be roughly proportionate to the costs imposed by provision rules [Ost90]. Secondly, appropriation rules restricting time, place, technology and/or quantity of resource units should related to local conditions [Ost90]. Ostrom defines this principle in later work as: there should be congruence with the local ecology, amount of users that are authorized to harvest and their responsibilities for contributing labor or other resources [Ost02]. Morrow and Hull restate it as: appropriation and provision rules are congruent with the resource and with the cultural norms and social and economic patterns of interaction of the appropriators. In other words, the rules should be perceived as fair by the people who are influenced by those rules. A perceived fairness increases likelihood of cooperation with the institution in place.

Collective choice arrangements

The idea of this principle is that most individuals affected by the operational rules should be able to participate in modifying the operational rules. [Ost90] Ostrom discusses that the advantage of this rule is that this allows institutions to better be able to tailor their rules to local circumstances, because the individuals who directly interact with one another and with the physical world can modify the rules over time so as to better fit them to the specific characteristic of the setting [Ost90]. This does not mean that an individual has to have every possible property right in order to be able to participate, he needs to have at least claimant property rights [Ost08], see the previous section with a discussion of actor roles.

Monitoring

Monitoring is both about monitoring the resource system as well as compliance to the operational rules. [Ost08] Depending on the scale, storability, mobility and cost of measurement of the common-pool resource, effective monitoring may or may not be possible. However, monitoring is always considered important, as it provides insight in the actual actions of individuals, and will therefore allow the institutional arrangement to work more effectively. [Ost08] In other words, it is very hard to successfully reduce the presence of collective action problems, without monitoring. First management needs to know what is going on, before effective action can be undertaken to solve possible issues. Monitors, who actively audit common-pool resource conditions and appropriator behavior, are accountable to the appropriators or are the appropriators themselves. [Ost90]

Graduated sanctions

This principle dictates that appropriators who violate operational rules are likely to receive graduated sanctions (depending on the seriousness and context of the offense) from other appropriators, from officials accountable to these appropriators, or from both. [OST90] These sanctions are based on operational rules designed by the institution that governs the common-pool resource. However, these rules are not always formally written down. Sanctions from informal rules such as community norms can be effective as well. [Ost08]

It is interesting to note, that it should not be a complete certainty that punishments or rewards are given, in order for an institution to be effective and reduce collective action problems. The individual consider undesired behavior to be likely to be punished [Ost90]. Thus in order to take the institution seriously, the individual should take into account the cost of punishment as a reality; he should not be able to discount it easily, in order for the regulating effect of sanctions to be effective. If he does not believe that the punishment will be actually performed, the effectiveness of the institution is likely to suffer.

Conflict-resolution mechanism

Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials. [OST90] Usually this involves the right to go to court over some dispute. [Ost08] In field settings, applying the rules is never unambiguous, even when the appropriators themselves are the monitors and enforcers [Ost90]. Therefore, in order to resolve these ambiguities a conflict-resolution mechanism needs to be in place. The mechanism itself can be

both formal and informal in nature [Ost90]. Depending on the potential of conflict in a Commons a more formal structure may be necessary, rather than a more informal conflict-resolution mechanism.

Minimal recognition of rights to organize

The rights of appropriators to devise their own institutions are not challenged by external governmental authorities that have the ability to undermine the institutions [OST90]. For example, fishermen in a fishery are allowed to decide upon rules to make sure that the population of fish is sustained, without external government intervention. Considerable evidence exists in the field studies where violations of this principle have been associated with less successful community-based resource management regimes. [Ost08]

Nested enterprises

This is for common-pool resources that are part of larger systems. Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises. [OST90]

6.5.2 Relevance of design principles

Ostrom suggests that these design principles could be used as the starting point for conducting a search of appropriate means of solving problems. One can then translate them into a series of questions that could be asked when thinking about improving the robustness of a common-pool resource system [Ost08]. We use these principles used as guidelines for requirements for the shared meeting room reservation system for MB. In this paragraph we discuss how the best practices discussed are relevant for the actors, processes and artifacts we have identified in this chapter.

The design principles have been relevant in two ways, first of all any insights in new processes or actors or artifacts have been included in our analysis of the actors, processes and artifacts that we will use as a basis for the IT requirements. Secondly, the design principles make clear that organizational changes are required as well: the school of Management and Governance needs to think about the implementation of a collective choice arrangement and decide on the operational rules to use. We provide an analysis of the current situation with regard to collective choice arrangement and operational rules in chapter 7.

Design principles	Help to resolve which problems:
1,2,3	Collective action problems in Commons such as: free-riding, problems associated with subtractability of use (overuse, equitable distribution of resources)
4, 5,6	Improve robustness of the institution (provide continuous mechanisms for invoking and interpreting rules and finding ways of assigning sanctions that increase common knowledge and agreement
7	Prevents those who want to evade local systems from claiming a lack of legitimacy

8	Large scale problems are reduced (monitoring becomes harder in larger scale commons)

Figure 23 Relevance of design principles adaptation from [Ost90][NRC02][Ost08][McG00]

The relevance of each design principle for the sustainability of a Commons can be seen in Figure 23. Clearly defined boundaries, congruence and collective choice arrangements enable that the individuals in a Commons have the tools to deal with any collective action problems. Monitoring, graduated sanctions and a conflict mechanism improve the robustness or effectiveness of the institution (governing body) to allow the individuals in the Commons to deal with collective action problems. Minimal rights to recognize allow individuals to actually create a collective choice arrangement, which is necessary to improve the robustness of the institution. Finally, nested enterprises are a way to cope with large scale problems, of cost of measurement (see discussion of Common-pool resource).

6.6 Best Practices IT

In this section an answer is given to the question: “what best practices can be learned from comparable IT systems?” To answer this question we have studies three cases. The first case is that of Spitsmijden where we see a Commons situation that uses technology to monitor the use of appropriators in a Commons. The second case is ROC Friese Poort where we see the application of monitoring technology in a school of environment to handle the unplanned use of meeting rooms. The third case is that of Microsoft where we see how this company has arranged for its employees to reserve rooms in their office near Schiphol.

6.6.1 Spitsmijden

Spitsmijden is a project done by collective Transumo that has been done to research the problem of highway traffic jams in the Netherlands. Specifically the goal is to expand the repertoire of control mechanisms with regard to road usage during peak hours. The first test was done in 2007 and led to the conclusion that financial stimuli work to reduce behavior that leads to peak hour traffic jams. Spitsmijden 2 is the second test performed by Transumo in the line of the Spitsmijden project. The goal in this test was to answer three questions: do rewards work over a longer period of time? How important are alternative modalities for behavioral changes? Does peak hour avoidance behavior of the participants lead to noticeably less traffic during peak hours or is the space filled up by latent demand? [SPI09]

Spitsmijden 2 is an interesting case for this research because it shows a possible way for IT to contribute to Commons problems that exist in the operational world. First of all, let us see why the Spitsmijden case can be used in this research. In general a good is considered a Commons when it is hard or costly to exclude an individual and the resource units produced are considered subtractable. [McG00] In case of highways the highway could be considered the resource system, while space in time used on that highway is the resource unit produced. When one driver is driving his/her car on the road (appropriation), another driver cannot occupy the same space in time, at least not without causing discomfort for both drivers. Thus the subtractability clause is satisfied. With regard to excludability, in the Netherlands there are no toll ways or other means to deny an individual access to the highway; resulting in that it is hard to exclude an individual from a highway, fulfilling the excludability clause. Thus according to the excludability and extractability clause Dutch highways can be considered a Commons. Specifically highways in recent years have been categorized an infrastructure Commons, a physical resource system made by humans for public consumption. [Hes09]

Now that we have established that this case can be used, let us see how technology was employed in Spitsmijden 2 and how it could be applied to the Commons framework. In the actual Spitsmijden 2 test technology was employed to measure participants’ behavior. [Spi09] Four different technologies were used to measure that behavior: cameras, GPS, Electronische Voertuigidentificatie and log entries. Firstly, cameras were used to register all passing vehicles to collect data for behavioral analysis. A total of twenty cameras were placed on the highway, located on fixed locations, using a license plate recognition system. Secondly, smartphones were used to collect data about individuals’ travel behavior.

Each participant in the test received a smartphone equipped with GPS technology and a unique identifier. Every second the software on the smartphone recorded the location of the telephone and transmitted the data to a central database. Thus it was possible to record behavior of individuals while they were not in the car, to create better insight in the individuals' behavior. Thirdly, Electronische Voertuigidentificatie was used as an experiment by a subset of the participants. This technology was at the time of Spitsmijden 2 in prototype status and worked as follows: each participating vehicle had an EVI-chip, which contains an electronic vehicle identification code. Each vehicle also had a central unit and RFID reader and a GPS-OBU. The On Board Unit (OBU) combines GPS information with the vehicle identification, which is obtained through the central unit and EVI-chip. Fourthly, participants were asked to keep a digital log of their travel behavior.

Measuring participants' behavior is defined as the monitoring process in the operational world. Based on the information provided in the Spitsmijden case this would mean that IT enabled monitoring could be useful in a Commons situation where: a) the resource system has well defined boundaries, b) the renewability of resource units is instantly, c)there is a high cost of measurement (resource units are non-storable, and mobile). As a side note, apparently the costs of measurement are not too high to prohibit the deployment of the Spitsmijden test. This could mean that the information provided is valuable enough to warrant making monitoring technology investments.

6.6.2 ROC Friese Poort

ROC Friese Poort is a school that has implemented a system to increase the occupancy of class rooms. A roster system has been coupled with a lighting system to detect whether a room is in use. If it the lights are out the room is made available in the software system. This software system can be accessed through various touch display screens in the school, allowing students and teachers to easily see which rooms are available for use.

In this case the rooms in the Friese Poort can be considered the resource system, producing time to spend in the rooms. The interesting thing about this system is that it combines automated monitoring functionality with a way to make a non-storable resource unit storable. That is, if a room is open and nobody uses it, time that could be spent in it, is lost forever. However, this system creates a virtual representation of the resource system and allows appropriators to appropriate time in those rooms in advance. Furthermore, the system aims to have an up-to-date view of the physical world, by using the lighting system to check for availability. By updating the virtual representation with each change in the physical world, the availability information the system provides becomes much more valuable simply because it is likely to be correct. This availability information is accessible by any appropriator, which allows the appropriator to check at the last moment whether there is a room available for an unplanned meeting, ad hoc counsel with a student, or other last minute use for a room. This in turn allows the occupancy to be much higher, because the system allows the user to reserve room in a flexible enough fashion to accommodate those ad hoc meetings.

Thus, due to the nature of IT to provide information in a fast accessible way to individuals, the appropriation process itself can change dramatically as people better understand the resource system and how, the way and speed , resource units are produced.

6.6.3 Microsoft

We have interviewed two people at the Outlook, the Microsoft office near Schiphol Amsterdam, to find out the concepts behind their room reservation system. The results of these interviews can be read below. We discuss which rooms are available to the employees, how they are used, and what ICT is used to facilitate the use of those rooms.

Firstly, Microsoft has around 850 employees in the Netherlands, and around 623 workspaces in the office near Schiphol. The Microsoft room reservation system is part of a larger service called the hospitality team. The hospitality team takes care of all facilities. This includes a broad spectrum of services, aimed at taking care of the supporting facilities for both employees and guests. For example, when an employee organizes a meeting, the hospitality team takes action to make all arrangements for any possible guests, such as parking passes, access passes, etc. But also, catering services for the meeting are handled by the hospitality team.

Secondly, our interviews were mainly aimed at getting a better understanding of the rooms, and how they are used by the employees and the supporting room reservation system that handles the reservations. With regard to the infrastructure: The Microsoft building has several floors with meeting rooms on each of them. However, not all meeting rooms can be reserved. The community area has eight meeting rooms (which have to be reserved to be used, officially). On the sixth floor there are an additional eight meeting rooms which can also be only used through reservations. On the second, third, fourth and fifth floor there are at least six meeting rooms on each floor, which can be used without reservations. In fact it is impossible to reserve these rooms.

Thirdly, reservation and actual use of a meeting room. The meeting rooms at Microsoft are used for more formal meetings, for example with guests or other important meetings. Employees use a form to request service from the hospitality team. This form handles, amongst others, the actual reservation of the room, but also asks whether catering is necessary, whether guests will be attending, whether parking passes or Wi-Fi is necessary. Basically the form allows the employee to arrange for any facility a guest may need. With regard to the actual room reservation, the start and end date, start and end time of the reservation, the contact details, cost Centre, the amount of persons and the required facilities of the room need to be filled in. After the form has been filled in, the hospitality team takes care of the arrangements that need to be made. In order for the employee to use the room, all he needs to do is to go to the room and sit in it. There is no separate check in feature. The reservable rooms do have a small computer display near the room that displays all reservations for that day.

Fourthly, unplanned meeting rooms use. As discussed before, Microsoft has made the choice to split up the rooms in two categories: rooms that can be reserved and rooms that cannot be reserved. The rooms that cannot be reserved do not use any technical interface, an employee, possibly in the presence of his meeting group, walks by to see whether they are in use, and if not, has to physically sit in them to claim the room. The employee can then message/e-mail his other employees to let them know in which room they will meet.

Fifthly, the reservation system. Microsoft uses Outlook and Exchange to handle the reservations for the meeting rooms. For each room an Outlook calendar has been made, which is stored on the exchange server. The hospitality team is the only group of employees that has access to that system. All employees can reserve meetings via the form, which is accessible via the intranet.

Each meeting room in the community area and the sixth floor has a small mounted computer display (Windows embedded device) that displays reservations for that room for that day. This display is meant to display output, it is not meant to be used as an input device.

6.7 Conclusion

In this chapter we have given an answer to the question: "What are the desired roles, processes and technology for an information system to support planned and unplanned use of the shared meeting rooms?" We have answered this question by answering two sub questions; we discuss these answers summarized below.

a. *What best practices for information systems can be learned from Institutional analysis literature to support use of a shared resource?*

Firstly, we have looked at Commons literature to identify three levels of analysis, operational, collective choice and constitutional choice. For each of these levels we have identified the, from an information system perspective, relevant actors, processes and artifacts.

The operational level is about the actions of individuals that directly affect the physical world. [Ost90] The collective choice level defines the rules that are used in the operational level; for example the do's and don'ts with regard to appropriation or provision). [Ost08] The constitutional choice level is about defining the rules for the collective choice level. [Ost08] These collective choice level rules then in turn help define the operational choice levels. What can be done at a higher level will depend on the capabilities and limits of the rules at that level and at a deeper level. [Ost08] We also have chosen to slightly deviate from the typology of the three levels of analysis as it allows for a more logical categorization of certain actor roles (monitor, enforcer, and arbiter). We use these actors, processes and artifacts as a basis for the processes our information system is going to support.

Secondly, we have discussed best practices for Commons, i.e. those factors that allow Commons to endure over longer periods of time. We have used the Design principles as proposed by Ostrom [Ost90]. These principles are: Clearly defined boundaries, Congruence between appropriation and local conditions, Collective choice arrangements, Monitoring, Graduated sanctions, Conflict-resolution mechanism, Minimal recognition of rights to organize, and for Common-pool resources that are part of larger systems: Nested Enterprises.

The design principles are relevant for our Information system in two ways, first of all any insights in new processes or actors or artifacts have been included in our analysis of the actors, processes and artifacts that we will use as a basis for the IT requirements. Secondly, the design principles make clear that organizational changes are required as well: the school of Management and Governance needs to think about the implementation of the collective choice arrangement and operational rules used.

b. *What are the best practices in the market with regard to comparable information systems?*

The second sub question has been answered by looking at three different cases. The first case is that of Spitsmijden where we see a Commons situation that uses technology to monitor the use of appropriators in a Commons. The second case is ROC Friese Poort where we see the application of monitoring technology in a school of environment to handle the unplanned use of meeting rooms. The third case is that of Microsoft where we see how this company has arranged for its employees to reserve rooms in their office near Schiphol.

From Spitsmijden we have learned that ICT enabled monitoring is useful for infrastructure Commons (the same Commons category as the shared meeting rooms at Ravelijn), even when there are high introduction costs involved, because the resource units are non-storable and mobile for Spitsmijden. Furthermore, Spitsmijden also has shown that rewards are useful to use to promote wanted behavior this can be used for the requirements of the information system as an addition to the graduated sanctions design principle from Ostrom [Ost90].

ROC Friese Poort has shown us that monitoring technology for unplanned use can consist of using the lighting system to identify whether someone is in a room or not. This allows the system to know whether a room is in use, without the user having to do anything. In turn, the accuracy with regard to room availability of the system improves, and makes the system more valuable for the people at the school.

Microsoft is the third case we have researched. The Microsoft room reservation system is part of a larger service called the hospitality team. The hospitality team takes care of all facilities for their employees and any guests they may have (ranging from Wi-Fi, to parking passes, to catering). Microsoft has decided to functionally split up rooms in two categories: rooms that can be reserved, and rooms that are meant for unplanned use. The rooms that can be reserved are reserved via the hospitality team, and are also meant for more formal meetings (hence the hospitality team). Each of those meeting rooms has a wall mounted display near the room to show people the reservations for that day, Outlook and an exchange server is used to record the room reservations. The rooms for unplanned use have no dedicated information system; people have to physically walk by the room to see whether it is available.

7 Current situation Part II – A Commons perspective

In this chapter we provide an answer to the two sub questions: "*What actors, processes and artifacts exist within the current situation, taking the Commons framework as a reference?",* and "*How well does the organization in the current situation score with regard to current application of the identified best practices for Commons?"*

This chapter is therefore an addition to the first current situation chapter. After our analysis of Commons literature we found that several processes and actors and artifacts were not yet discussed in our current situation chapter. Therefore we apply two levels of analysis to the school of Management and Governance to find out how the resource system, collective choice arrangement and relevant actors and processes take place in Ravelijn. We omit the constitutional choice level of analysis as this level is a given for us in this research, we do not aim to change it, or support it in our system. The collective choice level has been included, as the output (operational rules) may be relevant for our information system. This analysis allows us to get a better understanding of the current situation from a Commons perspective, which in turn allows us to evaluate how the current institution and related processes work.

Secondly, we discuss how well the school of Management and Governance scores with regard to the commons best practices. Any possible shortcomings from a Commons best practices point of view will be included in the Requirements specification.

This analysis of the current situation has been based upon interviews with employees and observations we have made while doing the interviews.

7.1 Operational choice level

We firstly discuss the operational choice level. In the table below, Table 10, we provide an overview of the actor roles and processes as defined in chapter 6, we also state for each actor whether a formal function at the school of Management and Governance corresponds to it and, if applicable, how the relevant processes are performed. We discuss each of the processes, not previously covered in chapter 4, in more detail below. This means that all processes except for monitoring and appropriation are discussed in this section. At the end of this section we also discuss the feedback process between the operational and collective choice level. Communication of operational rules to operational level is discussed in the collective choice level section next.

Commons Actor	Function at Ravelijn	Commons Process	Processes at Ravelijn
Authorized viewer	• Any individual who may enter Ravelijn, which could basically be anyone	Access the Commons	Walk through the door at Ravelijn
Appropriator	• MB employees, • MB students, • Future: every employee and student on the campus	Appropriation	Reservation for future use Use without reservation
Producer	• Reception desk • Huismeester Ravelijn • Management school of Management and Governance • Facilitair Bedrijf	Maintenance to the resource	Maintenance of the rooms
Provider	• Facilitair Bedrijf	Arrange for provision of the resource	Rents the shared meeting rooms to the school of Management and Governance
Enforcer	• Huismeester • Reception desk • Secretaries	Enforce rules	No formal enforcement
Monitor	• Periodically by students	Observe and record displayed behavior by appropriators	Students physically walk through Ravelijn
Proprietor	• Management	Distribute property rights	Sets policy for who may reserve and use rooms
Arbiter	• Most likely: reception desk	Resolves conflicts between appropriators	No formal arbitration

Table 10 Actors, processes in Ravelijn at operational choice level

7.1.1 Access the Commons

During opening hours any individual can simply walk through the rotation door into Ravelijn, thereby accessing the commons. Outside opening hours it's currently not possible to enter Ravelijn for regular employees and/or students, but there is to be a card system to be implemented that allows certain employees or students to enter the building. Two different representations of the resource system can be distinguished: physical and virtual. The physical representation is the actual shared meeting rooms. These shared meeting rooms themselves can be locked, but there are some floors where the rooms are unlocked by default. In the case of physically viewing the rooms, there is no formal check whether an individual is allowed to see/access the commons.

The virtual representation is that of the shared meeting rooms in the Outlook agenda. In the virtual case, it becomes a lot easier to check whether someone is allowed to see/access the commons. Only reception has access to the Outlook agenda, and thus can act as a gatekeeper of the virtual representation.

7.1.2 Maintenance of the resource

This is a combined effort of both reception desk, management MB and Facilitair Bedrijf. Reception desk and management MB handle the requests for maintenance, Facilitair Bedrijf performs the actual maintenance, such as repairs.

7.1.3 Arrange for provision

Currently we have identified the owner of the shared meeting rooms as the directeur bedrijfsvoering, who rents the shared meeting rooms (in fact Ravelijn) from Facilitair Bedrijf. As such he can be considered, from the operational world perspective, to be the owner of the Common Pool Resource. The case of usage of shared meeting rooms by external parties has occurred. However, these do not occur on continuous basis, but rather a single meeting held at Ravelijn.

7.1.4 Enforcement

It was hard to find the operational rules in place, it was also hard to find out who and how enforces those rules. One has been found: reception checks whether an individual is a student or employee at MB. If not, the shared meeting rooms cannot be used by that individual. Otherwise we have found no rules that limit unwanted behavior or try to encourage wanted behavior. We think that this is also the reason that it is hard to find an enforcer role, there are simply no rules to enforce.

7.1.5 Distribute property rights

As the monitor, enforcer (and as we will see), collective choice participant positions are not formally acknowledged the proprietor role in the case of Ravelijn is also not explicitly available. Of course management decides who may reserve and use rooms, but the other roles are not formally decided.

7.1.6 Conflict resolvement

We have found that in the current situation, if there are conflicts between appropriators, the appropriators handle these themselves. For example, a common occurrence is that someone is sitting in a room where someone else has made a reservation. Usually the people without the reservation are asked to leave, and they generally do so. The most likely party to get involved when a conflict arises is reception desk, as they are responsible for handling all reservations, and would be a logical contact point for appropriators.

Processes between operational level and collective choice level

7.1.7 Feedback to collective choice level

There is no explicit process of providing feedback about the operational world to the collective choice level. Informally people who have decision power on the collective choice level may talk with people who operate on the operational level.

7.1.8 Common Pool Resource

In this paragraph we discuss the shared meeting rooms as a common-pool resource. First we discuss the resource system, next the resource units and finally the renewability, scale, and cost of measurement characteristics.

7.1.8.1 Resource system

At Ravelijn the resource system is the physical pool of shared meeting rooms. Currently the pool consists of 36 shared meeting rooms, which are located throughout the building. These rooms can be categorized in five types based on the amount of people and specific facilities that room might have, see Table 11. Please note that the Ravelijn houses many more rooms, such as college rooms and offices. However those rooms are outside of the scope of this research.

Type	Size (in persons)	Number of rooms	MB ownership?	Other notable characteristics
Oval VIP Room	40	1	MB	Can only be reserved for VIP worthy events
Meeting room A	16	2	MB	One of these rooms has a video conferencing set up
Meeting room B	8	21	MB	
Meeting room C	6	11	MB	
Meeting room D	5	1	MB	

Table 11 Specification of the shared meeting room pool at Ravelijn

7.1.8.2 Resource units

Each of shared meeting rooms at Ravelijn produce time slots that people can claim to spend time in. Depending on the opening hours of Ravelijn, Ravelijn can produce:

shared meeting rooms * # of opening hours = X hours of available meeting space per day

Ravelijn is usually open between 08:00 and 18:00 thus providing access to the rooms for 10 hours per day. This would mean that the resource system produces 36 * 10 = 360 hours of shared meeting room usage per day. This is an interesting element as it would mean that by merely having the Ravelijn open for a longer period of time, the production capacity of the resource system could be increased. Of course practical constraints such as working day hours should be taken into account before demanding that everyone should have their meetings till eight o'clock in the evening.

7.1.8.3 CPR characteristics

In chapter 6 we have discussed the three characteristics of common-pool resources: renewability, scale, and cost of measurement.

With regard to *renewability*.; the shared meeting rooms are almost instantly renewable. When someone is done using the room, as soon as they have left the room, it is available for use to another individual. This means that from a Commons management perspective, the resource should be easier to manage (as we do not need to take into account regeneration time). *The scale of the resource* is around that of a medium sized common-pool resource. Due to the large amount of users, 1,600, management of the resource becomes more complex, as the resource is too large to be informally managed. Formal arrangements need to be set up. *Cost of Measurement* is decided upon storage and mobility. The resource unit, time to spend in a room, is not storable by default. However, the information system that stores reservations creates the effect of future storability. This means that where in the past unspent time would be lost forever, now mechanisms can be thought up by the collective choice arrangement to

motivate people to use rooms that are unused. Therefore, by allowing people to reserve rooms (which is in their benefit), better monitoring information about the actual usage is generated, which results in lower cost of measurement, when compared to no information system at all. Secondly, the mobility of the rooms is almost nonexistent (Excluding physical relocation of rooms), therefore the cost of measurement should be lower than compared to mobile commons, such as wild life.

In conclusion, the shared meeting rooms as a common-pool resource should be one of the more manageable types of Commons as the renewability is almost instantly, the resource units are future storable and the mobility is low. Only the scale of the resource creates a need for a formal management arrangement, to reduce the effects of collective choice problems.

7.2 Collective choice level

The result of the processes in the collective choice world is to provide a set of operational rules aiming to solve collective action problems, make the Commons sustainable over time, and/or other goals the collective choice arrangement might have. The operational rules at MB are informal in nature, or at least the complete set of formal rules is very well hidden. During the research we have attempted to make clear how exactly rules are created, invoked and evaluated, and who is responsible. It appears that all scientific employees of MB have at least some influence in how the shared meeting rooms are used, albeit in an informal way. This means that employees might talk to their bosses about any disgruntlement they might have with how the rooms are currently being used. Employees sometimes also try and change the operational rules. For example, some secretaries have attached notes to the meeting rooms stating that these cannot be used by students. A summary of the actors and processes of the collective choice world at Ravelijn can be seen in Table 12 below.

There is no formal path to evaluation or explicit collective choice responsibilities attached to a specific function, except for one: management. What we did find was that Management MB is responsible for making the resource available, and hierarchically it would make sense to at least include management as a collective choice participant. However, from a Commons best practices point of view it would be beneficial for the robustness of the institution to include as many appropriators as possible in the decision making about operational rules.

Commons Actors	Functions at Ravelijn	Commons process	Processes at Ravelijn
Collective choice participant	Employees MB	Prescribe operational rules	Informal communication
	Employees MB	Invoke operational rules	Informal communication
	Employees MB	Evaluation of operational rules	Informal communication
	Employees MB	Apply operational rules	Informal communication either in spoken word or written down
Monitor	None explicitly found	Monitor collective choice arrangement	Informal communication
Enforcer	None explicitly found	Enforce collective choice arrangement	Informal communication

Table 12 Collective choice actors and processes at Ravelijn

Please note that apply operational rules is also the process that connects between the operational choice level and the collective choice level. The operational rules are currently only communicated informally, which was why it was quite hard to identify the current operational rules.

7.2.1 Operational rules

The rules, Figure 24, that Ravelijn has in place have been categorized in the seven types of operational rules that exist within Commons (see chapter 6 for a more detailed explanation on the rules). The rules that are currently in place have been gathered through interviews with several employees, reception, professors, secretaries and the director of business.

Interestingly, from these interviews it was found that Ravelijn has very few explicit rules, although in 2009 there were plans by employees to make rules with regard to using the shared meeting rooms, see Appendix D. The lack of rules, enforced by the school of Management and Governance, does not mean that there are no social norms that individuals at Ravelijn abide to. It does however mean that there is a larger chance for people to display unwanted behavior, such as overuse, as there is no formal regulation.

Boundary Rules

a. When a person is an MB Employee or MB student, he/she is allowed access to the shared meeting rooms pool

Scope Rules

b. The main goal of the shared meeting rooms is that they are to be used for meetings
c. Rooms can be reserved to use on a specific time in the future
d. If a room is free, an individual may claim it to have meeting in the available point in time

Position and Authority Rules

e. MB employees and students can appropriate rooms from the pool
f. When an individual is done with the meeting he/she should make sure the room is tidy for the next meeting
g. There is an informal fair use policy with regard to the amount an individual can make use of a room
h. Reception desk handles reservations for shared meeting rooms
i. A reservation of a room has priority over ad hoc use, people who have reserved a room can kick out people who are using that room without a reservation

Aggregation rules

j. None found

Procedural Rules

k. None found

Information rules

l. All employees have access to the overview of reserved rooms (Agenda)

Pay off rules

m. The costs for providing the shared meeting rooms are shared between the departments of the school of Management and Governance
Sources: This inventory of rules is based on interviews and informal conversations with secretaries, manager MB and professors

Figure 24 Rules shared meeting rooms Ravelijn

As can be seen from the rules, Ravelijn currently has some rules in place to manage usage of the shared meeting rooms. Interestingly, none of these rules have a specific punishment or reward attached to them, indicating that they are implicit social norms, rather than explicit law-like rules. The design principles state that sanctions should be available, in order to make the CPR sustainable. This means that MB should more clearly define the consequences of not adhering to the rules, specifically because the strength of the community is not necessarily high enough to warrant effectiveness of social norms.

Furthermore, these rules are not communicated to the entire community, raising the question: are these rules known to enough people to be effective? We think that this is currently not the case. MB should make an effort to communicate the rules better, so that people have a better understanding of what they are and are not allowed to do.

Finally we can ask the question: are there enough rules in place to enable sustainable behavior in this CPR? We think that the answer to this question is also no. For example, responsibilities and authority rules should be better defined. Therefore MB should pay attention to creating a complete set of rules which have consequences (punishment or reward) attached to them to create an effective institution.

7.3 Constitutional choice world

Constitutional choice world provides the rules on how the collective choice world should be run. At the school of Management and Governance this would mean that the situation is analyzed from a University wide perspective. In the constitutional choice world Facilitair Bedrijf, the other faculties and College van Bestuur as well as the department of Information Management are all parties that have influence on the rules of the collective choice world, i.e. how the faculty is run. It is outside of the scope of this research to go in depth on this level of analysis. Although it is important to note that the results of this world do influence the collective choice world, these changes take a lot of time to be implemented and might fundamentally change the situation at Ravelijn. For example, in 2009 Facilitair Bedrijf sent out a memo to change the way rooms are used by the faculties, recommending pooling all meeting rooms of every faculty into one big pool. Even though this memo has been accepted by the College van Bestuur, these changes have currently not yet been implemented at MB. In the meantime, MB does need a system. Therefore in this research we have taken the current institution as a given.

7.4 Ravelijn & Best practices Commons

The sustainability of a Commons depends on how well the design principles as discussed in chapter 6 are applied within that setting. In the next section I will discuss how and if the design principles exist within the context of the shared meeting rooms of MB.

7.4.1 Boundaries

In the beginning of this research a bit of puzzling was involved to find out which rooms were the exact shared meeting rooms and which individuals are allowed to use them. The tricky part is that there are a number of different rooms for group use purposes in the Ravelijn, such as college rooms, practicum rooms and the shared meeting rooms. The shared meeting rooms can be reserved only through reception in Ravelijn, the other rooms are reserved through Reserveringsbureau. The scope for the reservation system of MB is to accommodate the reservations of shared meeting rooms, not the other rooms.

Receptioninsts told us during interviews that both employees and students affiliated with the faculty Management and Governance may reserve/claim these rooms; students and employees of other faculties can sometimes reserve them, but the reception was vague about the specific circumstances.

Interestingly College van Bestuur has agreed with a memo, written by Facilitair Bedrijf in 2010, that states that shared meeting rooms of each faculty are to be put in a UT wide pool; that is, they should be allowed to be used by any UT employee or student. Thus there is a discrepancy in UT wide policy and MB specific policy. This means that the number of possible users of the meeting rooms may change in the future, as well as the way these rooms might be reserved.

7.4.2 Congruence between appropriation and provision and local conditions

The congruence is currently out of balance. When the Ravelijn was built, the offices for employees were deliberately made smaller and the number of meeting rooms was deliberately increased. In Capitool, the previous MB building, the meeting rooms could be only used by employees; now they can be used by both employees and students. However, there is no mentioning of reduced locations for students to meet in the Plan van Eisen for Ravelijn. Thus currently students receive full benefits, but seem to not have contributed to the costs. They did not have to sacrifice space, they only gained space. In the meanwhile, employees did have to sacrifice work space. This incongruence is felt by the departments as well, as notes are being attached to the doors of shared meeting rooms, with the note “these room are not for student use”.

Thus somehow a balance need to be reached for all appropriators involved. A good starting point would be for the system not to allow to students to reserve rooms for future use, they can only use rooms that are available at that moment. This assumes that employees can generally plan their meetings, and thus unused space is not required. However, this assumption is not entirely correct as we saw that employees also have unplanned meetings. Therefore MB needs to adjust their operational rules to address this incongruity, for example by limiting the amount of use by students. The exact solution falls outside the scope of this research, however the IT system should be able to support such operational rules.

7.4.3 Collective choice arrangement

As described in this chapter there is an informal collective choice arrangement where mainly secretaries, reception and management feel responsible for the way the shared meeting rooms are used. An informal collective choice arrangement can work, however it would be useful to also involve other employees, researchers and professors, and students to create sustainable use of the resource. By involving more people greater support is created for these rules [Ost08].

7.4.4 Monitoring

Monitoring is currently insufficient; a periodical measurement by having a student walk through the building does not provide the information necessary to truly understand the usage of the shared meeting rooms. The sample size is too small to detect possible deviations such as peak use, i.e. specific times that are much more popular than others.

7.4.5 Graduated sanctions

Currently there are no sanctions as a consequence of appropriation behavior that negatively impacts the sustainability of the resource. In Commons generally people are punished if they use too much resource (contributing to over-use), or if they use the resource without having appropriation rights (Free-riders). Currently no norm is established on what constitutes as sustainable behavior within the shared meeting room setting, therefore it is difficult for MB to instantiate rules that deal with overuse. Even more importantly, it is currently unknown whether over-use occurs, and whether there are free-riders or the number of free-riders is high enough to negatively impact the sustainability of the resource. Thus before looking into solutions that reduce over-use and free-riders, MB first needs to know what is actually going on.

For the system it is quite important to know the rules that might be used, as these place different demands on the system.

7.4.6 Conflict-resolution mechanism

This mechanism ensures that conflicts with regard to the use of shared meeting rooms are resolved. The rationale for such a mechanism is that individuals will trust the institutional arrangement more, as conflicts can be handled via that arrangement. The more scarce the resource, and the more important the Commons is for the survival of the appropriators, the more important the conflict resolution mechanism becomes. [Ost90] In case of MB conflicts may occur when someone without a reservation is using the room, while another group does have a reservation for that specific time. To increase the trust in the institutional arrangement of MB it would be useful to acknowledge arbiters to resolve conflicts.

7.4.7 Minimal recognition of rights to organize

In the setting of MB, Facilitair Bedrijf en College van Bestuur would be the parties who would be able to undermine the institution present at MB. From discussions with management of MB it seems that MB has reasonable possibilities to run the usage of rooms as the faculty wants, even though Facilitair Bedrijf is a party that tries to influence how the rooms University wide are used. Thus for the purposes of this analysis there is a minimal recognition of rights to organize.

7.4.8 Nested Enterprises

From a University Twente wide viewpoint there are nested enterprises, as each faculty can be considered a separate enterprise. Each faculty can decide how much space and what type of rooms are needed for the faculty, and can decide upon policies with regard to the actual usage of those rooms. The nota on Future Resource needs as written by Facilitair Bedrijf suggests as much. [FB09]

7.5 Conclusion

In this chapter we have expanded upon the original current situation analysis and have analyzed how well the school of Management and Governance performs with regard to the best practices for Commons governance. We have seen that on an operational level the monitoring processes, enforcement processes and arbitration processes are at most informally available. This is understandable as there is no policy with regard to management of the resource as a Commons (that is to reduce problems of overuse, or waste of resources). Therefore the first step for the school of Management and Governance should be to improve upon the first three Commons best practices: better define the boundaries of the resource, improve monitoring and then improve the congruence between appropriation and provision. In other words, management should first know what the resource is, who the users are. Then the information system should support the monitoring of the usage of those users. Finally, while the right monitoring information is being generated, management of the school of Management and Governance should implement a collective choice arrangement to design better operational rules to reduce the problems of overuse and waste of resource.

8 Requirements Specification

The goal of this chapter is to answer the main question of this research: *What are the requirements for an information system to support planned and unplanned use of the MB owned shared meeting rooms in Ravelijn?* Based upon the answers we have gotten to the sub questions we have created a set of recommendations for key requirements. We have synthesized our insights with regard to the desired components, and current situation at the school of Management and Governance, combined with stakeholder wishes into a first version of key requirements, this first version can be found in Appendix F.

We discuss the revised version of the requirements specification, which takes into account the feedback we have received during the validation process, described in chapter **Error! Reference source not ound.**. Firstly we present the stakeholder wishes. Secondly we discuss the organizational requirements that need to be met in order for School of Management and Governance to be able to deal with the expected collective action problems of overuse and free-riders. Thirdly we present the key requirements of the ICT system. We have defined the requirements for the ICT system at the domain-level. This level focuses on describing the user tasks that the ICT system should support. We discuss the choice of the domain level in section 9.3.

8.1 Stakeholder Wishes

In this section we provide an answer to the sub question: "What are the wishes of stakeholders with regard to use of shared meeting rooms?" To answer this question we have interviewed various stakeholders as identified in chapter 3. During the interviews with the various stakeholders, reception desk, employees, students, and management, we also discussed the wishes each stakeholder has for the system. The interviews can be found in Appendix D. From these interviews we have distilled the wishes and discuss them below for each stakeholder group.

8.1.1 Secretaries

Several interviews were held with secretaries from different departments at MB. From these interviews the following insights with regard to requirements for a new room reservation system were gained:

- Secretaries want insight in which rooms are available; specifically they want to be able to view the Outlook calendars. They believe this would make it much easier for them to reserve rooms.
- They would like to be able to reserve shared meeting rooms themselves, rather than via reception. As they have many reservations to make, they think it would be much quicker for them to be able to reserve rooms for themselves.
- For a future system they want to have contact details recorded for each reservation. For example to make trading reservations more easily, but also because they sometimes forget for whom the reservation has been made.
- A mechanism to handle changes in the world in a fitting way; Sometimes it happens that a shared meeting room is temporarily used for another purpose than meeting rooms, such as a temporary office. Currently in this situation all reservations were simply deleted from that room in Outlook, rather than notify the secretaries that the room was no longer available for meeting.
- Currently extra facilities such a beamers or lunch have to reserved separately, secretaries think it would be easy if those facilities could be reserved all in once with the room reservation.

8.1.2 Students

Students have two main wishes for a future system:

- They would like to be able to see which rooms are available and when, without having to contact reception. Also, as the information in the reception room database is not always up to date, they would also like to be able to easily see the available rooms, without actually needing to go to that specific room, to check whether it is actually available.
- They would like to be able to reserve shared meeting rooms.

8.1.3 Employees

Several teaching employees were consulted to find out what wishes they had for a new room reservation system. Like the students the two main wishes were that they would like to be able to:

- access the room agendas themselves,
- Be able to reserve rooms themselves.

8.1.4 Reception desk

A couple of interviews were held with reception. They didn't mind the current way of working, in fact some of them stated that they wouldn't like it if people would be able to reserve rooms themselves (perhaps due to giving up some feeling of control).

8.1.5 Management

The interviews held with management showed one thing very clearly:

- Management would love to have a better insight in the actual usage of rooms, thus a system that can generate more precise management information would fit the bill. Management finds it unclear what the actual demand for shared meeting rooms is. It could be that there are too little rooms (at a certain time), it could be that there are more than enough rooms, thus it useful to management to know what the actual usage (and possibly demand) is for the shared meeting rooms.
- Management MB sometimes lends or hires rooms to other faculties. This is usually done informally, but functionality to accommodate the leasing or selling of rights of appropriation could be useful.
- Management finds it important that the system should fit the way of working of the people at the faculty. Management would rather have a lower occupancy rate and an improvement of the employee satisfaction than a lot of stress and a high absenteeism [Sch10]

8.2 Organizational Requirements

As we have discussed in chapter 5, in order for the shared meeting rooms to be used in both the planned and unplanned manner, we need to minimize the impact of three collective action problems: overuse, free-riders and waste of resources. These problems can have a significant negative effect on the capability of the resource to provide rooms for unplanned use. Therefore we need to keep in mind that the information system should not be the goal in itself, but rather a tool to make sure that the organizational goal is achieved. From Commons theories we have learned that effective institutions,

those institutions that can deal with these problems, share eight design principles. We have applied the first seven design principles to the situation of the school of Management and Governance, with regard to the shared meeting rooms, in chapter 7. Based upon the insights gained in this chapter we provide the following six organizational requirements, Figure 25, that enable the school of Management and Governance to better govern the shared meeting resource and handle the collective action problems.

Org R1. School of Management and Governance must resolve differences between Facilitair Bedrijfs' policy and internal Policy.
Org R2. Appropriation must be fair for the individuals involved
Org R3. The school of Management and Governance must implement a formal collective choice arrangement to prescribe, invoke, evaluate and apply the operational rules.
Org R4. the school of Management must improve monitoring
Org. R5. Graduated Sanctions must be implemented to enforce operational rules
Org R6. Conflict resolution mechanism must be implemented

Figure 25 List of Organizational Requirements

8.2.1 Org R1: School of Management and Governance must resolve differences between Facilitair Bedrijfs' policy and internal Policy.

This requirement is based on design principle 1: Boundaries. As discussed before, the school of Management and Governance currently does not officially allow external employees and students to reserve the Ravelijn Shared meeting rooms. This is not necessarily an issue, as long as the policy by Facilitair Bedrijf is not enforced. However by enforcing Facilitair Bedrijfs' policy, it could cause a further incongruence in perceived fairness of the rules. That is, people from other faculties do not contribute to the costs of providing the meeting rooms, but are allowed to benefit from the resource. A possible solution: MB employees should be able to easily reserve and use the other faculties' meeting rooms as well. However, management of the school of Management and Governance should take into account the negative effect the added demand (by external people) and possibly implement operational rules to keep appropriation fair.

8.2.2 Org R2: Appropriation must be fair for the individuals involved

As discussed before, the employees have seen their offices being reduced in size due to the move to Ravelijn. This is their contribution to the costs of providing the shared meeting rooms. MB Students may use these rooms, but have not lost space, they have gained space to meet in. This is not fair from an employees' point of view. It actually increases the likeliness that departments reserve the shared meeting rooms nearby, simply to have it reserved for their department. This is of course undesirable, as it reduces the amount in which the shared meeting rooms can be used by the entire faculty in an unplanned manner. A possible solution to this issue may be to not let students reserve in advance, only let them use the rooms in an unplanned manner. However, if demand by students is too high, it would create a large demand for unplanned use of the rooms, which in turn could lead to the shared meeting rooms always being full with students. This in turn could lead to employees taking counteractive measures, and reserve rooms for their department in advance. This is also undesirable, as it leads to strategic behavior. Rather we would create trust between the users, peace of mind with the employees

that they can reasonably expect to use rooms when needed. A possible solution may be to limit the total amount of time students can spend in the shared meeting rooms, either individually or for entire groups. In the end, the specific rules in place are not set in stone, and should be adjusted over time to reflect the way management of the school of Management and Governance wants the rooms to be used. This dynamic property is reflected in the next organizational requirement.

8.2.3 Org R3: the school of Management and Governance must implement a formal collective choice arrangement to prescribe, invoke, evaluate and apply the operational rules.

We have not found a group of people who are formally responsible for the responsibilities of the decisions that need to be made on the Collective choice world. In order for the faculty to be able to create more a more fair distribution of the resource, and provide operational rules that reduce or limit any collective action problems that cannot be solved in a technological way, a collective choice arrangement needs to be in place. As stated before, by involving more people in the process of deciding upon the rules, support for the rules should become greater [OST08]. We think that the secretaries, reception desk should be included, as they seem to be the people who know what is going on with regard to appropriation of the shared meeting rooms by employees. The students are missing from this arrangement, we think a delegation of students should be included as well to increase cooperation.

8.2.4 Org R4: the school of Management must improve monitoring

As discussed, the quality of the monitoring information is currently not high enough to know in which degree problems of overuse, free-riders and waste of resource are occurring. This lack of knowledge makes it hard for management to know whether these possible problems are hindering the capability of the shared meeting rooms to be used in an unplanned fashion. Therefore monitoring information needs to be improved. It is important to note that monitoring consists of two different elements on an operational level: 1) monitoring of usage of the shared meeting rooms by individuals, 2) compliance of individuals with the operational rules. The ICT system can help to improve the monitoring of usage, we discuss the specifics later on in this chapter. The ICT system could possibly help with recording the compliance of individuals' with the operational rules, however, this depends on the exact operational rule. Therefore we have included monitoring as an organizational requirement, as it may be that some operational rules cannot be (cost efficiently) monitored by technology, but can be by humans. An example would be, free-riders. The ICT system may be able to detect that someone is present, but is not able to detect whether that person has the right to be there. A secretary on the other hand could perhaps see whether that specific person is an employee or student, and perhaps even whether that employee is an School of Management and Governance employee.

8.2.5 Org. R5: Graduated Sanctions must be implemented to enforce operational rules

Sanctions, there are currently no sanctions in place to regulate behavior. As discussed in chapter 7, in order to sanction or reward, we need to know which behavior is correct and which is not. Therefore, should congestion, free-riders and/or other collective action problems (waste of resources) be present the school of Management and Governance should perform the following steps in order to reduce them.

1) The problems should be detected, which will be possible in the future due to improved monitoring by the ICT system. 2) The collective choice arrangement needs to set up a set of rules that they think is able to reduce the collective action problems. 3) These rules need to be implemented, and, equally important, be actually enforced.

In the first version of the information system requirements we have made suggestions to include fines for certain unwanted behavior. However, after validation, these punishments seem to be hard to enforce. Therefore we think that management should look at other enforceable punishments such as losing reservation rights for employees if they behave in an unwanted way. Another interesting approach could be to provide rewards to promote cooperation, in combination with punishments to reduce unwanted behavior. For example, Management MB could use the ICT system to provide employees with three reservations per month per default and provide them with achievements to increase that number, by using the rooms in a way that positively influences the capability of the shared meeting rooms to be used in an unplanned manner. However, in order to be able to implement such incentive structures, we first need to know more about the actual appropriation behavior by employees and students, which is why monitoring is so important.

8.2.6 Org R6: Conflict resolution mechanism must be implemented

In the next part of this chapter we provide the recommendations for the ICT system to actually reserve and record the use of the shared meeting rooms by individuals. As the use of the shared meeting rooms becomes more formal, we recommend that a conflict resolution is implemented to handle any conflicts that may arise between appropriators (or free-riding individuals'). As the ICT system will now be able to support the registration of both planned and unplanned use, free-riding behavior may become apparent (which in the previous situation would not). Therefore we suggest that MB assigns people the role of arbiter to handle such conflicts, based upon the operational rules. We think that reception desk is the most likely department within the school of Management and Governance to handle this task, as during the interviews they were the people who felt responsible for making sure that the shared meeting rooms were used in a responsible manner.

8.3 Recommended Operational Rules

In chapter 5 we have discussed the possible issues resulting from overuse, free-riders, wasteful use of the resource (through no-shows, larger than required bookings and longer than required bookings) and other possible collective action problems.

As discussed before in chapter 7, there are no rules present at MB that deal with these collective action problems. Furthermore, there is currently no reliable monitoring information available to determine in what amount the collective action problems. Therefore, if we are to provide recommendations to the already existing set of rules, the focus of the operational rules should firstly be to support the generation of useful monitoring information. By focusing on collecting better quality monitoring information, the collective choice world participants will have the information needed to devise new rules that enable the organization to determine in what amount the collective action problems are present and which ones should be solved through operational rules. Below we discuss our

recommendations for the operational rules that the school of Management and Governance should use in combination with the proposed ICT system.

Update after Validation: There have been changes to the operational rules suggested after the validation. These changes have been based upon a) new practical insights through validation, which made some rules not practically feasible or undesirable, and b) new insights based on additional literature. Firstly, the categorization of rules, which has been expanded with the category 'information rules'. The reasoning for the expansion is that this new categorization provides a more complete insight in the types of rules necessary to create the desired outcomes with regard to behavior of individuals. We discussed the rule categories in depth in chapter 6.

Secondly, in the first version of the operational rules we recommended to include fines when people repeatedly exhibit wasteful behavior through no-shows. During validation however, we received remarks from the director that fines cannot be handed out. A possible solution could be to rename the fines to invoices. However, we have reason to assume that the actual consequence of repeated no-shows should be re-evaluated due to the lack of credibility in the current punishment. As discussed in chapter 6, a sanction should be considered credible in order to be effective [Ost90]. As it is currently unlikely that either fines or invoices can be collected, we recommend a different punishment. A solution was provided to us during validation: (temporarily) revoke reservation rights for people who are repeated no-shows. We agree that this alternative punishment is more realistic and has therefore been incorporated in the operational rules.

Thirdly, in the first version of the suggested operational rules we included the rule that the meeting rooms should only be used for meetings. This rule came about from the designation of the pool rooms as shared meeting rooms, and therefore has been adopted in the rules. However, we believe that realistically this rule is not enforceable. A lot of effort would be required from the school of Management and Governance to check whether the rooms are used for meetings. Furthermore the rule did not state any negative consequences to using the room for non-meeting purposes, which further questions the usefulness of this specific rule.

Please note that these rules are not to be set in stone. As discussed in the requirements for the organization: in the future the collective choice participants should actively evaluate the effectiveness of the rules and adjust them, or provide new rules, to reduce unwanted behavior.

The updated rules can be seen in Table 13 below.

1. Operational Position rules
1.1. Authorized viewer
1.2. Appropriator – unplanned use
1.3. Appropriator – reservation privileges for self
1.4. Appropriator – reservation privileges for self and others
1.5. Monitor
1.6. Enforcer
1.7. Arbiter
1.8. Proprietor

1.9. Producer
1.10. Provider

2. Boundary rules

2.1. See Table 14 , third column

3. Scope rules

3.1. A person should check into a room when using that shared meeting room via the ICT System
3.2. When a person does not check in within 10 minutes after the start of his/her reservation, this is considered a no-show.
3.3. Cancellation of a reservation within less than one hour of the actual meeting counts as a no show
3.4. When a meeting ends the appropriator should check-out of the room via the ICT system.
3.5. A reservation for a room has precedence over unplanned use of that same room at the same time period

4. Authority Rules

4.1. See Table 15 , second column

5. Aggregation rules

5.1. No show: When a person has three no-shows, his/her reservation rights will be removed for two weeks. He/she is still able to appropriate shared meeting rooms in an unplanned manner
5.2. If a person is again a no show for three times, his/her reservation rights will be removed for four weeks. He/she is still able to appropriate shared meeting rooms in an unplanned manner
5.3. If, for a third time, a person is a no show for three times, his/her reservation rights will be removed for eight weeks. He/she is able to use the room via the ad hoc method

6. Information rules

6.1. All individuals who have access to Ravelijn should have access to a real time overview of the availability and reservations of meeting rooms
6.2. All individuals who have access to Ravelijn should be made aware of the operational rules

7. Pay off Rules

7.1. Maintenance and provision of the shared meeting rooms is paid by the school of Management and Governance

Table 13 Suggested operational rules

The table, Table 14, below presents the roles as defined in the operational position rules in Table 13. In the second column the authority rules for each role are defined. The authority rules state the actions assigned to an individual at a certain node. The boundary rules define the individuals or groups of individuals who may hold which position.

Position	Boundary rules	Authority rules
Authorized viewer	• Any individual who may have access to Ravelijn, and does not belong to any of the roles defined in the rows below.	Has the right to enter Ravelijn
Appropriator – unplanned use	• Students school of Management and Governance	Has the right to use the shared meeting room, but does not have the right to reserve a shared meeting room
Appropriator – reservation privileges for self	• Employees school of Management and Governance	Has the right to use the shared meeting room, and has the right to reserve a shared meeting room
Appropriator – reservation privileges for self and others	• Reception desk Ravelijn, • Secretaries school of Management and Governance	Has the right to use the shared meeting room, and has the right to reserve a shared meeting room for both self and other individuals
Producer	• Reception desk • Huismeester Ravelijn • Management school of Management and Governance	Constructs, repairs, or takes actions that ensure the long-term sustenance of the shared meeting rooms (i.e. the physical infrastructure) itself.
Provider	• Facilitair Bedrijf	Rents the shared meeting rooms to the school of Management and Governance
Monitor	• All appropriators with reservation rights	observes actions of individuals with regard to use of the shared meeting rooms
Enforcer	• Department heads for application of punishments/rewards to employees • Reception desk for application of punishments/rewards to students school of Management and Governance • ICT system for appropriators with reservation rights	Apply punishments and rewards based upon the operational rules
Proprietor	• Management school of Management and Governance • Department heads school of	Has the right to determine who else will have the right of access to a resource and whether that right can be transferred

	Management and Governance	
Arbiter	• Reception desk • Huismeester • Management school of Management and Governance	Resolves conflicts between appropriators

Table 14 Authority and Boundary rules

There are a few design choices behind the boundary rules, specifically the positions of enforcer, monitor, proprietor and arbiter. We discuss these now. Firstly, the enforcer role. This role is recommended to be held by: department heads, reception desk and the ICT system. Department heads can informally confront an employee with his/her behavior, which is currently also done in other situations such as print behavior. If an employee uses too much paper, a department head can confront that employee. Thus, the department head is a natural fit for the enforcer role for employees. However, students do not have this interaction with department heads. We could of course have recommended that department heads take up this responsibility as well, but we think that reception desk is a more natural fit. The reason is that currently students claim a room via reception desk. Therefore, reception is already used to dealing with students. Finally, the ICT system provides the possibility to enforce the no-show related aggregation rules, by possibly automatically removing/restoring reservation privileges after aggregation rules have been broken.

Secondly, for the role of monitor we have chosen to allow all appropriators to be a monitor, as this conforms to best practices in Commons. Therefore there should be a mechanism that allows appropriators to report unwanted behavior by others to the enforcers.
Thirdly, we discuss the proprietor role. As with enforcers, it seems logically to take the organizational hierarchy of the school of Management and Governance as a basis. Therefore we have chosen to make management of the school of Management and Governance in combination with the department heads the person who may decide who can access and use the shared meeting rooms.

The final role is that of arbiter. We think that, given the current duties of reception desk, the reception desk including Huismeester is the most appropriate functions at Ravelijn to hold the arbiter position. They are the constant factor in the building, generally present, and available for assistance should an employee or student need it. Therefore, the arbiter role seems a logical extension of their current activities. They are the most likely to be able to quickly respond to conflicts, should they arise. Should larger conflicts arise, management is the appropriate party to handle those conflicts.

We have discussed the organizational requirements and the recommended operational rules to be used. Next in this chapter we discuss the requirements for the ICT system that helps support the planned and unplanned use of the shared meeting rooms, using the discussed organizational requirements and recommended operational rules as a basis.

8.4 Requirements information system

Lauesen discusses that requirements can be described on four levels: goal-level, domain-level, and product-level and design-level [Lau02]. See appendix J for an overview of the specifics of each requirement level. We have chosen to do the ICT requirements at a *domain level,* based on two reasons. Firstly, management has no specific software package in mind at this point in time. Therefore we think it is in managements' best interest to let them have flexibility in choosing a software package supplier. Domain level requirements provide this flexibility, while still providing adequate task support [Lau02]. Secondly, adequate task support means that we can use the best practices discussed in chapter 6, to define those elements that should solve the root problems as discussed in chapter 5, while leaving enough room in the details to let management have freedom in which software architecture is used to fulfill the requirements. Goal-level requirements do not provide the level of detail the domain level requirements provide. We feel that design and product level requirements are too restrictive at this point in time. Specifically design level requirements may force the management of the school of management and governance in a direction that is not necessarily the best way. For example, a vendor might have a cutting edge technology to more adequately address the root problems that this information system should overcome.

Lauesen suggests that a specification should contain the following parts: business goals, context diagram, user tasks and quality requirements. The business goals describe the goal of the system in terms of how the ICT system should benefit the organization. The context diagram shows the limits of the functionality of the system. User tasks show how the user interacts with the system. Quality requirements provide information about critical quality factors [Lau02]. We follow this guideline in this research.

8.4.1 Business goals

Business goals are the high level reasons for getting the new product [Lau02]. In chapter 5 we have discussed the problems that currently exist in this situation. We have also related the problems to each other in a causal chain. From this problem bundle we have defined the following reasons for getting a new ICT system:

a) Replace the current ICT system, which is unable to support planned and unplanned use of the shared meeting rooms
b) Enable a more efficient reservation process for employees
c) Provide useful monitoring data with regard to the use of the shared meeting rooms

8.4.2 System limits

Now that we have discussed the organizational requirements, we move on to the scope of the ICT system. The scope shows what functionality is within our system and what functionality is not [Lau02].

We provide this scope, through a context diagram. A context diagram is a useful way to show the scope of the system by viewing the product as a black box surrounded by user groups and external systems with which it communicates. [Lau02] The scope of the ICT system for planned and unplanned use of the shared meeting rooms can be seen in Figure 26. There are three entities: user groups, external ICT

systems and our system (in the middle). The user groups have been based upon the positions discussed in the recommended operational rules. Between the user groups, external systems and our system are arrows, these arrows indicate how each entity interacts with the system; it shows the flow of data. In order for this data to flow, a user has to either be able to input that data or receive output from the system via what are called 'interfaces'. An interface is defined as input to the ICT system or output from the ICT system. Each term seen in the context diagram is a different interface, and is discussed in detail below.

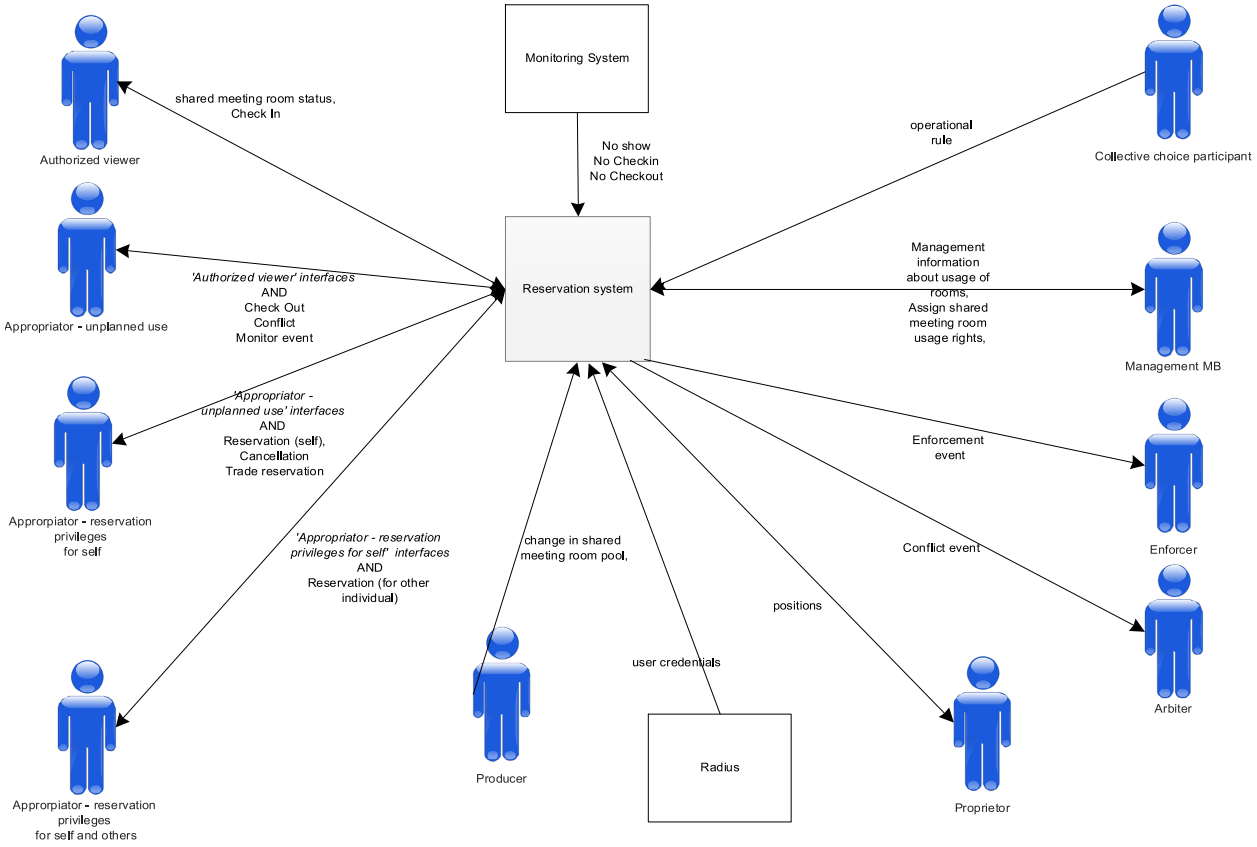

Figure 26. Context diagram Reservation system MB

R1. The system should support all the interfaces and actors shown in the context diagram.

The system should support all organizational positions, and the actions they can undertake (see operational rules in the previous section). The reason to support all processes in the operational world is that in order for people to use the system for unplanned use, the system needs to contain up to date information about the shared meeting room availability, and therefore all behavior related to the shared

meeting room needs to be recorded into the system. This way, the system can provide the right information at the right time to appropriators and allows them to easily see which rooms are available at a given time. In turn, by storing this information in a database, we can provide monitoring information to the collective choice world; for example, information about the usage of the resource and possibly compliance with operational rules. This allows the collective action arrangement to see whether current rules are working to reduce or minimize collective action problems. The monitoring information also provides the producer, i.e. management of the school of Management and Governance with information, about how often and by whom the shared meeting rooms are used. This allows the producer to better determine the need for the resource, and allows him to make adjustments for future infrastructure needs. In the next sections we discuss each user group and the corresponding interfaces with the ICT system.

Authorized viewer

The authorized viewer is a person who may enter the resource pool, but has no other rights. In the case of the shared meeting rooms this position is useful to indicate a) people from other faculties who have a meeting with a person who may reserve/appropriate shared meeting rooms at Ravelijn b) employees and students from the school of Management and Governance who are not logged in. To make the information about rooms, and their availability, easily and quickly accessible the system should therefore provide an interface that allows any person to quickly view the status of a room, without having to log in.

After validation update: An authorized viewer should also be able to check in for a meeting that he is attending. The reason is that the original reservee may be or expect to be too late, this way other people can check in for the room. We explain the mechanism for authorized viewers check in in the task descriptions. From an monitoring point of view the ICT system should also support check-in and check-out of a room. This is a way to define that the an appropriator has actually started to use the room, or has stopped using the room. By having a check-in and check-out procedure the system is likely to contain more correct and up to date monitoring information about usage of these rooms. In turn this allows other employees to see which rooms are in use at that moment via the ICT system, without needing to go to the actual meeting room to see whether it is in use or empty.

Appropriator – unplanned use

Appropriators with unplanned use rights are currently students at the School of Management and Governance. This is the most basic form of appropriation, this appropriator can claim a room for himself, but cannot reserve rooms for later use. This appropriator has the same interfaces as the authorized viewer, but also has the possibility to check out (as he can claim rooms for himself), the possibility to enter a conflict (which may occur due to scheduling conflicts) and the possibility to enter a rules violation event. A rules violation event is an event where the appropriator sees something that he believes is a violation of the rules, in other words, he can be a monitor.

The reason for this specific appropriator type is as follows: we have discussed in the organizational requirements that employees of the school of Management and Governance carry the majority of the costs for these rooms by working in smaller offices, while the students do not contribute in a similar

fashion. Therefore in order to bring some equality into this situation, different types of appropriators have been created, with different rights in how they can use the rooms. We discuss the 'appropriator – reservation rights self' next.

Appropriator – reservation privileges for self

This is the second appropriator role, to reflect that reservation is a privilege, not a right. Employees of the school of Management and Governance hold this position by default. This position has the same interfaces as the appropriator – unplanned use position, and has also the following interfaces: reservation, cancellation and swap. These three interfaces reflect the fact that this appropriator can make reservations for shared meeting rooms. He can also cancel a reservation (to free up the room for other appropriators). Finally he can also swap a reservation. Although reservation slot exchange is currently mainly done by secretaries, we suggest to support this process in the system for this appropriator role as well, as it could reduce the faulty/incorrect reservations in the system. These three extra interfaces allow MB employees to reserve rooms themselves, without having to consult the reception desk.

Appropriator – reservation privileges for others

The third type of appropriator has the same interfaces as the appropriator – reservation privileges, and can also make reservations for other individuals. Secretaries of the school of Management and Governance and reception desk Ravelijn fall under this type of appropriator. The additional interface for this type of appropriator is: reservation (for other individual).

After validation update: in the first version only secretaries could check-in for other employees, but remarks were made that this may be too cumbersome. In order to solve this issue, we have changed the check-in procedure in such a way that the reservee is in control of who may check-in (basically anyone who has the check-in code). The result is that the check-in (for others) interface is now available to authorized viewers and all appropriators.

Producer

This position is the second position that reception desk can hold. This position is supported by the system to make sure that changes in the real world are also reflected in the database of the ICT system. For example, changes in allocations of rooms, additions of new shared meeting rooms, or temporarily not making the shared meeting rooms available for use, are all changes in the real world that affect the availability of the shared meeting rooms. Therefore there is the interface change in shared meeting room pool, to record these changes in the ICT system.

The reason that reception should perform these tasks is that they currently are at the center of day to day facility related communication, and thus are the most logical choice to handle these updates and changes.

Proprietor

This position decides who may have access to the resource, i.e. define who has the right to claim and reserve rooms. With regard to our ICT system this position is basically a user admin, an individual who can give other individuals appropriation rights (including reservations), or remove them. Therefore an

interface positions is created to let the proprietor add, edit, and remove positions (the user groups discussed in the system limits) for an individual.

Arbiter

The arbiter position is responsible for resolving conflicts. As discussed in the recommendations for the operational rules, there are two functions within the school of Management and Governance to hold this position. For day to day conflicts, such as a scheduling conflict reception desk should be able to handle these. For more serious conflicts management is the logical function to handle these. The arbiter has one interface with the system and that is “Conflict”, where he receives notifications of conflicts (from appropriators) and can act upon this conflict.

Enforcer

In the first version of the system we did not include specific enforcer roles, as the ICT system was responsible for enforcing rule infractions. After validation the operational rules upon which the enforcer role was based, have changed too much for the ICT system to reliably singlehandedly hold the enforcer role. Therefore the department heads and reception desk can now also hold the enforcer role, and should have an interface with the ICT system to act upon rule violations. This interface is Enforcement event.

Management MB

Management MB is the role that is interested in management information. Therefore the system should provide an interface that enables management to view information about the usage of the resource. This means that the monitoring section of the system should be able to record the necessary data.

Collective Choice Participant

The collective choice participant is a person who maintains the operational rules in the system. The system should have an interface that allows that individual to view, create, update and remove rules.

Monitor

Commons theory suggests that the monitor usually is a person. In the case study of Friese Poort it was shown that monitoring information can also be generated through. It is our recommendation that the ICT system should support both input by people as well as technology to monitor usage. The benefit of technology is that it can always monitor, as long as the technology is working. Therefore it places less stress on the collective choice arrangement to find incentives to motivate people to monitor the usage of the resource. However, individuals should still have the possibility to report abuse of the resource, and an interface is necessary to accommodate these reports (which has already been discussed in appropriator – unplanned use). More in depth discussion of monitoring is provided in the task descriptions.

Radius

An interface has to be made to Radius, the UT wide user credential system. This allows all individuals to use our ICT system via their usual username and password.

8.4.3 Task Descriptions

In the next sections the tasks are described that the system should support. Please note that it provides a selection of the tasks we have considered to be of primary interest to MB, because they help solve the root problems. In the next section we provide feature requirements for other functionality that is useful to include in the requirements, but do not require task descriptions to be specified.

Tasks and support is a method to describe tasks, domain problems, and the possible support for them [Lau02]. This method describes activities that humans and computer do together [Lau02]. Therefore these tasks describe what activities the ICT system should support. We also provide a possible solution for how the system could achieve this task, taking into account the root problems that need to be solved. The benefit of using Task & Support to describe functional requirements is twofold: a) customer can easily validate them; b) developers can better understand the requirements and check that their design is adequate [Lau02].

R2. The ICT system should support tasks 1.1 through 1.13

The format of Tasks and support is as follows. We provide the name of the task, which corresponds with the interfaces provided in the system limits. For each of these tasks we discuss the purpose, which actors may perform these tasks and the frequency we expect that the task is performed per time unit. Next we discuss the sub tasks of the task, problems, and variants on the task. Please note that the number of the variant corresponds with the sub task it is a variation. The problems are those we have identified in the old way of working, see problem six for a detailed problem bundle. On the right side we provide a solution to how we think the sub task could be supported by the ICT system. These solutions are based upon the found best practices in the external market, as discussed in chapter 6.

8.4.4 View room availability

Task: 1.1 View room availability Purpose: An authorized viewer can see an overview of available rooms Users: authorized viewers and all appropriator types Frequency: Often (anywhere between 25 and 2,000 times per day)	
Sub tasks:	Proposed Solution
1. See currently available rooms **Problem**: Information in the reservation database is not up to date and not	ICT System shows overview of currently available rooms. System also displays all reservations with contact details of the person who has made the reservation.

necessarily congruent with the real world	
Variants: 1a. Check room availability near the room itself	ICT System displays the availability of the room on that day, with the possibility to view the entire availability agenda of that room via a touch screen mounted near the room
1b. Find the availability for a certain date and/or room size	ICT system displays all available rooms that match the criteria entered by the user.

Table 15. Task 1.1 View room availability

8.4.5 Check-in

To support the unplanned use of shared meeting rooms in a user friendly manner it is important that the information about availability of the shared meeting rooms is up to date. The reason is that in case of an unplanned meeting the individual typically wants to quickly find a room. Therefore a correct virtual representation of the availability allows that individual to find a room without having to physically walk through the Ravelijn in search of a room.

Therefore the system needs some way to know that the room is in use. ROC Friese Poort uses light sensors to detect whether a room is in use, which provides information about the availability of the room. However, a light sensor does not provide information about who is using the room. From a Commons perspective we would like to know who is in that room, as it would provide better information about individual usage, and therefore would allow us to measure individual appropriation patterns. This information in turn could provide a baseline for fair use, and allow for better operational rules to be devised to ensure sustainability of the resource (i.e. reduce overuse or free-ridership).

To record whether the room is used and who is using it a simple solution from the hotel industry can be used: a check in by the customer. In a hotel a customer checks in to let the hotel know that the booking is actually used. In our ICT system the check in task allows the individual to confirm that he/she is using the room, optionally on basis of a reservation made earlier. This task is described in Table 16 below.

Update after Validation: We have received suggestions that other people should be able to check in, for example, if the original reservee is hindered due to some circumstance, the other people of the meeting should be still able to check-in the room for that meeting. This functionality has been included in the new version of check in, by making people check in with a code, rather than their Radius user credentials.

Task: 1.2 Check in to a room

Purpose: An authorized viewer (with reservation) checks into a room to use at that time. The check in procedure sets the room to an occupied status in the system. This shows other people, who are looking for a room, that this specific room is already in use. Recording results of the check-in function enables monitoring information about room use. Users: any individual who has a check-in code Frequency: often	
Sub tasks:	Proposed solution
1. Find reservation to check in for	System displays availability and upcoming reservations for that day on wall mounted screen physically near the room.
2. Select reservation	System displays check-in screen after selection of reservation, an individual can check in by entering the check-in code.
1. Check in by entering check-in code on wall screen **Problem: room might be physically locked**	System records that a check-in has been made for a reservation, the room is set to occupied status.
Variants	
1a. User checks in without reservation **Problem**: little motivation for an individual to record the usage in any system	System provides log-in screen via tablet on the wall/outside room, where people can use their Radius account to claim a room for unplanned use for a selected amount of time.

Table 16 Task 1.2 Check in

8.4.6 Reserve room

The solution provided in task 1.3 solves the main problems the employees and secretaries had with the current reservation system: they could not make their own reservations, but always had to do this via reception. The system should make a distinction in the types of authorized appropriators as discussed previously.

<table>
<tr><td colspan="2">Task: 1.2 Reserve a room

Purpose: An authorized appropriator with reservation rights reserves a room for later use

Users: Appropriator – reservation privileges for self, appropriator – reservation privileges for others

Frequency: Often</td></tr>
<tr><td>Sub tasks:</td><td>Proposed solution</td></tr>
<tr><td>1. Get overview available rooms (see Task 1.1)</td><td>ICT System shows rooms in an outlook calendar style with availability of each room, displays all reservations with contact details of the person who has reserved</td></tr>
<tr><td>2. Log in</td><td>System shows log in screen

In order to make a reservation the user needs to log in</td></tr>
<tr><td>3. Make reservation

Problem: Contact information of the reservee is not consistently stored in the database.

Problem: Functional Beneficiaries cannot reserve rooms in the Outlook system themselves.

Problem: Reception is not always available when trying to make a reservation.</td><td>System shows the room reservation screen where all necessary details (user contact details, reservation information) need to be filled in to reserve the room. System also sends an e-mail to the reservee with reservation information and a four digit check-in code.</td></tr>
<tr><td>Variants:

4a. Authorized appropriator wants to invite other users to the meeting</td><td>System should allow other people to be invited to the meeting, system sends reservation information with check in code to each invited individual.</td></tr>
<tr><td>3a. Secretary/reception makes a reservation for another user</td><td>System allows people with a appropriator – reservation privileges for self and others to select another (at least) authorized viewer to make a reservation for that individual.</td></tr>
</table>

Table 17 Task 1.3 reserving a room

Validation update: the check-in code is sent with the original reservation confirmation to deal with the issue that originally only a reservee could check-in, and in case of delay, the reservation would be cancelled or counted as a no show. In the revised version the system sends a check in code that any individual, who has that code, can enter into the system, to check into that room for a specific meeting. Please see the check-in task description for more detailed information.

8.4.7 Check-out

After the people in the shared meeting room are done using the room, the system should know that the room is again available for use. Therefore a check out task is necessary. In case of a reservation an end time is already available, which would mean that the system automatically logs out the user when the reservation has ended. In case of unplanned use the appropriator has specified the duration and can also be logged out automatically. Should the meeting end early a user should also be able to check out manually to free up the room for others to use. The task of checking out can be seen in Table 18 below.

Task: 1.4 Check out room Purpose: An authorized viewer is done with the meeting and checks out to release the room back into the pool, so that others can see that it's available in the system and use that shared meeting room. User: authorized appropriator Frequency: often	
Sub tasks:	Proposed solution
1. Check out room **Problem:** check out is currently not required	System displays a check out screen (simple press of the check-out button combined with the check-in code)
Variants: 1. Automated check out	Systems automatically checks out appropriator when the specified period of time in the check in or reservation has ended. The system sets the room to available.

Table 18 Task 1.4 Check out room

Update after validation: we have received questions as to why a person would check out. The current reason is that it is beneficial to the other users, not necessarily to the person check himself out. The collective choice arrangement may need to think about what incentives could be provided to people to check out. For example, further rules would be beneficial when people use the rooms for less time than they reserve (or claim) them for. This would create a situation where the system has a higher occupancy rate than real life.

8.4.8 Monitoring

The goal of monitoring in Commons is to provide insight into the actual usage of the resource and the effectiveness of the operational rules in place. As discussed before, the school of Management and Governance currently has no specific rules that deal with a reduction or prevention of overuse, free-riders and no-shows. The main goal of the monitoring interface is therefore firstly to provide insight in the actual usage and aim to detect in what degree congestion, free-riders and waste of resource are present. To accomplish this goal we want the system to record which individual is using the rooms at what time.

During the analysis of the current situation several shortcomings in the current monitoring were found that prohibit management from getting usage information reliably from the ICT System:

- Cancellations of reservations are not reported to Reception desk.
- Actual appropriation of the shared meeting room is not recorded in the Outlook Agenda
- Actual unplanned use of the shared meeting rooms is not recorded in the Outlook Agenda
- Wasteful use of the resource through no-shows
- Presence of free-riders is unknown
- Amount of congestion/overuse is unknown

In appendix G we discuss three possible monitoring options: light sensors, user self-check in, and mutual (peer) monitoring. The proposed solution for MB is to use all three monitoring options to create better information about usage of the resources. Mutual monitoring is in theory the monitoring solution that provides the best results, but is also the hardest to accomplish. It is also the most labor intensive option; therefore it should be mainly used for detecting free riders, as the other two monitoring options can already detect the other activities we want to monitor. It is important to note that not only management benefits from this information, but other appropriators as well. The three monitoring alternatives should provide real time updates to the system, allowing the reservation information in the ICT system to be constantly up to date and congruent with the real world. This gives employees the flexibility to know what rooms they can use for unplanned meetings without having to actually walk past each room, losing valuable time.

In conclusion, to let the ICT system be successful in supporting planned and unplanned use, the shortcoming described above need to be solved. Therefore three monitoring interfaces have been created: no show, no-check in, no-check out. The task descriptions of the monitoring activities are presented below:

Task: 1.5 No show Purpose: Record that a person does not show up for his reservation, and set the room on available status. User: Reservation system Frequency: Unknown	
Sub tasks:	Proposed solution
1. Trigger: System has a reservation planned, but no one has checked in after 10 minutes of the beginning of the reservation	System sets the status of the reservation to no show and frees up the room for use for other people.

Table 19 Task 1.5 Detecting a no show

Task: 1.6 Record no check in Purpose: The system records that an individual has used a room without checking in (indicating either a free rider, or an authorized appropriator who has not taken the effort to check in) Users: all authorized appropriators Frequency: unknown	
Sub tasks:	Proposed solution
1. Detect no check in through sensor in the room	System displays no current reservation information on wall tablet with and an authorized appropriator notices that someone is using the shared meeting room
1. Request to record no check in	System gives option to record a no check in, gives a notice to user asking to first ask the person who is using the room to check in.
1. Confirm no check in	System displays log in screen to confirm the record of no check in. System records the no check in record for

	reward/punishment purposes
Variant	
1. Automated no check in detection	Movement sensor in the room detects that there has been movement for more than 10 minutes, while there is no reservation or check in record in the system. System records the usage without check in

Table 20 Task 1.6 Record no check-in

Task: 1.7 Record no check out Purpose: The system records that an individual has neglected to check out after a meeting, while the meeting has ended earlier then the reservation will officially end Users: all authorized appropriators Frequency: unknown, hopefully as little as possible	
Sub tasks:	Proposed solution
1. Detect no check out	System displays on the wall tablet that the room is in use, an authorized appropriator notices that the room has not been checked out
1. Request to record no check out	System gives option to record a no check out
1. Confirm check out	System displays log in screen to confirm the record of no check out. System records the no check out record for reward/punishment purposes

Table 21 Task 1.7 Record no check out

8.4.9 Enforcement

The design principles for successful Commons prescribe that operational rules should be present that enable sustainable use of the Commons and that these rules should be enforced in order to create a sustainable Commons. In section 9.2 we have discussed the suggested operational rules at this point in time for the school of Management and Governance. The ICT system should be able to detect whether overuse, free-riders, no-shows, longer than required bookings are occurring and in what amount. In the first version we have included tasks that suggested that the ICT system itself could enforce rules. After validation we have come to the conclusion that the, at that time suggested operational rules to reduce no-shows with fines, are currently not implementable. Therefore we have changed the enforcement tasks that the ICT system should support. The ICT system is now only responsible for notification of rule infractions to relevant parties. This change leads to the following interface required for Enforcers.

Task: 1.8 Enforcement event Purpose: System sends notification to authorized appropriator to let that person know that he/she violated a procedural rule and what the expected correct behavior is. Users: System Frequency: unknown	
Sub tasks:	Proposed solution
1. Record violation	Whenever a violation is recorded (monitor tasks monitor these violations), the system notifies the authorized appropriator of this violation. The responsible enforcer is also notified of the rule infraction

Table 22 Task 1.8 Enforcement event

8.4.10 Management information

Based upon conversations with management and Commons theory, the system should be able to provide the information presented in Figure 27 below. The system records this information via the tasks described in the previous sections. The system should also be able to aggregate the recorded data into useful management information, see Figure 27.

Insight in actual usage

- Number of reservations per room per period of time
- Average length of reservation and possible outliers
- Average reservations per person and possible outliers
- Number of cancellations, no-shows, can be down drilled to specific persons
- #hours unauthorized use (use of rooms without checking in or making a reservation)
- Number of swaps
- Number of conflicts reported

Insight in effectiveness of the operational rules

- Number of infractions over time
- Number of provided rewards/punishments over time

Figure 27 Management Information

The corresponding task can be seen in the table below.

Task: 1.9 View management information Purpose: View management information Users: Management Frequency: unknown	
Sub tasks:	Proposed Solution
1. Log in	System shows log in screen, user is to be authenticated as management
2. Request management information	System shows via web interface the desired information about room usage

Table 23 Task 1.9 View management information

Additionally for collective choice participants the following interface is necessary to determine the success of rules that are supported by the ICT System.

Task: 1.10 View operational rules effectiveness Purpose: View management information Users: collective choice participant Frequency: unknown	
Sub tasks:	Proposed Solution
1. Log in	System shows log in screen, user is to be authenticated as management
2. Request operational rules effectiveness	System shows via web interface the desired information about operational rules.

Table 24 Task 1.10 View management information

An example of a rule is: "When a person does not check in within 10 minutes after the start of his/her reservation, this is considered a no-show." The collective choice participant should be able to make the rule active or inactive (invoke) or change a variable such as the 10 minutes (revision or rule). Also, in case of rewards or punishments that are administered via the system, the value (height) of these rewards should be able to be changed.

8.4.11 Report Conflict

This interface is used by the appropriators to report a conflict. As it is currently still unknown which exact form the conflicts will be, we have chosen to include this functionality with regard to appropriation. Therefore the system can provide an interface on the touch screens to report a conflict.

Task: 1.11 Report conflict Purpose: User can ask for assistance of Huismeester, reception to a conflict Users: Authorized appropriators Frequency: unknown	
Sub tasks:	Proposed Solution
1. Report conflict	System shows report conflict button on touch screen
2. Enter Conflict	User enters a short description of the conflict. System notifies reception of conflict to arbiter via e-mail

Table 25 Task: 1.11 Report conflict

8.4.12 Notification of Conflict

After a conflict has been reported, the idea is that the responsible arbiter takes action to solve the conflict. The following interface is necessary to provide this functionality.

Task: 1.11 Notification of conflict Purpose: After a conflict has been reported, the arbiter is made aware of a conflict. Users: Authorized appropriators Frequency: unknown	
Sub tasks:	Proposed Solution
1. Conflict event	System notifies arbiter of a conflict

Table 26 Task: 1.12 Notification of conflict

8.4.13 Change in shared meeting room pool

In this task the reception makes sure the changes in the real world are entered into the system. These changes include rooms being transformed to temporary offices or simply maintenance being done to those rooms.

Task: 1.13 Update the virtual representation of the shared meeting room resource Purpose: To create/remove/edit/temporarily disable/enable a room by Reception Users: Reception Frequency: 0-10 times per year	
Sub tasks:	Proposed Solution
1. Log in	System shows log in screen, user is to be authenticated as a producer
2. Enter the desired update	System gives options of creating a new room, editing the features of a room, remove the room from the system or temporarily disable a room. The user fills in the necessary data
3. Confirm update	System saves the update, in case of removing/temporarily disabling a room sends out an update to all users who had a reservation in the room on that date , that it is no longer possible to have a meeting in that room. The reservation is still saved, but

	is no longer attached to a room (if possible, the system checks for comparable rooms and changes the reservation to that room)

Table 27 Task: 1.13 Update the virtual representation of the shared meeting room resource

8.4.14 Additional functional requirements

In this section we discuss the other functionality that is useful to include in the requirements, but do not require task descriptions to be specified.

R3. The ICT system shall also support the additional functional requirements discussed in section 8.4.14

1. An ICT administrator should be able to add, delete, remove users
2. The ICT system should support a link to Radius in order to let the UT wide user credentials to be used as log-in credentials for the ICT system.
3. The ICT system should support creation, editing and removal of an operational rule.

8.4.15 Required technology

In the task descriptions in the previous sections there was some talk about specific kinds of technology. It is useful to include an overview of all technology to be used in the reservation system:

R4. The ICT system shall support the technology proposed in section 8.4.15

a) Wall Mounted tablet for each of the 36 shared meeting rooms, linked to the system, displaying room information, and supporting check in functionality.

- The reason for checking in via the touchscreen physically near the wall is as follows: this reduces the amount of cheating the system that can be done. By checking in on a tablet device on the outside wall of the room, you can only log in when you are physically near the room. If for example checking in via a web interface would be possible, it would be much easier to hoard rooms, i.e. reserving them without those rooms being used. It should be only possible to check in a specific room to which that specific tablet device is allocated.
- It makes it easier for appropriators to quickly claim a room, because they can claim a room when they are standing next to it, rather than at their own computer.

b) Movement sensor in each shared meeting room, linked to the reservation system to monitor actual usage of that room. This allows the system to detect the presence of possible free-riders

c) Support of mobile devices such as smart phones and tablets to reserve rooms. This makes it easier for people to reserve rooms.

d) A separate computer near reception for people to see which rooms are available, where their meeting is, and to reserve a room. This makes it easier for authorized appropriators without reservation rights, currently students, to see which rooms are available without having to ask reception desk. Reception desk can still have a degree of control, as they can see the computer and see which students make use of the computer.

8.4.16 Quality Requirements

R5. The ICT system shall support the quality requirements in section 8.4.16

This section discusses the non-functional requirements for the system.

1. The system should contain up to date (within 5 minutes) information about the status of reservation rooms

This requirement ensures that the system is actually useable with regard to unplanned meetings, where it is important to be able to quickly find rooms. We have chosen to use a five minute window

2. The system should be available both during and outside office hours to people who want to reserve shared meeting rooms.

Employees are often working after hours; in the current system it is impossible to reserve a room after hours, as there is no reception. In the new system the authorized appropriators should be able to reserve rooms outside of office hours.

3. The system should be perceived as usable by MB employees and students.

8.5 Conclusion

In this chapter we have provided the requirements for the Information system to support the planned and unplanned use of the shared meeting rooms at Ravelijn by the school of Management and Governance.

Firstly we have the sub question 4c: '*What are the wishes of stakeholders with regard to use of shared meeting rooms?*

To answer this question we have interviewed various stakeholders as identified in chapter 3. During the interviews with the various stakeholders, reception desk, employees, students, and management, we also discussed the wishes each stakeholder has for the system. The main points from this analysis is that secretaries, employees and students all would like to be able to access the room reservations themselves, as well as be able to reserve rooms themselves. Interestingly, reception desk was satisfied with the way of working, and had no desires for the future. This may be because we have done this interview at the previous building, where only 250 employees used four rooms, instead of nearly 1,600 people using 30 rooms. The change in workload may have been hard to anticipate for reception desk.

Finally management is interested in getting better insight in the actual usage of rooms. He also finds it very important that the system should fit the way of working of the people at the faculty. He would rather have a lower occupancy rate and an improvement of the employee satisfaction than a lot of stress and a high absenteeism [Sch10]

Secondly we have presented the key requirements of the information system, which consists of three parts: organizational requirements, recommended operational rules, and the ICT system requirements. The organizational requirements consist of recommended changes in the processes and roles at Ravelijn. The ICT system requirements discuss the key functionality of the shared meeting room reservation system.

9 Validation

In this chapter we discuss the validation of both the requirements analysis and the research process itself. A solution design is valid if the designed solution is expected to reduce the gap between experiences and desires that it sets out to reduce [Wie07]. Firstly we discuss the validity of the requirements specification and secondly the validation of the research process.

9.1 Specifications Requirements

Tests are according to Lauesen the best way to validate requirements that is to see whether the customer gets what he expects and whether it is realistic that he can get it [Lau02]. Specifically for task descriptions, two approaches can be used: simulation and walkthrough. Both approaches consist of carrying out the tasks for specific test scenarios with expert users, writing down any problems with carrying out the task as described [Lau02]. In the case of simulation paper slips with the data can be used to perform the task [Lau02]. In a walk-through it is just checked that the steps look right. In this validation the simulation method has been used due to time constraints.

Ideally validation sessions should have been held with multiple persons of each of the user groups, i.e.: students, employees, secretaries, reception, management and people who fall under the authorized viewer user group. Unfortunately due to time constraints validation had to be limited to sessions with a student, employee, management, and an authorized viewer. Five people have been interviewed to find out how well they believe the requirements specification solves their problems. We have used the requirements specifications as discussed in Chapter 8 as a basis for the walk through. During each session with each stakeholder we have asked about any uncertainty, concerns or faults they noticed with the specifications.

9.1.1 Student

Rules related comments

The student stated that he would like to be able to reserve rooms for use in the future. He finds the rewards interesting, but also comments that these rewards could be easily abused, by having other students violating the rules and him reaping the benefits.

Requirements related comments

He finds the new way of reserving much easier than the old situation, where he always needs to go the reception. He likes that the availability of rooms can be viewed on his smart phone. However, again, he would like to be able to reserve rooms himself as well.

9.1.2 Employee

Rules related comments

He is intrigued by the use of invoices for use and the fact that the appropriators can also be responsible for monitoring. However he has his doubts about the effectiveness and practicality of the current set of rules. He is interested in the possibilities of virtual reputation to use as method to encourage sustainable behavior. Cancellation: He suggests that a cancellation within an hour should not count as a no-show, but should still be frowned upon.

Requirements related comments

With regard to Reservation: he suggests that a unique pin number is created for each reservation that can be used to check in to the room. This allows anyone who is attending the meeting to log in. He is also interested in integration of the reservation system with outlook.

Monitoring: He is worried about the sensitivity of the sensors. The current movement detection sensors are not calibrated well enough and turn off the lights if a person does not move enough. He suggests that a single no movement detection might be too sensitive. He suggests a second check such as "no movement within 30 seconds" after the first "no movement detection " trigger to prevent people from being suddenly checked out.

9.1.3 Management

Rules related comments

He suggests that a scheduling conflict should be called a *use conflict*, and that a use conflict should be solved by giving the person who has reserved the room priority over other persons. He comments on the aggregation rules that he is not authorized to distribute fines, invoices would be possible though. He suggests the use of invoices instead. For example, employees and students receive an invoice of 20 euros for incorrect use of the rooms (no-shows). The reason for 20 euros per hour, is that this is the cost price. He does not expect the payment to be made, but thinks it might be a good tactic to show the value of these rooms and hopes that people will use the rooms more responsibly, as the invoice can be easily avoided by simply cancelling reservations.

On a more general note, as a manager he is interested in the well-being of employees and the perceived atmosphere at work, he noticed in his previous job that a too harsh, too strict, environment leads to higher non-attendance. Therefore he wants to make sure the rules and the workings of the system do not force the employees in a certain direction, but rather aids them in doing their jobs. This is something to take into account when further refining the operational rules.

Requirements related comments

With regard to the requirements, he notices that some users might object to tablet devices being used as check in panels, due to personal objections against iPad like devices. The management information functionality provides the information he is interested in.

9.1.4 Authorized viewer #1

Rules related comments

The person believes that the operational rules need to be operationalized further; instead of saying "reserve for later use", the operational rules should specify the minimum amount of hours such as "reserve for future use that is at least 24 hours from now".

Secondly, he suggests that the operational rules are to be in line with the house rules of Ravelijn. He does not know whether the rules currently are in line with the house rules, but it seems reasonable that they should.

Thirdly, he believes that the procedural rules are slightly confusing, the who/what is sometimes unclear to him. He suggests making them simpler, better defining the trigger, person involved and consequences of this rule.

With regard to punishments: the authorized viewer thinks that it is unlikely that the mechanism will work for employees to change behavior by getting invoices for unwanted behavior. He believes this is due to the open informal academic culture on University Twente; academics are used to operating independently and can be a bit stubborn sometimes. He believes that it is more likely for a professor to go elsewhere for his rooms, rather than pay the invoice, or put effort in monitoring.

He also thinks that the financial stimuli might work for students, but is concerned about the financial administration handling. He thinks that the administration costs for the faculty might be too high to be able to maintain the application punishments. He suggests a different solution which is to only punish users by temporarily disabling their right to use shared meeting rooms in the system.

Requirements related comments

Reservation and appropriation

It took some time to explain functionality of the check in and check out functions. He is uncertain about the benefits of the check in for the authorized user. He suggests integration with the single sign on system of the University, as this would enable the system to know the status of the user (MB employee, MB student or other). He also suggests that students can reserve rooms, but rather only a very small time in advance, such as 30 minutes. This would allow the students to have a break first before having the meeting.

Monitoring

No show mechanism: He believes that the no show mechanism is a source of trouble, as no-shows might be triggered too quickly, leading to awkward situations where a room is freed up if the person who made the reservation was too late. He thinks this might be a problem especially for professors. He is in agreement with the possibility for secretaries to check in for professors.

9.1.5 Authorized Viewer #2

Rules related comments

With regard to the Boundary rules he finds it too rigid that only MB employees can make use of the shared meeting rooms. With regard to the scope rules he expects that it is impossible to let the shared meeting rooms only be used for meetings, as meetings and educational purposes overlap. For example, a teacher who meets with students; should this be classified as a meeting or educational purpose use? He also finds the 24 hour time frame with regard to reservations too strict, he suggests using a shorter time frame, where it is possible to reserve a room in the morning for that afternoon.

With regard to procedural rules, the no show: he only finds it acceptable if meeting rooms can be booked at any beginning time, not only at half or whole hours. He provides an example: "if you have a meeting with external people who are running late. It would be inconvenient if an individual had to sit there just to not lose the room. " He also comments that it is important to make people aware of why they should adhere to the rules, i.e. what is the benefit of checking in, communicating a cancellation. This way they can easily learn the benefits of performing desirable behavior, rather than simply being punished for undesirable behavior.

With regard to aggregation rules: he comments that the "in a row" clause can be easily circumvented, thus it would be wiser to omit the "in a row" clause for the no-shows. He also comments on the use of the word fine, that it is not possible to use fines from a Collective Labour Agreement perspective. He also wonders whether the invoice is for the person or the department, whether there are practical situations where these fines are used, and whether these rules might lead to compensations by employees in other areas. He also comments that he finds that monitoring by employees comes across as tattling, which he considers to be quite undesirable. Also the financial handling of these rewards could be quite expensive, and may not even be possible due to UT policy about cash transactions.

Requirements related comments

The authorized viewer #2 comments on the reservation and appropriation part of the system, specifically the check in function: "what is the reason for choosing a tablet to check in?"

9.2 Research validation

Hevner et al. provide guidelines, **Error! Reference source not found.**, which a researcher should take nto account when performing IS research. This research has used the approach by Hevner et al. as the research approach. Therefore a suitable method of validating this research process is to evaluate how well the research conforms to these guidelines.

Table 1. Design-Science Research Guidelines	
Guideline	**Description**
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Table 28 Design-Science Research Guidelines (Adopted from [HMP04])

9.2.1 Design as an artifact

This research has resulted in a set of specifications for a shared room meeting reservation and management of use system for faculty Management and Governance at University Twente. This set of specifications has been based upon Commons theories, best practices and the context (people, processes and IT) of the faculty. Thus the result is both scientifically founded and still has a practical fit with the organization.

9.2.2 Problem relevance

Location infrastructure is an important issue for management, as infrastructure is costly. Therefore management wants to make sure that buildings are used efficiently and effectively. This led to this research, as management was interested in a better way of offering shared meeting rooms, where usage would first of all be more suited to the actual way of working within the faculty, usage could be monitored, and eventually better managed to enable higher effectiveness in use of the resource and efficiency.

9.2.3 Design evaluation

The artifact of this research has been evaluated through simulation sessions with prospective users. As discussed in the previous section, ideally more people would have been involved in these sessions, unfortunately this was not possible due to time constraints. The method itself of validation was qualitative in nature, placing responsibility on the person holding the evaluation to get the best out of

the persons doing the validation with. The design evaluation could have been improved further by using walk through instead of simulations, as this would actively involve the prospective user in a natural way to perform the new process steps in the various functions such as reserving and checking in to rooms. In turn this might have provided further insights on the validity of the requirements specifications.

9.2.4 Research contributions

The contribution of this research is that Commons theories have been used as a foundation to develop a system that aims to support the operational world and sustainability management of the Commons. We have shown that the theories used provide general insights in how to manage Commons; however, the effectiveness of a Commons is mainly determined through how well the people and institution of the Commons perform with regard to the seven design principles. Unfortunately these design principles are considered under development by the author E. Ostrom, and we feel that these principles are too abstract to be directly implemented in a system. For example, while the principles state that graduated sanctions should be applied, no specific guidelines on what sanctions might work within certain settings. Rather we believe that these principles should be used as areas of concern during the development and evaluation of current organizational policies, and those policies and strategies in turn influence the requirements for the IT system.

9.2.5 Research Rigor

The design of the artifact has been based upon existing methodologies, theoretical foundations have been used to come to the artifact itself. Best practices in the market and Commons theories have been used to develop the requirements specifications, next to the wishes of the stakeholders for the desired situation. The evaluation of the artifact has been done through a qualitative approach, which is more subjective in nature than a quantitative approach, and therefore by nature more open to interpretation errors.

9.2.6 Design as a search process

The approach of the design has been to ask the main question, which has been answered through multiple sub questions. Each sub question provided a piece of the puzzle that allowed answering the main question. During this process scope was defined by making the choice not to go deeper into specific subjects. In future research these subjects, such as specific operational rules, or the application of rewards and punishments, or investigating the possibilities of knowledge management theories could be further researched.

9.2.7 Communication of research

This thesis has been written with both technological and business oriented people in mind. The thesis has been proof read by multiple people; the supervisors as well as peers with academic degrees in the area of Business Information Technology.

9.3 Conclusions

The validation of the requirements specification shows that while in general the people were satisfied with the specifications for the ICT system, some elements such as the no show mechanism need to be

further adjusted to the situation. We have taken the results of the validation into account, and they have been incorporated into the requirements specification as discussed in chapter 8.

The accompanying rules need a revision before they can be implemented at Ravelijn, as we found some practical limitations that influence the practicability of the rules. These revised rules can also be found in chapter 8. It is important to remember that our requirements specification is only the first step of the design cycle. The next step for the school of Management and Governance is to translate our requirements into a prototype, where both the functionality and operational rules can be further refined by evaluating the prototype and making enhancements in both the organization and the ICT system.

The validation of the research process shows that in general we have adhered to the research guidelines, although the research evaluation could have been more elaborately performed if time would have been available. The benefit of a more user involved validation of the artifact is that first of all a greater group of people would have been involved, making sure that the requirements are better validated. Secondly, larger stakeholder involvement is in correspondence with the Chaos 10 project success factors, which is likely to lead to a successful implementation of the Information system [SG01][AHD12].

10 Conclusions

This thesis is the result of a master assignment performed for the school of Management and Governance at University Twente. We have engineered a set of requirements for a new information system to support planned and unplanned use of shared meeting rooms, based upon both practical considerations and theoretical insights. This fulfills the goal set in chapter 1: "To provide recommendations for the requirements of an information system that facilitates in-advance bookings and last-minute use of the shared meeting rooms in Ravelijn to the school of Management and Governance"

This chapter provides an overview of research contributions, our rationale for our research lens, the answers to the research questions and our main recommendations for the requirements. We also discuss the validation of the research, the research limitations and finally we present suggestions for next steps for the school of Management and Governance and future research.

10.1 Research Contributions

We discuss our research contributions from two perspectives: the scientific contributions and the practical contributions for the school of Management and Governance.

Scientific

We have contributed to the science community in the following ways with this research:

- **Contribution to the body of knowledge for best practices in information system that support planned and unplanned use of shared (meeting) rooms**
  In our preliminary literature research we did not find literature that could provide us satisfactory best practices for information systems that support the use for shared (meeting) rooms. We have found a literature domain, Commons literature, which has the possibility to provide interesting insights in the roles, processes, artifacts, typical problems, and best practices for a certain type of goods. These goods are called Commons. The classification of a good or resource as a Commons is based on two characteristics: a) it is hard to exclude an individual from using that resource and b) the good is subtractable; when one person uses it, less is available for other individuals.
- **Identification of collective action problems as relevant problems**:
  The application of Commons theories has led us to find a set of problems, collective action problems, which influence how well the resource can be supplied to end users when flexibility is important. With flexibility we mean the amount in which the resource can be used for both planned and unplanned use. For example: management finds it important that the rooms can be used for last minute meetings. Suppose that the collective action problem of congestion occurs. This means that shared meeting rooms are generally in use, and it is hard for an individual to find a free room. If that individual has reservation privileges it is likely that he will start to show strategic behavior, and starts reserving rooms, just to make sure that he has a room available, should he need one. This leads to the situation that the many rooms are reserved in advance, which reduces the amount in which unplanned use can be supported, even

further. These problems cannot be solved in a pure technological manner, they require arrangements between the individuals in a Commons to be made [Har69].

- **Identification of best practices for Commons that allows an organization to effectively deal with collective action problems:**
  We have investigated the best practices Commons theories recommend for resolving those collective action problems and have incorporated these suggestions into organizational requirements. It is important to note that at the beginning of this research we thought the solution would be purely ICT focused. However, it turned out that in order for the shared meeting rooms to be used in a planned and unplanned fashion, firstly the organization needs to be able to support this flexibility; the ICT system can only be a means to achieve this.
- **Case studies to provide insight in usage monitoring, enforcement and reservation technology**
  We have also done three field studies: Spitsmijden, ROC Friese Poort and Microsoft. These three studies have provided insights that allowed us to make a translation from the abstract Commons best practices into ICT requirements. These three studies have shown us that depending on the technology available and awareness of the collective action problems, the ICT system can fulfill a specific role.

Practical

Our practical research contribution is that we have:

- **Translated Commons best practices into organizational and ICT requirements:**
  Finally we have translated the Commons best practices into a combination of organizational and ICT requirements. This translation step is not arbitrary, design choices need to be made taking into account the context of the situation. Specifically, not all design principles were appropriate for this case of Commons, we think this is due to the nature of the infrastructure Commons, where use of the resource is less life critical, which differs from typical socio-ecological Commons.
- **Provided a set of organizational and ICT requirements**
  We have provided a set of requirements both for the organization as well as the ICT system. The school of Management and Governance should fulfill these to be able to successfully support the planned and unplanned use of the shared meeting rooms. We provide an overview of the recommended requirements in 11.4.

In the next sections we discuss the answers to our sub questions, of which the answers have been the basis for our recommendations.

10.2 Research lens choice

We have chosen to perform this research using Commons literature as a research lens. The reason for this choice is as follows: during the research setup we were discussing in which direction to take this research. The problem was that at that point in time, the school of management and Governance was still housed in the old building, where the way the shared meeting rooms was very different on two

points: students were not allowed to use the rooms and employees had larger offices in which they could hold meetings. Therefore we assumed that the need for those rooms in the old building was simply less critical than in the new situation, where both students and employees use the rooms, and the building is designed in such a way (smaller offices) that use of the shared meeting rooms is promoted. This means that the new situation places different demands on the system than the old system. Now as we wanted the requirements for the new system to minimize pitfalls that might reduce the usability of the system, we started looking for best practices in literature. From this preliminary research we found an interesting set of theories: Commons theories. These theories provide insight in how shared resources can be successfully managed, and what typical processes occur in those successful settings.

The shared meeting rooms can be seen as a Commons; they fulfill the a) low excludability and b) highly subtractability characteristics that define Common-pool resources. Firstly, the shared meeting rooms can be used by anyone; the policy of the school of Management and Governance is that the shared meeting rooms should be available to all students and employees to use (it is therefore hard to exclude an individual from using the rooms). Secondly, when an individual uses a shared meeting room, it is unavailable for another individual to use ((high subtractability). Therefore, we have used Commons theories as our research lens.

This research lens provides us with insights about the typical actor roles, processes and artifacts that are of relevance for our information system; as well as the best practices in creating and maintaining Commons that minimize/solve collective action problems (discussed in chapter 5).

10.2.1 Reflection on the research lens choice

After having performed our research the question arose: did the Commons theories help us to create a set of key requirements? We believe the answer is yes.

Commons theories have shown us that the goal of the school of Management and Governance is not feasible by merely implementing a new ICT system. The goal for this system at the beginning of the assignment was to support both planned and unplanned use. Commons theories have provided us with an explanation of the factors that prohibit the school of Management and Governance of offering unplanned use of the shared meeting rooms to employees and students: overuse and free-riders. The problem with overuse, free-riders and other collective action problems, is that they are not technologically solvable [Har69]. Hardin illustrates this through the game Tic-Tac-Toe. In this game there is no technological way to win the game; the game will end in a draw. He suggests that a person can only win by giving a radical meaning to the word “win”, for example by hitting the opponent on the head [Har69]. Additionally, Commons theories provide insight on how organizations can successfully deal with these problems by creating and enforcing social arrangements, and we have used those insights as the basis for our key requirements.

10.3 Answers to the research questions

We have defined the main question for this research as "*What are the requirements for an information system to support use of the MB owned shared meeting rooms in Ravelijn?*" To provide an answer to this main question we have answered sub questions, of which we discuss the answers in this section.

1. *Who are the stakeholders for this project?*

We have answered this question in chapter 3. We have used the Onion stakeholder model to make explicit the stakeholders from a systems perspective. All default roles as proposed by the Onion model have been found present for this research, and have been specified. This analysis provides us with the roles of people at Ravelijn, whom we have consulted in order to gain the knowledge necessary to provide answers to the research questions.

The stakeholders found can be seen in the table below, **Error! Reference source not found.**:

The System

Onion Model Stakeholder role	Role at Ravelijn
Normal Operator	• Current: Reception desk • Future: employees, students
Operational Support	• Reception
Maintenance Operator	• ICTS

The Containing System

Onion Model Stakeholder role	Role at Ravelijn
Functional beneficiary	• Employees • Students • Management
Purchaser	• Management school of Management and Governance
Product champion	• Management MB
Interfacing Systems	• ICTS

The wider environment

Onion Model Stakeholder role	Role at Ravelijn
Financial Beneficiary	• Management School Management and

		Governance	
	Negative Stakeholder	• Possibly FB	
	Regulator	• Information Management UT	
	Developer	• ICTS or to be determined	
	Consultant	• Researcher	
	Political Beneficiary	• Management School of Management and Governance • Director of Studies	

Table 29 Stakeholders for the information system under development

2. *What is the current situation with regard to use and monitoring of usage of shared meeting rooms at MB?*

This question has been answered in chapter 4. We have found that rooms are used both in a planned and unplanned way. The planned way is the process where a reservation is made through the reception desk, and the room can be used by the reservee at a later time. The unplanned way is the process where someone needs a room at that moment to have an ad-hoc meeting. Reservations via the planned way are recorded by the reception desk, use of the rooms via the unplanned way are not. Currently these shared meeting rooms can only be used by employees and students of the school of Management and Governance. However, there are plans by Facilitair Bedrijf to make these shared meeting rooms University wide shared rooms, meaning that these rooms may in the future be used by employees and students of other faculties. Currently, only employees can reserve rooms in advance, students can only make use of rooms that are available at that point in time.

Management has conducted an ad-hoc monitoring project to get a better understanding of the usage of the shared meeting rooms by having a student walk by each room and write down whether the room is in use at that point in time. However, this project was done at the previous building, in which the rooms were used differently. Currently no official monitoring process is used.

The technology used to handle reservations for the shared meeting rooms consists of a computer with Outlook Calendar installed to record reservations. Only the reception desk has access to this computer, employees and students have to contact reception to make reservations.

3. *What are the problems in the current situation that prevent the information system to support planned and unplanned use of the resource?*

This question has been divided into three sub questions. The answers to these three sub questions we have performed a stakeholder analysis, written down observations and performed a literature study to find similar problems described in the Commons literature. The result of this chapter is a problem bundle that makes explicit the root problems that need to be solved. These root problems are:

- Cancellations are not communicated to the reception desk
- Reservation trades by secretaries are generally not communicated to the reception desk
- Contact information of the reservee is not consistently stored in the database
- Room designation changes are handled in such a way that reservations are lost.

- No-shows are not recorded in the system
- Meetings that take extra time (or less time) are not recorded into the system
- Functional Beneficiaries can only access reservation information / room availability via reception desk, they cannot quickly access this information themselves
- No digital confirmation is sent to the reservee of a room
- Unplanned use of the shared meeting rooms is not recorded in the Outlook Agenda
- Functional Beneficiaries cannot reserve rooms in the Outlook system themselves
- Extra facilities for a meeting have to be reserved separately.
- Functional Beneficiary: Reception is not always available when trying to make a reservation
- Ineffective institute to regulate behavior

4. *What are the desired roles, processes and technology for an information system to support planned and unplanned use of the shared meeting rooms?*

This question is answered in chapter 6. We have discussed lessons learned from Commons literature, best practices in the market and the wishes of the stakeholders.

Lessons from Commons literature

We have used the Institutional Analysis and Development framework, which provided us with three different levels to analyze a Commons situation. The first level is the operational level where the resource is actually used. The second level is the collective choice level, where choices about how the resource should be used are determined. The third level is the constitutional choice level where people decide on how to decide how the resource should be used. For the situation at Ravelijn we focus on supporting the processes at the operational level and take into account the information needs of the collective choice level. In literature we have found typical processes that occur in Commons, and we have found seven design principles for Commons that are typically present in Commons situations that successfully deal with the problems of overuse and free-riders. The roles, processes and artifacts found can be seen in Figure 28 below.

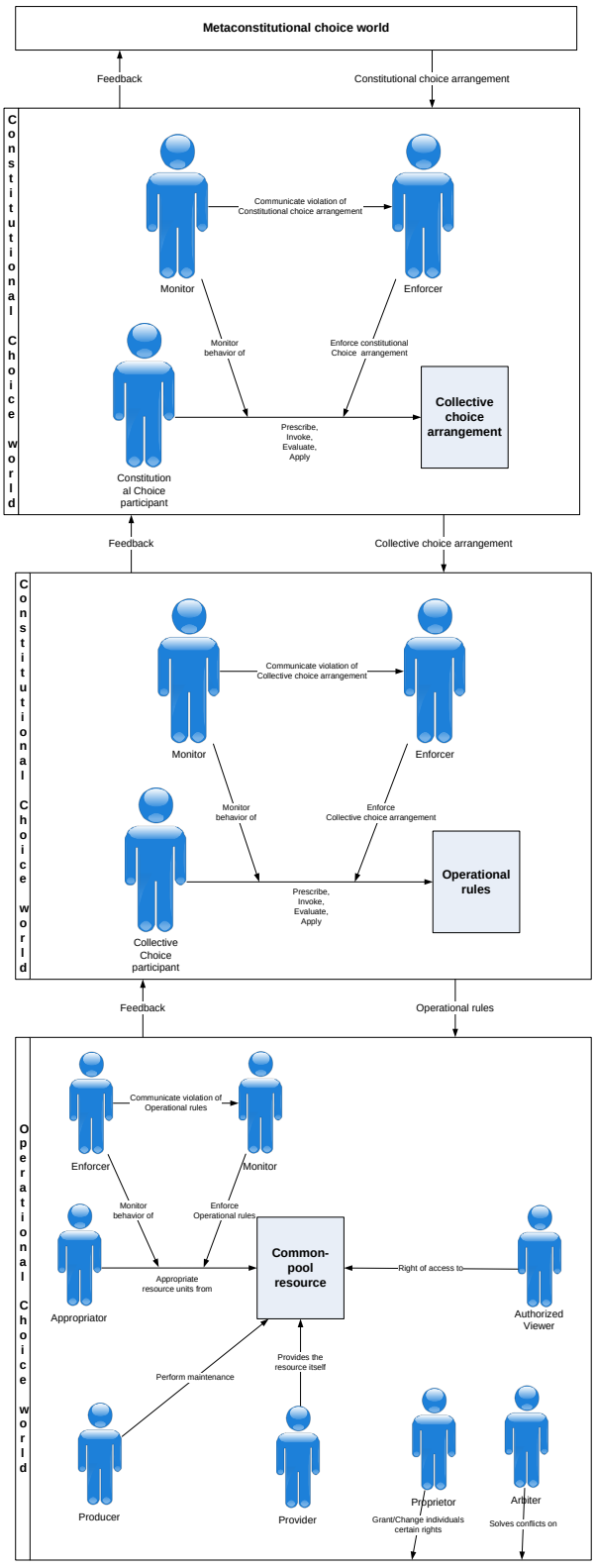

Figure 28. Actors, processes and artifacts on the three levels of analysis

The best practices found for Commons can be seen in Figure 29 below:

Commons Design Principles

1. Clearly defined boundaries
2. Congruence between appropriation and local conditions
3. Collective choice arrangements
4. Monitoring
5. Graduated sanctions
6. Conflict-resolution mechanism
7. Minimal recognition of rights to organize

For Common-pool resources that are part of larger systems:

8. Nested Enterprises

Figure 29 Common-pool resource system design principles (Adopted from [OST02])

The answer to this question has provided us with answers on which roles, processes and elements are generally present in successful Commons; that is, it has provided us with an organizational blueprint. Based upon this organizational blueprint, we can deduce information technology requirements that support the reduction of overuse and free-riders in the situation of Ravelijn. This analysis has also shown us that the requirements for the information system for the school of Management and Governance will contain not only an ICT component, but an organizational component as well.

Best practices comparable ICT systems

This question is answered in chapter 6. The answer to this question is much more technologically oriented than the previous question. It aims to solve the experienced problems by the stakeholders, as discussed in sub question 3. We have taken the room reservation system at ROC Friese Poort and Microsoft as a basis for our best practices analysis. ROC Friese Poort is an example of how improved information provision can reduce user experienced congestion, i.e. it shows that by improving information provision, people can be informed on the fly that a room one floor up is available for an ad hoc meeting. ROC Friese Poort enables this improved information by having implemented a room reservation system with touch screens near each room that provides room reservation functionality. The rooms are equipped with light sensors that detect whether a room is being used. These two elements, touch screens and occupancy sensors enable the information system to be used as a real time map of the availability of rooms. Interestingly, these rooms can only be used in an ad hoc basis. The system does not support reservations. Management of ROC Friese Poort is satisfied with this solution as it has improved the occupancy rate of the building.

The second best practice is the Spitsmijden case which has provided insight in how to perform monitoring activities in a Commons where the resource units are non-storable. It also has shown us how technology can be used to implement a monitoring system and combine this with automated enforcement as well. Furthermore, it has shown us that not only punishments, or graduated sanctions as the discussed design principles state, are applicable to change behavior. Incentives are also a

mechanism that can be used to improve the likeliness of desired behavior in infrastructure Commons. This possibility of incentives, or rewards, should be further explored by the collective choice arrangement for the shared meeting room commons situation at Ravelijn. Punishment (or sanctions) reduces selfish behavior, while rewards enable cooperation. [AH02] This means that punishments can be expected to be used to reduce unwanted situations, while rewards can be used to create an environment where people may be willing to proactively undertake action to create a better situation for the faculty itself, i.e. attain the goal of a flexible organization in a flexible building.

Wishes Stakeholders

The answer to this question is discussed in chapter 8. During the interviews to find out the problems in the current situation we have also asked stakeholders what they would like to see different in the new situation. Mainly these wishes are that the problems experienced are solved.

The answers to these sub questions have provided us with the information to answer the main question and recommend a set of requirements for an Information system. The requirements specification can be found in chapter 8. It is important to note that in order to solve the problems of overuse and free-riders first of all the organizational needs to be changed by taking into account the seven design principles for successful commons. These seven principles influence which processes are performed, by whom, and how they are performed. The suggested changes in the organization influence in turn the requirements for the information system.

5. *What actors, processes and artifacts exist within the current situation, taking the Commons framework as a reference?*

This question has been answered in chapter 7, the current situation part 2. After we had researched the Commons best practices we needed to revisit the current situation, as a number of new processes were identified that we needed to further investigate, to get a better feel of the requirements for the new Information system.

We see that on an operational level the monitoring processes, enforcement processes and arbitration processes are at most informally available. This is understandable as there is no policy with regard to management of the resource as a Commons (that is to reduce problems of overuse or waste of resources). Therefore the first step for the school of Management and Governance should be to improve upon the first three Commons best practices: better define the boundaries of the resource, improve monitoring and then improve the congruence between appropriation and provision. In other words, management should first know what the resource is, and who the users are. Then the information system should support the monitoring of the usage of those users. Finally, while the right monitoring information is being generated, management of the school of Management and Governance should implement a collective choice arrangement to design better operational rules to reduce the problems of overuse and waste of resource.

6. *How well does the organization in the current situation score with regard to current application of the identified best practices for Commons?*

We have answered this sub question in chapter 7 as well. The boundaries of the resource are clear, although they are complex. There are many types of rooms on the campus, and depending on the type,

they may have a different reservation process or purpose. Firstly, the boundaries of the users are not clear. On the one hand there is the current policy of the school of Management and Governance that only their students and employees may use the resource. On the other hand, Facilitair Bedrijf has issued a nota to make UT wide pool rooms out of the currently faculty specific shared meeting rooms. This nota has been agreed upon by College van Bestuur. Thus this difference needs to be resolved, and will likely have a profound impact on both the organization and the information system.

Secondly, congruence between appropriation and provision and local conditions is out of balance. . When the Ravelijn was built, the offices for employees were deliberately made smaller and the number of meeting rooms was deliberately increased. In Capitool, the previous MB building, the meeting rooms could be only used by employees; now they can be used by both employees and students. However, there is no mentioning of reduced locations for students to meet in the Plan van Eisen for Ravelijn. Thus currently students receive full benefits, but seem to not have contributed to the costs. They did not have to sacrifice space, they only gained space. In the meanwhile, employees did have to sacrifice work space.

Thirdly, there is a collective choice arrangement present, although informally. In order to make the collective choice arrangement more likely to succeed more different individuals (students as well as employees) need to be involved in the creation and evaluation of operational rules.

Fourthly, as already discussed, monitoring is insufficient and needs to be improved upon. We provide suggestions on how monitoring can be improved with the new information system.

Fifthly, graduated sanctions are not present. Furthermore, there are no sanctions at all present, which should be present in order to decrease collective action problems. We provide suggestions for sanctions on the identified collective action problem of no-shows.

Sixthly, there is no formal conflict-resolution mechanism available, although reception desk and Huismeester are likely candidates for those roles.

Sevently, for the purposes of this analysis there is a minimal recognition of rights to organize. And eightly, nested enterprises are available on a University Twente wide perspective, but this presence is not relevant for our purposes.

10.4 Recommendations

We have synthesized the answers to our sub questions into an answer to our main question: "*What are the requirements for an information system to support use of the MB owned shared meeting rooms in Ravelijn?"*

We have included both organizational and ICT requirements to enable the school of Management and Governance implement *a)* revisions in the organizational structure and processes needed to be able to support a flexible use of the resource and *b)* an ICT system that can support:

- the organizational structure that is necessary for the organization to support planned and unplanned use

- the reservation (planned) use process and unplanned use process
- The generation of better monitoring information through technology for both the purposes of occupancy information and monitoring information that is relevant to evaluate effectiveness the operational rules.

You can find the entire set of requirements in detail in chapter 8. We have summarized the organizational and ICT requirements below:

10.4.1 Organizational requirements

In Figure 30 we present the organizational requirements. By following these requirements the school of Management and Governance will be able to improve the efficiency in supply of the resource, in turn allowing for better planned and unplanned use of the shared meeting rooms. We also make recommendations for operational rules to improve monitoring and reduction of waste of resources through no-shows, see Table 13 and Table 14 in chapter 8.

Org R1. School of Management and Governance must resolve differences between Facilitair Bedrijfs' policy and internal Policy.

Org R2. Appropriation must be fair for the individuals involved

Org R3. The school of Management and Governance must implement a formal collective choice arrangement to prescribe, invoke, evaluate and apply the operational rules.

Org R4. the school of Management must improve monitoring

Org. R5. Graduated Sanctions must be implemented to enforce operational rules

Org R6. Conflict resolution mechanism must be implemented

Figure 30 Organizational requirements

10.4.2 ICT requirements

We provide the requirements of the ICT system in the following form: functional requirements (what should the system do), nonfunctional requirements (warrant the usability of the system), suggested technology to support use of the system. These requirements can be found in Figure 31 below.

Functional requirements

For the actual ICT system we recommend that it should support the following functionality, which we provide in depth descriptions of in chapter 8.

ICT R1. View room availability
ICT R2. Check in (let the system know that you are using the room)
ICT R3. Reserve a room
ICT R4. Check out (free up the room in the system for other people to use)
ICT R5. Monitoring of usage (no-shows, record of no check in, record of no check out)

ICT R6. Enforcement of operational rules (notification of rule violation to enforcer)
ICT R7. Management information (usage, and information about the effectiveness of the operational rules)
ICT R8. Report conflict by student or employee to reception desk

Additionally the system should support the following functionality:

ICT R9. An ICT administrator should be able to add, delete, remove users, and set user rights
ICT R10. The ICT system should support a link to Radius in order to let the UT wide user credentials to be used as log-in credentials for the ICT system.
ICT R11. The ICT system should support creation, editing and removal of an operational rule.

Suggested Technology

A. Wall Mounted tablet for each of the 36 shared meeting rooms, linked to the system, displaying room information, and supporting check-in functionality.
B. Movement sensor in each shared meeting room, linked to the reservation system to monitor actual usage of that room. This allows the system to detect the presence of possible free-riders
C. Support of mobile devices such as smart phones and tablets to reserve rooms. This makes it easier for people to reserve rooms.
D. A separate computer near reception for people to see which rooms are available, where their meeting is, and to reserve a room. This makes it easier for authorized appropriators without reservation rights, currently students, to see which rooms are available without having to ask reception desk. Reception desk can still have a degree of control, as they can see the computer and see which students make use of the computer.

Quality Requirements

Q R1. The system should contain up to date (within 5 minutes) information about the status of reservation rooms. This requirement ensures that the system is actually useable with regard to unplanned meetings, where it is important to be able to quickly find rooms. We have chosen to use a five minute window.
Q R2. The system should be available both during and outside office hours to people who want to reserve shared meeting rooms
Q R3. The system should be perceived as usable by MB employees and students.

Figure 31 ICT requirements

10.5 Validation

The validation of the requirements specification shows that while in general the people were satisfied with the specifications for the ICT system, some elements such as the no show mechanism need to be further adjusted to the situation. We have taken the results of the validation into account, and they have been incorporated into the requirements specification as discussed in chapter 8.

The accompanying rules need a revision before they can be implemented at Ravelijn, as we found some practical limitations that influence the practicability of the rules. These revised rules can also be found in chapter 8. It is important to remember that our requirements specification is only the first step of the design cycle. The next step for the school of Management and Governance is to translate our requirements into a prototype, where both the functionality and operational rules can be further refined by evaluating the prototype and making enhancements in both the organization and the ICT system.

The validation of the research process shows that in general we have adhered to the research guidelines, although the research evaluation could have been more elaborately performed if time would have been available. The benefit of a more user involved validation of the artifact is that first of all a greater group of people would have been involved, making sure that the requirements are better validated. Secondly, larger stakeholder involvement is in correspondence with the Chaos 10 project success factors, which is likely to lead to a successful implementation of the Information system [SG01].

10.6 Research limitations

We have aimed to arrive at realistic and feasible requirements by taking into account perspectives of multiple stakeholders, best practices and theoretical concepts from commons literature. Still, there are limitations to the research performed. This section discusses those limitations.

Firstly, our research performed is the first iteration of the design cycle. We have based our key requirements on theory and best practices, and have limited this research to a requirements specification. In further iterations these requirements can be translated into working prototypes, where the information system can be field tested. As we currently have no field tests of the system, we expect that the functionality of the ICT system, the operational rules and the organizational structure will change to adapt to new insights during each of these iterations. The process of creating a sustainable institution is an iterative process [NRC02].

Secondly, the scope of the case setting used in this research has been limited to only the shared meeting rooms in Ravelijn that can be used specifically by the school of Management and Governance. We had to limit our research to these types of rooms in order to make the project feasible for a Master project. There are, however, many more types of rooms in Ravelijn, not even mentioning the rooms in other buildings on the university campus. The trouble with the choice for the scope lies here: the idea behind the school of Management and Governance in Ravelijn is to have a flexible organization in a flexible building. In order to truly be flexible, it would seem logical to investigate the option of making all types of rooms reservable in the same fashion as shared meeting rooms. The benefit would be that this would increase the potential supply of space, merely by removing restrictions of type of use for the resource. In turn this could reduce the risk of congestion, increase the possibility for flexibility (unplanned use). Unfortunately, in order to be this flexible, a solution should be found to the different reservation procedures and departments that exist on University Twente. This was simply too big a challenge to reasonably expect to overcome in a master thesis project, and therefore we have specifically chosen for the shared meeting rooms as a pilot project. However, this choice does mean that the solution for the

school of Management and Governance cannot be simply scaled up to an UT wide solution; adjustments need to be made.

Thirdly, part of this research has been performed while the faculty was still in the old building. Stakeholder interviews have been held at that time, which means that the views of the stakeholders then may not be the views they have now. The process of reserving rooms has stayed the same, but the unplanned way of using rooms has become much more important. This means that stakeholders may start to experience problems or realize they have wishes that they did not have at the time these interviews were held. We have tried to overcome this limitation by including possible problems from literature and basing the requirements specification on best practices and literature. However, as we found when looking at theory on appropriate institutions, the process of creating a sustainable institution is an iterative process [NRC02]. Therefore we expect that more work needs to be done by the people at the school of management and governance in order to create a working information system that allows for an optimal combination of planned and unplanned use.

Fourthly, we have used a limited set of best practices in Commons theory. There are additional best practices such as Wade (1988), Baland and Platteau (1996) Agrawal has compared these studies to each other to create an aggregated list of success criteria [NRC02]. We have not included these results in our research. Although we do not suspect that the inclusion of these studies has a significant outcome for the requirements of the information system for the school of Management and Governance, we do feel the need to explicitly mention that these best practices have not been used.

10.7 Future research

Firstly, the most important element to further research for Management of the school of Management and Governance is that of the operational rules. During our validation process it became clear that the suggested operational rules started a great deal of discussion. Specifically the punishment/reward related rules were the subject of debate. This is understandable, as there currently are no consequences to making use of the resource in a way that might not benefit the group as a whole. We think that our recommendations provide a good basis for creating awareness, and further development of appropriate rules. Further development of operational rules enables the organization to get the desired behavior from the employees and students at the school of Management and Governance. As we discussed in the limitations, this is only the first design cycle, our requirements should now be translated into a prototype and be subjected to field tests to further refine the operational rules and the corresponding ICT functionality.

Secondly, our recommendations for key requirements are focused on enabling better monitoring information, which we think is the basis for better operational rules. The ICT system itself could be further developed as a tool that allows for experimenting with rules and rewards/punishments to promote desired behavior by individuals using shared meeting rooms. This could make the ICT system function as a research tool to test various sets of operational rules. As an addition, it would also be interesting to see how IT can influence the need for formal rules. Ostrom discusses that when a group becomes too large, or fragmented, informal rules become less effective. [Ost90] As we have already discussed, IT can influence the properties of resource systems, perhaps it can also influence how people

perceive the strength of a community, and in turn the effectiveness of informal rules may increase. The benefit of informal rules is that they generally are considered to be easier to manage, requiring less effort [Ost90].

Thirdly, an important element in Commons theories is how individuals come to choose a certain behavior. It would be interesting to see how big of a role IT can play. In the desired components chapter we have discussed that institutions can be formal and informal by nature, i.e. behavior is regulated either by formal rules, or informal constructions such as social pressure [Ost90]. One possible route of research would be to investigate whether IT can influence the perceived cohesiveness or transparency of a group, which would allow more informal rules for larger communities. The advantage would be that more easily manageable institutions could be created for Commons settings that would traditionally require more formal, and costly, institutions. Secondly, perhaps IT could enable successful, more informal in nature, settings, by implementing a personality into the system that acts as a virtual monitor or even enforcer. Research has already shown that computers can be given personalities, merely by simply changing the choice of words [RN02]. It would be interesting to see whether it is possible to implement virtual personalities that can take on roles such as enforcer, or even arbiter in Commons settings. Also, the possibilities of a reward mechanism modeled as a game could be examined, as this could provide a fun alternative to promote cooperative behavior, rather than simply reducing unwanted behavior.

Fourthly, we have noticed that lessons from Commons literature require a translation step to ICT system requirements. Commons literature deals with how people organize themselves to cope with social dilemmas. ICT however is a tool to achieve those goals; it is not a goal in itself. Therefore a design principle such as *monitoring* needs to be operationalized before it can be implemented. This process of operationalization is not arbitrary, and we believe that this translation step should be reconsidered with changes in either new technology or changes in how people deal with Commons. Advances in better understanding of successful Commons management can result in more finely tuned ICT systems. Vice versa, ICT can create fundamental changes in how well certain Commons can be managed. To give an example, in our case the fact that an ICT system is used to claim resource units in the future, gives the resource system a storability characteristic, which it would not have without that ICT system.

Fifthly, a difficult issue in Commons theories is that there is a lack of causal relations between processes, results in processes, and design principles [NRC02]. The more new insights are found in the causal relationships are found, the better IT can be used to support the sustainability of the resource by enforcing the causal chains that improve on sustainability. Thus, it would be interesting to see how IT could perhaps be more effectively of efficiently applied to help support sustainable Commons.

Finally, the fields of knowledge management and psychology could provide interesting insights in how to motivate people to make explicit knowledge about their use of the resource and monitoring information, i.e. it could help provide new insights in how to motivate monitors to put in the effort of monitoring.

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Appendix A. Dictionary

Common-pool resource = a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use. [Ost90] Consists of a resource system that produces resource units.

Commons = the shared resource and the property rights system through which the use of the resource is managed. [Hes08]

Appropriator = individual who withdraws resource units from the resource system. [Ost90]

Appropriation = withdrawal of resource units from the resource system. [Ost90]

Claimant = an individual who has appropriation rights, but may also regulate the use patterns of other harvesters and to transform a resource system by building improvements. [Ost08] The enforcer role is part of the claimant role.

Enforcer = an individual that may apply punishments and rewards based upon the behavior by other individuals [Ost90]

Monitor = an individual who observes actions of individuals in a Commons [Ost90]

Producer = an individual or organisation who constructs, repairs, or takes actions that ensure the long-term sustenance of the resource system itself. [Ost90]

Proprietor = an individual who has the right to determine who else will have the right of access to a resource and whether that right can be transferred. [Ost08]

Operational choice level = Is a level of analysis to for the purpose of analyzing Commons. On this level the actions of individuals directly affect the physical world. [Ost08] This is the level where the common-pool resource, appropriation and production process are analysed.

Collective choice level = Is the level where rules for the operational world are defined. Collective decisions are made by officials to determine, enforce, continue or alter actions authorized within institutional arrangements. [Mcg00]

Constitutional choice level = This level of analysis is about decision being made on how to run the collective choice world. [McG00]

Institutional arrangement = a term with a lot of discussion about the exact and correct meaning. In this research it is used to describe the prescriptions that humans use to organize all forms of repetitive and

structured interactions.[Ost08] In other words: these are the rules under which people cooperate with each other. In Commons the goal of an institution is to generally to either solve or reduce the likeliness of certain collective action problems, such as overuse, free-riders (poachers). [Ost90][Ost08]

Operational rules = the rules used by enforcer to punish or reward behavior of appropriators

Shared meeting room = A specific type of project room at Ravelijn which are managed by MB (through a rent contract with Facilitair Bedrijf). These rooms are currently available to all students and employees at MB. Although there are plans to make all types of project rooms available to all students and employees on University Twente.

Resource system = Resource systems are best thought of as stock variables that are under favorable conditions capable of producing a maximum quantity of a flow variable (resource units) without harming the stock or the resource system itself. [OST90]

Resource units = Resource units are those objects that can be appropriated by individuals. [Ost90] Examples include ecological examples such as: apples from an apple tree, water to dump toxic waste in. More abstract units such as time/space on highways or speaking time at parliament are nowadays considered resource units from a common-pool resource as well.

Appendix B. Overview reservable rooms University Twente

Overzicht ruimtes op de UT, nav gesprek met Marc Hulshof, 19 november 2009.
Opgesteld door F. Snels

Naam:Poolzalen
Aantal: +/- 50
Omschrijving: zalen zoals collegezalen
Systeem: ZBS
Eigenaar ruimtes: FB
Reserveren: via reserveringsburo die vervolgens ZBS gebruikt voor de reservering

Naam: jaargangzalen
Aantal: +/- 25
Omschrijving: studenten blijven zitten, docenten wisselen van lokaal, multifunctionele ruimtes
Systeem: eigen systeem per faculteit, onbekend
Eigenaar ruimtes: faculteit
Reserveren: onbekend

Naam projectruimtes
Aantal: +/- 100
Omschrijving: ruimtes te gebruiken voor studentopdrachten (vaak kleine vergaderruimtes)
Systeem: niet uniform over de faculteiten heen, soms outlook
Eigenaar: faculteit
Reserveren: soms een schriftje bij de balie, soms outlook of anders.

Naam: vergaderzalen
Aantal: +/- 50
Omschrijving: vergaderingen personeel (dus ook docenten) UT
Systeem: niet uniform, veelal outlook per faculteit of dienst (soms/meestal via secretariaat)
Reserveren: via outlook of anders

Naam culturele zalen
Aantal: +/- 10
Omschrijving: audiozalen, theaterzalen, etc zoals agora, T1300, audiozalen,
Systeem: Planon
Reserveren: via reserveringsburo die vervolgens ZBS gebruikt voor de reservering

Naam: sportzalen
Aantal +/- 20
Omschrijving: gymzalen, fintessruimtes, etc.
Systeem: vermoedelijk planon
Reserveren: vermoedelijk via reserveringsburo

Naam: gemeenschappelijke ruimtes
Aantal: +/- 20
Omschrijving: entreeruimtes, kantines, een hal, allemaal lokaties voor receptie, ontvangsten, feestjes, borrel
Systeem: onbekend
Reserveren: onbekend

ZBS:
Maatwerk voor reserveren collegezalen. Waarom maatwerk ? geen gewone uren maar lesuren. Allerlij roostertechnische hulpmiddelen. ZBS wordt vervangen door Syll+ (en dus niet door planon.

Planon: facilitair management systeem dat een module ruimtebeheer kent. DEC 2009 operationeel. Ruimtebeheer kan alle kenmerken van een ruimte vastleggen zoals vierkante meters, eigenaar, prijs tbv doorbelasting, verwarming, faciliteiten, incidenten, etc. Er zijn +/- 6000 ruimtes op de UT. Belangrijke module is het doorbelasten van ruimtes aan faculteiten. Planon is DE bron voor alle ruimtes op de UT. Dus bv kamernummers worden bepaald door FB.
Onbekend is hoe goed een planon reservingsmodule is.

Syllbus plus: is een roosterprogramma tbv onderwijs. Wordt waarschijnlijk in 2011 in productie genomen. Gaat ZBS vervangen.
Onbekend is hoe goed een Syll+ reserveringsmodule is.

Appendix C. Stakeholder Questionnaires

Secretaresses

1. Reserveert u wel eens vergader kamers op het Capitool? Zo ja, voor wie?

2. Indien u voor iemand anders een reservering maakt, hoe laat hij/zij u weten dat hij/zij een kamer wil reserveren?

3. Welke stappen voert u uit om een vergaderkamer te reserveren?

4. Hoe communiceert u het met de reserveerder als de kamer is gereserveerd?

5. Wat doet u als u geen kamer kan reserveren in het Capitool op een bepaalde datum?

6. Wat doet u als er helemaal geen kamer beschikbaar is op de gewenste datum?

7 . Reserveert u wel eens kamers buiten het Capitool? Zo ja, hoe gaat dat in z'n werk?

8. Wat vindt u slecht aan de huidige manier van vergaderkamers reserveren?

9. Wat zou u graag willen kunnen bij de nieuwe manier van vergaderkamers reserveren?

10. Heeft u nog overige zaken die u kwijt wilt?

11. Zijn er nog mensen waarvan u denkt dat het handig is als ik daarmee ga praten met betrekking tot het reserveren van project kamers?

12. Met wie neemt u contact op als Outlook niet werkt?

13. Bij afspraken: worden marges meegenomen in de afspraak? B.v. iemand wil een afspraak van 2 uur, dan nog wat extra tijd voor eventuele uitloop erbij reserveren.

Receptie

1. **Hoeveel project kamers zijn er op het Capitool die gereserveerd kunnen worden?**
2. **Wat voor vaste faciliteiten hebben deze kamers?**
3. **Wat voor faciliteiten zijn er nog extra te regelen voor elke kamer Hoe kunnen deze worden gereserveerd?**
4. **Wie mogen er project kamers op het Capitool reserveren?**
5. **Via welke communicatie middelen kan er bij de receptie een kamer worden gereserveerd?**
6. **Welke stappen voert u uit om een project kamer voor iemand te reserveren?**
7. **Welke informatie heeft u nodig van degene die de kamer wil reserveren?**
8. **Welke applicatie(s) gebruikt u om een kamer te reserveren?**
9. **Wordt er een bevestiging gegeven aan de reserveerder als de kamer gereserveerd is? Zo ja, in welke vorm (e-mail, telefoon, mondeling, etc)?**
10. **Bij wie kunt u aankloppen mocht het reserveren van een kamer niet lukken?**
11. **Welke problemen vallen u op in de huidige manier van reserveren?**
12. **Overig gedachtes?**
13. **Zijn er nog mensen waarvan u denkt dat het handig is als ik daarmee ga praten?**

Medewerkers: Onderzoekers

1. **Reserveert u wel eens een van de 4 vergaderruimtes in het Capitool? Zo ja, voor welk doel?**
2. **Welke stappen onderneemt u om een vergaderruimte te reserveren?**
3. **Wat vindt u slecht aan de wijze waarop nu kamers gereserveerd kunnen worden?**
4. **Hoe ziet u dat samenwerken in de Ravelijn gaat, wat voor ideëen heeft u daar bij?**

Studenten

1. **Welke stappen onderneemt u om een vergaderruimte te reserveren?**
2. **Wat vindt u slecht aan de wijze waarop nu kamers gereserveerd kunnen worden?**

Management

Welke problemen ervaart u met de huidige manier waarop de vergader kamers gebruikt worden?

Hoe zijn deze problemen onstaan denkt u?

Wat ziet u voor oplossingen?

Appendix D. Stakeholder Interview answers

Normal Operators

Interview Normal operators #1

Naam: Receptie
Datum: 17-11-2009
Onderwerp: huidige processen, technologie, infrastructuur, huidige problemen

- **Hoeveel project kamers zijn er op het Capitool die gereserveerd kunnen worden?**

  Op dit moment zijn er 4 kamers die op deze manier gereserveerd kunnen worden:
  25 Personen
  15 personen
  8 personen
  6 personen

- **Wat voor faciliteiten zijn er nog extra te regelen voor elke kamer. Hoe kunnen deze worden gereserveerd?**
  Beamer: Doet de reserveerder zelf via ICTS door daar een call aan te maken, d.w.z. een e-mail te sturen.

- **Wie mogen er project kamers op het Capitool reserveren?**
  Medewerkers en studenten voor colloquiums.

- **Via welke communicatie middelen kan er bij de receptie een kamer worden gereserveerd?**
  E-mail, telefoon, fysiek langsgaan

- **Welke stappen voert u uit om een project kamer voor iemand te reserveren?**
  a. Secretaresse of medewerker belt of mailt naar Receptie, met de vraag een kamer te reserveren. Hierbij wordt aangegeven om hoeveel personen het gaat en welke datum.
  b. Receptie checkt availability en geeft terug dat de kamer gereserveerd kan worden, of niet.
  c. Indien de kamer via e-mail is gereserveerd: bevestiging terug via e-mail.
  d. Indien de kamer via tel wordt gereserveerd: tel nr opgeven bij reservering, mocht er iets opkomen dan kan door receptie gebeld worden.
  e. Indien niet, dan gaan we weer naar stap 1, totdat er een kamer gevonden is. Indien kamer in Capitool niet te reserveren is op het gewenste tijdstip, gaat de secretaresse of medewerker naar andere gebouwen kijken.

- **Welke informatie heeft u nodig van degene die de kamer wil reserveren?**
  Hoeveel personen voor de kamer.
  Voor welke datum
  Telefoonnummer van reserveerder.

- **Welke applicatie(s) gebruikt u om een kamer te reserveren?**
  Applicatie gebruikt door Receptie voor boekingen: Outlook
- **Wordt er een bevestiging gegeven aan de reserveerder als de kamer gereserveerd is? Zo ja, in welke vorm (e-mail, telefoon, mondeling, etc)?**
  Ja, er wordt altijd een bevestiging gegeven, via het communicatie middel waarmee zelf ook de reservering door de reserveerder is aangegeven. Indien een e-mail, e-mail terug.

- **Bij wie kunt u aankloppen mocht het reserveren van een kamer niet lukken?**
  Huismeester

- **Welke problemen valt u op in de huidige manier van reserveren?**

- Als reserveringen gedaan zijn, graag een bevestiging sturen naar de reserveerder . Nu krijgt receptie vaak telefoontjes: wanneer had ik ook al weer gereserveerd?
- Alternatief: zorg dat de mensen die gereserveerd hebben inzicht hebben in hun eigen reserveringen. Een van de fulltime receptionisten meldde daarbij dat ze niet wil dat iedereen maar zelf kan reserveren.
- Een manier inbouwen waarbij annuleringen worden doorgegeven (wordt nu niet gedaan en schijnt wel vaak te gebeuren).

- **Overig gedachtes?**

  No Rooms available:
  Indien geen kamer beschikbaar: gaan mensen vaak naar instituut hiernaast. (afstand is dus belangrijk!)

  Reserveringen voor kamers buiten Capitool
  Alleen reserveringen binnen het capitool gaan via capitool receptie
  Buiten de faculteit: ander contact persoon. Gaat via reserveringsbureau op de campus.

  Maintenance
  * ICTS (Systembeheer) voor beamer en dat soort dingen.
  * Indien iets mis is: huismeester probeert het op te lossen. Als dat niet lukt in Planon naar FB.

- **Zijn er nog mensen waarvan u denkt dat het handig is als ik daarmee ga praten met betrekking tot het reserveren van project kamers?**
  nee

Interview Normal operators #2

Naam: Jeroen Harmsen
Functie: (receptie)
Datum: 2009
Onderwerp: huidige processen, huidige problemen en mogelijke verbeteringen

1. **Hoe gaat het reserveren van een kamer in z'n werk?**

Afstudeerders kunnen via BOZ zaaltjes reserveren voor hun praatjes. Vaak komt een secretaresse van de begane vloer fysiek naar de receptie (het rondje om is dus belangrijk), secretaresses op hogere vloeren bellen wat vaker.
Limiet qua reservering is nu niet aanwezig. Het gebeurt dat mensen marges meenemen in hun reserveringen. De vast receptionisten plannen zelf ook een marge in. Secretariaat doet dat zelf ook.

2. **Wat kan beter in het huidige reservering proces?**

Het is af en toe handig om te weten wie er precies in de kamer zit, deze informatie is nu optioneel en wordt daarom niet altijd ingevuld. Overzicht is belangrijk.
Secretaresses zelf meer inzicht geven. Op dit moment krijgt receptie regelmatig vragen van reserveerders over op welke datum nou precies de reservering was. Jeroen is niet voor het zelf laten reserveren van medewerkers; hij vreest een "hamsteren" effect.

3. **Operational Support**

Leren hoe receptie taken werken leer je van een meer ervaren receptionist (en/of de huismeester).
Als je hulp nodig hebt: ga je naar een meer ervaren receptionist of naar de huismeester.

4. **Afspraken**

Naast de eenmalige afspraken zijn er ook herhalings afspraken. Afdelingen als het financieel cluster en vakgroepen hebben b.v. maandelijkse vergaderingen. Afspraken worden ook al ver van te voren gemaakt. Anders is het voor die afdelingen lastiger om een zaaltje te regelen.
Heel veel docenten willen niet op kamer vergaderen, omdat ze b.v. een kamer delen met iemand anders en hen niet willen storen.
Een probleem van het ver af reserveren is, omdat er zo ver van te voren wordt gereserveerd, er bij afmelding niet altijd wordt doorgebeld naar receptie. (Wordt gewoon vergeten). Om dit op de lossen heeft Jeroen het volgende idee: niet te ver van te voren plannen. Jeroen merkt op dat dit misschien een te harde beperking is.

Lokatie is king

Vakgroepen die op de 3e verdieping zitten reserveren ook vaker op de 3e verdieping, er zijn dus kennelijk lokatie voorkeuren.

Bezetting

Vooral dinsdag en woensdag zijn druk. Maandag is toch vanaf 10 uur al bezet. Vrijdag is heel rustig.

Interview Normal operators #3

Naam: n/a
Functie: Reception
Datum: 04-09-2011
Onderwerp: focus op technologie

1. Weten jullie of een vergader kamer op een bepaald moment gebruikt wordt? (Is dat mogelijk om te weten door b.v. verwarming/air conditioning/gebruik apparatuur of andere sensoren?)

Voor zover de receptie weet niet, licht is een sensor die per kamer word geregeld, en staat niet in verbinding met elkaar.

Maintenance Operators

Name: Martin Bosker
Functie: ICTS
Date: 09-09-2010
Onderwerp: Mogelijke technologie oplossingen voor nieuwe systeem om registratie gebruik kamer te meten

1. **Wat is ICTS?**

ICTS is een shared service dat o.a. applicatie beheer op University of Twente verzorgt. Meer informatie is te vinden op: http://www.utwente.nl/icts/organisatie/

2. **Wat zijn de mogelijkheden om telefoon te gebruiken als inlog apparaat in vergaderkamers?**

Medewerkers kunnen met hun werknemer nummer inloggen, waardoor ze geidentificeerd worden. Eventueel zou er een koppeling gemaakt kunnen worden om die telefoon inlog gegevens te koppelen aan het invoeren van een record in de reserverings database van de shared meeting rooms.

3. **Wat zijn Authenticatie methodes die op de UT gebruikt worden?**

Windows niveau – active directory
Radius voor wlan

Functional Beneficiaries

Functional Beneficiary #1

Naam: Marc Wouters
Functie: Wetenschappelijk medewerker
Datum: 02-12-2009
Onderwerp: huidige situatie, problemen, en wensen nieuwe situatie

- **Huidige situatie**

Hij reserveert zelf niet vaak vergaderruimtes in Capitool. In de nieuwe situatie zal dit meer worden, omdat hij projectkamer zal reserveren voor studenten voor een vak.
Wouters vertelt dat project kamers voor studenten voor een vak via BOZ gerserveerd worden. Dit zijn zogenaamde blokreserveringen.
In de nieuwe situatie vindt hij dan ook dat blokreserveringen via BOZ moeten blijven gaan, omdat BOZ deze reserveringen dan mee kan nemen in het rooster.

- **Idee achter vergaderkamers in Ravelijn volgens Wouters:**

Het ontwerp gaat er van uit dat bij een meeting met meer dan 3 medewerkers uitgeweken wordt naar vergader kamer en niet op de eigen kamer wordt overlegd.

- **Issues huidige situatie**

- Op dit moment is het moeilijk om erachter te komen wie wanneer een kamer gereserveerd heeft
- Niet zelf kunnen reserveren van vergader zalen.

- **Wensen voor nieuwe situatie**
- Stel je hebt een vergader kamer nodig, je loopt langs een lege kamer. Dan zou het handig zijn om gelijk te kunnen zien of de kamer gereserveerd is, tot wanneer deze gereserveerd is. Wie gereserveerd heeft en eventueel dat de persoon de kamer daar gelijk kan reserveren. Liefst daar op die plek zelf, b.v. via een scherm aan de muur.
- Via pda reserveren vindt Wouters niet zo interessant.
- In elk geval vindt hij belangrijk dat het reserveren handig gebeurt; Dus niet eerst weer naar boven (eigen pc) te moeten lopen om te reserveren, aangezien het dan zo maar kan zijn dat iemand anders in de tussentijd het zaaltje reserveert.
- Touchscreen met invoer mogelijkheden zou handig zijn bij elke vergader kamer.

- **Faciliteiten vergaderzalen:**

Op dit moment, lang niet altijd beamers aanwezig, dat zou toch wel prettig zijn. Wouters vindt de huidige manier van beamers regelen onhandig, te veel gedoe, dit zou makkelijker moeten.
In Ravelijn zouden er mogelijkheden moeten zijn om informatie te kunnen delen (beamer, scherm, whatever). Hij vindt zelf kosten een belangrijk oogpunt om in de gaten houden.

- **Wie is nog meer interessant om mee te praten?**

Niko Groenendijk, bouwbeheer even vragen over de inrichting van vergaderzalen.

- **Extra gedachten**
- Openingstijden, als het gebouw tot 10 uur ‘s avonds open is, zou deze tot 10 uur ‘s avonds moeten kunnen reserveren.
- Afsluitbaarheid van ruimtes: indien je even gaat lunchen, dat hij op slot gaat en dat je het zelf weer op kan doen (dit is iets wat Nico zou moeten weten/beslissen).

Functional Beneficiary #2

Naam: Ton Spil
Functie: Wetenschappelijk medewerker
Datum: 03-12-2009
Onderwerp: huidige situatie, problemen, en wensen nieuwe situatie

1. **Reserveert u wel eens een van de 4 vergaderruimtes in het Capitool? Zo ja, voor welk doel?**
   Ton Spil reserveert deze kamers voor besprekingen waar hij zelf bij aanwezig is. Het is volgens hem mogelijk dat studenten hun colloquium in deze ruimtes houden, dat resrveren ze dan zelf.

2. **Welke stappen onderneemt u om een vergaderruimte te reserveren?**
   Meestal gaat het via de secretaresse, hij stuurt een e-mail of loopt even langs. meestal e-mail of even langslopen. Soms krijgt hij een bevestiging via de mail, als de reservering via mail is gegaan. Wat betreft extra faciliteiten: de vakgroep heeft een eigen beamer, deze kan via eigen agenda gereserveerd worden.

Met de beamer is het meestal een kwestie van navragen waar deze is, het is een informeel process en het kan dan zijn dat de beamer even zoek is.

3. Wat vindt u slecht aan de wijze waarop nu kamers gereserveerd kunnen worden?
Niet zo heel slecht, vaak is het mogelijk een zaaltje te reserveren. Buiten Capitool is het moeilijker om een zaal te reserveren. Omdat je niet rechtstreeks zelf zaaltje kan boeken.
Sommige zaaltjes zijn helemaal niet zelf te boeken, Horst zaaltjes Technology Exchange Room.

4. Hoe ziet u dat samenwerken in de Ravelijn gaat, wat voor ideëen heeft u daar bij?
Met eigen club (de vakgroep, man of 15) een paar vaste kamers, afboeken voor eigen gebruik, sleutel zelf voor te halen.

Multimedia room, 109,
Bij drukke tijden b.v. zalen voor vakgroepen reserveren, zodat vakgroepen.
Lokatie is belangrijk, omdat vaak mensen even op kantoor langskomen om even iets te overlegggen.

Overige opmerkingen
Hoe gaat MB om met de verhouding tussen intern en externe personen, krijgen externen ook toegang tot deze zalen?
Wat vergaderen betreft, hoeveel vrijheid geeft MB aan studenten om daar aan de slag te zijn.
Als de hokken leeg staan en je hebt als werknemer geen last van studenten, is het niet erg. Maar als het je eigen werkpatroon tegenwerkt, is het vervelend. Daarom is het volgens Ton belangrijk de balans tussen studenten en werknemers goed in de gaten houden.
Ton zou het fijn vinden als het systeem geintegreerd zou kunnen worden in Outlook. (de agenda functionaliteit)

Functional Beneficiary #3

Naam: Elke en Marian
Functie: Secretaresses
Datum: 27-11-2009
Onderwerp: huidige situatie, problemen en wensen voor nieuwe situatie

1. Reserveert u wel eens vergader kamers op het Capitool? Zo ja, voor wie?
Voor iedereen in de vakgroep die een kamer wil reserveren, b.v. docenten, medewerkers, onderzoekers.

2. Indien ju voor iemand anders een reservering maakt, hoe laat die persoon u weten dat hij een kamer wil reserveren?
Komt binnen lopen, telefoontje of e-mail. Geeft aan voor hoeveel personen en wanneer. Afspraak wordt genoteerd in outlook agenda van die persoon.
Vakgroep heeft eigen beamer, dus vaak gaat het reseveren van een beamer voor binnen de vakgroep niet eens via ICTS. Het scherm in b101 moet nog wel extra worden gereserveerd, gaat via receptie.

3. Welke stappen voert u uit om een vergaderkamer te reserveren?
Even bellen naar receptie, want een beller is sneller.

4b. Hoe communiceert u het als de kamer is gereserveerd naar de reserveerder?
Indien ze toegang hebben tot de agenda van die persoon: reservering wordt in de agenda van de reserveerder gezet. Anders word het via e-mail of telefoon gecommuniceerd.

5. Wat doet u als u geen kamer kan reserveren in het Capitool op een bepaalde datum?
Afh. Van wensen reserveerder uitwijken naar andere gebouwen, eerst institutenweg (nabijheid matters voor medewerkers!)

6. Reserveert u wel eens kamers buiten het Capitool? Zo ja, hoe gaat dat in z'n werk?
Ja, afhankelijk van wensen reserveerder: indien fancy: uitwijken naar broeierd, drienerburght. Gewone zaal: Instituten gebouw (bellen naar receptie)
Vooral wordt snel de telefoon gepakt, of het zalen beheer systeem erbij gepakt.

7. Wat vindt u slecht aan de huidige manier van vergaderkamers reserveren?
* mensen annuleren hun reservering niet als een vergadering niet doorgaat
* je kan niet makkelijk zien wie er al in een zaal zit op een bepaald moment (om eventueel mee te ruilen). Aanvulling: niet zelf inzicht hebben in de reserveringen, altijd eerst receptie benaderen. Dit vinden ze een omslachtige manier om bij die gegevens te komen.
* apart ICTS contacteren voor beamer e.d., behalve bij zalen waar die al standaard in zit. (moet je een call voor aanmaken)
* receptie vult niet altijd volledig reserverings gegevens in (naam reserveerder, contact gegevens)

8. Wat zou u graag willen kunnen bij de nieuwe manier van vergaderkamers reserveren?
* mochten kamers uitbreidbaar zijn, dat je dat dan in een overzicht terugziet (b.v. je hebt een zaal nodig voor)

9. Overig gedachtes?
Bepaalde tijden zijn populairder dan andere, die zijn dus ook eerder weg (10-11 uur), wellicht interessant hier rekening mee te houden

* Cor Cievit – 2125 – degene waarmee je op de UT zalen reserveert.

Functional Beneficiary #4

Naam: Joyce
Functie: Secretaresse
Datum: 06-12-2010
Onderwerp: aanvulling issues huidige situatie Ravelijn

- ***Wat doe je als je geen kamer kan reserveren in het Capitool op een bepaalde datum?***

  Kijken of er elders ruimte is. Andere kamer, buiten of op kantoor Paul. Faculty club

- **Wat vindt u slecht aan de huidige manier van vergaderkamers reserveren?**
- Af en toe is de receptie niet bereikbaar, dat is vervelend, want dan moet je er later weer achteraan.
- Onduidelijk of dat je als secretaresse inzicht in de vergaderzaal agenda hebt

- Kamer 1238 werd als kantoor ingezet in plaats van vergader ruimte → agenda werd gelijk geblokkeerd/verwijderd, receptie had geen rekening gehouden met al gemaakte afspraken.

Functional Beneficiary #5

Naam: Carla Knippers-Booijink
Functie: Voorzitter Gebruikers Overleg (functional beneficiary)
Datum: 24-11-2009
Onderwerp: huidige situatie, problemen en wensen voor nieuwe situatie

1. Reserveert u wel eens vergader kamers op het Capitool? Zo ja, voor wie?
Voor groepen, gebruikersoverleg, gebouwoverleg, receptie bellen. Afstand is belangrijk

2. Indien u voor iemand anders een reservering maakt, hoe laat hij/zij u weten dat hij/zij een kamer wil reserveren?
Vraag wordt neergelegd bij secretaresses, dan en dan, mondelijk en per e-mail.

3. Welke stappen voert u uit om een vergaderkamer te reserveren?
Zelfde stappen als andere gebruikers

4. Hoe communiceert u het met reserveerder als de kamer is gereserveerd?
Secretaresses maken voor een aantal mensen de afspraken, daar hebben ze een agenda voor. Soms mensen die zelf geen secretaresse hebben, maar dan informeel antwoord.

5. Wat doet u als u geen kamer kan reserveren in het Capitool op een bepaalde datum?
Eerst naar institutenweg, dan iets op de campus.
Heel vaak ook naar de broeierd (kamer overleg van hoogleraren). → Omdat het toch een iets luxere zaal moet zijn.

6. Wat doet u als er helemaal geen kamer beschikbaar is op de gewenste datum?
Andere datum gaan. Soms is een afspraak echt noodzakelijk om in het capitool te zijn (visitatie commissie). Mensen zijn, zolang je het goed alternatief en goed communiceert, niet beroerd om van kamer te wisselen.

7 . Reserveert u wel eens kamers buiten het Capitool? Zo ja, hoe gaat dat in z'n werk?
buiten beschouwing gelaten

8. Wat vindt u slecht aan de huidige manier van vergaderkamers reserveren?
- Geen overzicht van welke kamers er vrij zijn.
- Niet zelf kunnen reserveren. Het proces van reserveren via receptie is al uitgebreid. Dit is nog tijdrovender als je meer mensen hebt waarmee je een afspraak hebt, als er geen kamer beschikbaar blijkt te zijn.

9. Bent u issues over de huidige manier van vergader kamers reserveren bij de gebruikersgroep tegengekomen?

10. Wat zou u graag willen bij de nieuwe manier van vergaderkamers reserveren?

- Losse faciliteiten erbij te reserveren.
- Koffie en thee ook los te reserveren: vaak doen secretaresses dat nu zelf. Sodexo kan dat ook vanuit centraal regelen. Nu is dat bellen met Sodexo. Ook lunch erbij bestellen. Mocht dat opgenomen worden, dan is het fijn om te weten dat het ook geregeld wordt, dat je daar dus geen zorgen meer over hoeft te maken.
- Faculteitsraad, management team duurt al snel 2 uur. Kamer van hoogleraren ook 2 tot 3 uur. (Dus hierbij zou ook een borrel regelen fijn kunnen zijn.) Dit zou voor alleen secretaresses beschikbaar moeten zijn.

11. Wat zijn de wensen vanuit de gebruikersgroep voor de nieuwe flexibel reserveerbare projectkamers?

- Mensen hebben nu geen plek meer zelf om te overleggen met kleine groepen, mensen moeten dus zelf makkelijk inzicht hebben in het reserveringssysteem.
- Decaan, Paul van Loon, wil een innovatief systeem met aanwezigheids detectie.

12. Overig gedachtes?

Faciliteiten in Ravelijn:
Vaste faciliteiten: LCD scherm (met whiteboard functie). Er komen geen beamers aan de plafonds. Telefoon in de kamers.
Losse faciliteiten: Flip over,

Bij nieuwe mensen die het voor de eerste keer een kamer reserveren:
Hoeveel mensen passen erin, welke faciliteiten, wat voor opstellingen (Carre, blok, vrij). Ook b.v. een foto van de nieuwe zalen (3d impressie).

13. Zijn er nog mensen waarvan u denkt dat het handig is als ik daarmee ga praten met betrekking tot het reserveren van project kamers?

Secretaresse overleg
Paul van Loon

Functional Beneficiary #6

Name: Ton Wennink
Date: 2010 – 2011 (Compilation of multiple interviews)

1. Wat is met betrekking tot gebruik, het doel van de shared meeting rooms?

Ten eerste, een zo hoog mogelijke bezettings graad, op een manier dat het niet ten koste gaat van de sfeer in de faculteit. Dit betekent dat hij zo veel mogelijk wil beperken dat de regels met betrekking tot het gebruik te streng of te dwingend worden.

Het tweede punt dat hij aanbrengt is dat, mocht het blijken dat er veel leegstand in het gebouw is, hij deze ruimte weer terug kan geven aan Facilitair Bedrijf. Budgettair gezien is dat interessant, want het geeft de faculteit de mogelijkheid om het bespaarde geld aan andere zaken uit te geven. Echter benadrukt hij wederom, dat dit niet ten koste mag gaan van de sfeer op het werk. Hij heeft eerder mee gemaakt dat het ziekte verzuim omhoog ging door te strenge regels, en dat wil hij nu voorkomen.
Hierbij merkt hij ook nog op, dat besparingen voor de faculteit niet per se besparingen voor de

Universiteit zijn, want als er Universiteit breed leegstand is, worden de kosten uiteindelijk alsnog door de faculteiten betaald.

2. **Hoe gaat het monitoren van de bezettingsgraad in z'n werk?**

Periodiek wordt er een bezettingsronde gehouden. Hierbij loopt er een student langs in de Ravelijn en noteert welke zalen op dat moment in gebruik zijn en welke niet. Dit rapport wordt dan weer door management meegenomen bij het managen van de ruimte behoefte van de faculteit

3. **Wat zijn de huidige issues bij het monitoren van gebruik?**

Het is een moment opname, management weet niet in hoeverre deze moment opname representatief is voor het totale gebruik.

4. **Wat zijn de huidige regels op dit moment met betrekking tot (het gebruik) van de shared meeting rooms?**

Er is op dit moment geen protocol voor hoeveelheid gebruik door individu. Er zijn wel huisregels, maar deze zijn alleen gestoeld op veiligheid.
De shared meeting rooms zijn beschikbaar doordeweeks van 8 tot 8, dan is de receptie ook aanwezig.

Purchaser

None

Product champion

Product Champion #1
Naam: Jos van Hillegersberg Functie: Afstudeerproject initiator Datum: 2009 Onderwerp: uitgangspunten systeem, problemen die opgelost moeten worden
in basis uit de formele opdrachtsomschrijving; waar relevant aangevuld met informatie uit gesprekken gevoerd tijdens het project

1. **Issues in de huidige situatie met betrekking tot de shared meeting rooms**

- Er is mogelijk wasteful gebruik van de resource,
    a. mensen die niet op komen dagen (no-shows),
    b. er kamers worden geboekt voor langere tijdsduur, dan dat eigenlijk nodig is voor de meeting
    c. inefficient gebruik van kamers qua grootte, b.v. kleine groep mensen zit in grote kamer, terwijl een andere groep van mensen geen passende kamer vindt.

2. Wensen voor het nieuwe systeem

- Assigns meeting rooms to users of the building,
- Routes users to the room assigned to them, the use of smart signs, locks and panels should be investigated
- Monitors and reports on the actual use of rooms, use of sensors to monitor use should be considered
- Incorporates a mechanism to prevent waste of resources such as no-shows, booking rooms longer than required, booking larger rooms than needed. Use of incentives and fines could be considered
- Incorporates a mechanism to influence the matching between demand and supply. E.g. rooms close to the offices of the requester, with the right size for the meeting, etc. should get priority.
- Integrates to the relevant systems such as the exchange server and authorization server to find employees / students id's and calendars.

Interfacing Systems

Name: Reserveringsbureau
Date: 04-09-2011

1. Hoe gaat het reserveren van een kamer in werking (aanleiding, proces, communicatie met degene die wil reserveren, kosten?)

Indien de persoon een onderwijs gerelateerde reservering doet, is het gebruik van de ruimtes die aangeboden worden door het Reserveringsbureau gratis. Vakcodes worden gebruikt om de kosten van de kamers toe te wijzen. In andere gevallen kost het het individu geld. .

Meestal wordt er via de telefoon gereserveerd.

2. Welke IT wordt hiervoor gebruikt?
(Rol Planon/Syllabus)

ZBS wordt voor de onderwijs zalen in alle gebouwen, behalve de Vrijhof gebruikt. Planon gaat veel breder, heeft alle pooled zalen, en regelt ook zaken als onderhoud. Osiris zou in de toekomst het gebruik van alle kamers moeten gaan ondersteunen. Syllabus Plus is ook een optie die onderzocht wordt.

Timo (van) Limbeek - 2455 - vrijhof 333 kan meer inzicht in gebruikte applicaties op de UT geven.

Regulators

Naam: Nico Groenendijk
Functie: mede verantwoordelijk voor opstellen nieuwe gebruiks regels shared meeting rooms voor MB in Ravelijn.
Datum: 2009
Onderwerp: ontwerp keuzes bij gebouw Ravelijn, specifiek de shared meeting rooms. Infrastructuur constraints en ideeen over gebruik

Reserveerbare ruimtes Ravelijn:

- 1 x 40 person meeting room (oval VIP room) ← MB zaal
- 12 x 24 multifunctional purpose meeting room (either for one group of 24 people, or 3 groups of each 8 students) ← poolzaal, niet beschikbaar voor MB reserveringssysteem
- 2 x 16 person meeting room (one with video conferencing) ← video conf is niet door iedereen reserveerbaar (en is dus afsluitbaar).
- 21 x 8 person meeting room
- 11 x 6 person meeting room
- 1 x 5 person meeting room

1. **Waarom is er eigenlijk gekozen voor kleinere kamers voor medewerkers tov de manier van werken nu?**

   Faculteit historisch gezien verwend. Vastgoed groep Drienerlo heeft standaarden voor kamer groottes. Totale gebouw visie: kamers beperkt houden zorgt ook voor mogelijkheden in flexibele ruimte mogelijkheden, Studie landschap, project kamers etc.

2. **Wat is de reden voor een informatie systeem voor het reserveren van reserveerbare ruimtes in Ravelijn ipv de huidige manier van werken: receptie met outlook?**

   Op dit moment op een beperkte manier te maken met reserveren, vanwege weinig ruimtes. Op het moment dat er meer ruimtes komen moet je iets anders regelen.
   Maar ook, stukje, gebruikersvriendelijkheid. Mensen zijn vrij om ergens te gaan zitten, maar moeten ze wel weten of het gereserveerd is of niet.
   Studie landschap is in principe bedoeld voor studenten, maar het is de hoop dat ook medewerkers daar gaan zitten, b.v. met lunch.
   Lastig om van te voren te voorzien hoe het gebruik van project kamer vs open landschappen zal uitvallen. Mochten de project kamers weinig gebruikt worden, dan kan er altijd nog geschoven worden in de indeling van Ravelijn (flexibele wandjes die geplaatst en verwijderd kunnen worden).

   Indeling ruimtes is op basis van huidige bezetting + openstaande vacatures. Maar dit kan natuurlijk ook nog veranderen, daarom is de flexibele opzet van Ravelijn erg handig.
   Als studenten alle informatie hebben, weten ze wel waar ze kunnen gaan zitten als ze afzondering nodig hebben.
   De vraag komt op: wie mogen allemaal reserveren: Nico zegt dat er nog geen uitsluitsel over is gegeven, maar dat hij het in principe niet erg vindt om iedereen te kunnen laten reserveren. Hij denkt wel dat je iedereen in principe de mogelijkheid moet geven.
   Iedereen moet kunnen reserveren.

3. **Voor wie zijn de multi functionele zalen bruikbaar? B.v. is het alleen vanuit een vak als zaal voor studenten projecgroepen te gebruiken? Kunnen medewerkers ook deze zalen reserveren? Wie heeft er dan voorrang bij het reserveren?**
   In Ravelijn ook duidelijke scheiding tussen Poolzalen en MB zalen. Die keuze is gemaakt vanwege kosten toewijzing ruimte inrichting.
   Poolzaal, gaat via BOZ
   VIP zaal moet wel beperkt reserveerbaar zijn. Policy bedenken wanneer deze beschikbaar gesteld mag worden en aan wie.

4. **Worden de reserveerbare ruimtes afgesloten? Zo ja, hoe? En hoe krijgt een reserveerder toegang tot de ruimte?**
   De vergaderruimtes worden niet afgesloten, op de video conf zaal na. Indien wel afgesloten: Sleutel via receptie.

5. **Welke faciliteiten voor groepswerken zijn er in elk van de reserveerbare ruimtes beschikbaar?**
   Nog niet zeker, systeem moet zodanig ingericht worden dat hier rekening mee gehouden kan worden. Kan zijn dat een lcd scherm er in komt, maar ook is het mogelijk dat verrijdbare beamers gebruikt gaan worden. Studenten mogen dan ook gebruik maken van de beamers. Hij zou het liefst zien dat hier rekening gehouden wordt met het systeem (oftwel, dat een beamer erbij te reserveren is).
   Koffie/lunch is voor reserveringen door medewerkers te gebruiken. Op dit moment is het los vast geregeld, soms door catering soms een secretaresse die een paar kannen neerzetten en soms zelf bediening.
6. **Wat zijn de tijden waarop de reserveerbare ruimtes in Ravelijn toegankelijk zijn (en op welke dagen van de week)?**

Half 8 of 8 uur ‘s ochtends tot 10 uur ‘s avonds.

7. **Policy wbt extra faciliteiten als koffie/lunch voor bij afspraken in reserveerbare ruimtes, wat zou mogelijk moeten zijn voor medewerkers en wat voor studenten?**
   Ook nog niet zeker, per gebruikersgroep bekijken.

8. **Hoe vaak mogen studenten/medewerkers reserveerbare ruimtes reserveren?**
   Laissez faire aanpak, laten we kijken wat er gebeurt. Willen ze nu niet beperken tot een bepaald getal. Flexibiliteit is king. Zelfde met voorrang geven aan bepaalde mensen. Nico vindt inzicht in reserveringsgedrag in combinatie met daadwerkelijk gebruik erg belangrijk, zodat op basis hiervan gestuurd kan worden.
   Uitgangspunt: niet van te voren reguleren, maar kijken wat er gebeurt en op basis daarvan sturen.

9. **Kunnen studenten/medewerkers elk van de reserveerbare ruimtes reserveren of zijn hier beperkingen? B.v. de vip zaal alleen voor management.**
   Zie overzicht hierboven, alle project ruimtes zijn reserveerbaar door zowel studenten als medewerkers.

10. **Evenementen regelen?**
    Zijn meestal alleen de vip zaal en de college zalen voor symposia, dus is niet een onderdeel van

het reserveringssysteem.

11. **De menselijke factor**
    Idee voor Ravelijn is dat er duidelijke gedragsregels worden neergezet voor het gebruik van de zalen: houd het netjes.
    Het idee is: alles flexibel, je houdt alles open, daartegenover staat dat je verwacht mensen geen strategisch gedrag gaan vertonen en fatsoenlijk omgaan met de middelen die worden aangeboden vanuit Ravelijn.
    Communicatie is bezig om op een leuke manier deze gedragsregels neer te zetten: Bertiel Lankhaar, samen met Carla.
    Eventuele issues:
    Omdat de vergaderruimtes zo dichtbij de vakgroepen staan, is er mogelijk het gevaar dat mensen van de vakgroep die kamer zich gaan toe-eigenen. Dit is dus niet te bedoeling (d.w.z. dat het een koffie kamer wordt of er boekenkasten worden neergezet).
    Er worden afspraken gemaakt met de vakgroepen over het gebruik van deze project kamers (Dus dat ze voor iedereen zijn).
    Het idee is dat de huismeester in de gaten houdt of het gebruik correct is, i.e. geen oneigenlijk gebruik van de ruimtes.

    Maar daarnaast ook de dame van de ARBO die in de gaten houdt of de kamers niet oneigenlijk gebruikt worden. B.v. de vergaderruimtes mogen niet gebruikt worden als werkkamer, omdat je geen uitzicht hebt op de buitenwereld. Monique van schoonhoven.

Interviews met Frank Snels
Niet opgenomen in deze thesis.

Naam: Marc Hulshof Datum: 18-01-2011
Over nota ruimte gebruik: Ambitie UT groeien naar 10,000 studenten → is nu gelukt door ITC (maar is meeri n de maag gesplitst) Hoeveel collegezalen bij te bouwen? Antwoord: niets, er is genoeg ruimte, maar er wordt niet optimaal gebruik van gemaakt Echter, project ruimten (voor studenten) zijn te weinig. Er bestaat een gevoel van dat moet anders georganiseerd worden. Mogelijk antwoord: overhevelen van project ruimten naar centraal orgaan. Project ruimte: 6-8 personen, grote tafel, whiteboard Basis van het verhaal: studenten hebben geklaagd dat er geen ruimtes zijn, Hoe bepaal je ruimtegebruik: • Leegstand (vervuilt snel) → nu ongeveer 2 – 3 % (indicatie dat er nu

20-30 % leegstand zou aangeven dat er te veel is

- daadwerkelijk gebruik:

heeft het zin om het precieze kamergebruik te weten?
Ja, geeft nl motivatie

1. Kun je me uitleggen wat de relatie van FB met de faculteit MB is? (klant/opdrachtgever?)

FB → verhuurder
MB → klant

2. Wat zijn de diensten die FB aanlevert voor MB

42 ruimtes in totaal

3. Hoe zit het met ongebruikte ruimte bij ene faculteit (vanaf hoeveel ruimtes kunnen ze dit annuleren qua huur)

4. Welke andere partijen zijn er nog direct en indirect bij het beslissen over strategie/beleid ruimte gebruik?

FB is beheerder van alle ruimte. Ook vertantwoordelijk voor het gebruik en zo nuttig mogelijk inzetten (maximale bezetting realiseren).
CVB rekent FB op percentage.

VGD: bouwt nieuw bouw (gaat samen met FB straks)

5. Welke andere partijen zijn er nog direct en indirect bij het beslissen over gebruik ruimte gebruik?

Kunnen meten, dat is het allerbelangrijkste!!

Appendix E. Problems encountered by Stakeholders (mapped)

Problems \ Stakeholder roles	Normal Operator #1	Normal operator #2	Functional beneficiary #1	Functional beneficiary #2	Functional Beneficiary #3	Functional Beneficiary #4	Functional Beneficiary #5	Functional beneficiary #6	Product Champion #1
No digital confirmation of reservation is sent to reserver	x								
Cancellations of reservations are not reported to Reception	x				x				
Reception gets calls from people re-checking reservation information		x							
Contact information of the reservee is not consistently stored in the database		x			x				
Functional Beneficiaries can only access reservation information / room availability via reception, they cannot quickly access this information themselves			x		x	x	x		
Functional Beneficiaries cannot reserve rooms in the Outlook system themselves			x				x		
ratio between students and employees using the shared meeting rooms				x					
Extra facilities for a meeting have to be reserved seperately					x				
Functional Beneficiary issue: Reception is not always available when you need to make a reservation						x			
Room designation changes are handled in such a way that reservations are lost						x			
Current monitoring process is a snapshot of the situation, which is not necessarily a correct representation of the actual occupancy rate								x	
Possible wasteful use, in the form of: no-shows, longer than required booking of rooms, small groups using large rooms									x

Appendix F. Requirements (pre validatition version)

1. Organizational Requirements

Commons design principles are applied here

d.1. It should be clearly defined which rooms belong to the shared meeting room pool
d.2. It should be defined which individuals may use the shared meeting rooms
d.3. All roles defined in the framework should be formally appointed to people within MB
d.4. There should be a perceived fairness in the relationships between the benefits received and the contributions to the necessary costs of sustaining the system
d.5. Participation in making key decisions about the shared meeting rooms should include as much people as reasonably possible
d.6. The monitors should face appropriate incentives to monitor the commons, given the challenge of monitoring.
d.7. The rules used should be clear and easy to understand
d.8. Sanctions should be defined for unwanted behavior. These sanctions should be adjustable to the seriousness of the infraction without having to impose unrealistic sanctions, but be sufficiently large.
d.9. Rewards should be defined to further motivate cooperative behavior, and should be sufficiently large.

2. Technology requirements

d.10. Integration with outlook calendar
d.11. The system should use the standard UT identification/authentication method
d.12. Should support the possibility to use mobile devices as clients
d.13. Should support the possibility to check in and out of a shared meeting room via a paperless method
d.14. Should support the possibility to reserve a room via a paperless method

3. Non-Functional requirements system MB

d.15. The system should contain up to date information about the status of reservation rooms
d.16. The system should be available both during and outside office hours to people who want to reserve shared meeting rooms
d.17. The system should be composed of IT that is already available for MB if possible

d.18. The system should be perceived as usable by MB employees and students

4. Functional requirements system MB

d.19. Authorized viewer

4.1.1. View current reservations made in Ravelijn

4.1.2. View available rooms on basis of characteristics (size, features, availability on a specific date)

d.20. Appropriator

4.1.3. Log in to reservation system

4.1.4. View current reservations made in Ravelijn

4.1.5. View available rooms on basis of characteristics (size, features, availability on a specific date)

4.1.6. Reserve a room

4.1.7. Invite other people to the reservation

4.1.8. Change a reservation to another date or change the (number of) people

4.1.9. Cancel reservation

4.1.10. Swap reservation with other user

4.1.11. Enter conflict

d.21. Monitor

4.1.12. Appropriator with reservation does not show up (record no show after 10 min time out)

4.1.13. Check in (on basis of reservation)

4.1.14. Check in (without reservation)

4.1.15. Check out

d.22. Claimant

4.1.16. Add a new room to the system

4.1.17. Change characteristics of a room (size, features, availability for meetings)

4.1.18. Delete a room from the system

4.1.19. Temporarily disable room for meeting purposes (and notify the people who have already reserved this rooms on the disabled dates)

d.23. Proprietor

4.1.20. Give an individual or group of individual certain rights (authorized viewer, appropriator (employee, student), claimant, proprietor, owner)

d.24. Enforcer

4.1.21. Receive information (location, person, event, punishment) about a operational rules trigger event so that he/she can provide punishment or a reward

4.1.22. Enter the applied punishment/reward into a system
4.1.23. Apply punishment/reward via the system (depends on the operational rules in place)

d.25. Manager
4.1.24. Request usage statistics about the rooms
4.1.25. Request # times the operational rules were violated
4.1.26. Request # times which operational rules were enforced

d.26. Collective choice participant
4.1.27. Enter a new operational rule
4.1.28. Edit an operational rule
4.1.29. Delete an operational rule
4.1.30. View effectiveness of a current rule in place

d.27. Arbiter
4.1.31. Receive a conflict claim

Appendix G. Considered Monitoring Options

We have looked at three alternatives to monitor the usage of the shared meeting rooms. Inspiration has been drawn from the field studies and Commons theory, resulting in three monitoring solutions: a) sensors to detect presence (ROC Friese Poort), b) a user generated check in to acknowledge use of room (Microsoft), and c) providing all other authorized appropriators incentives to want to make the effort of monitoring (typical for classic Commons situations). How each alternative impacts the current lack in information can be seen in the table below.

Monitoring of / Monitoring solution	No-shows	Cancellations	unplanned meetings	Consistent recording of user specific usage for management information	Actual appropriation of reservations by reserver	Free rider detection
Light sensor	yes	yes	Yes	No	No	No
User self check in	Yes	Yes	Yes	Yes	Yes	No
Monitoring by other appropriators (mutual monitoring)	Yes	Yes	Yes	Yes	Yes	Yes

Table 30 Monitoring alternatives linked to monitoring goals

The light sensor alternative provides good information about checking whether reservations are actually used. The user information is already known, and via a simple check the light sensor can check whether the room is in use. However this information is not user specific. Having appropriators check in solves this issue by making appropriators themselves responsible for letting the system know that they are using the room, and that the system should set the room to a not available status. However, the problem of free riders and incorrect use of the system remain, which is where the mutual monitoring solution comes in. In this solution people are responsible, and should receive incentives, to communicate to others how to use the system and potentially notice that free riders are using the room.

Appendix H. Individual choice model

Each person makes a rational decision (albeit not always a conscious one) to exhibit a certain type of behavior [Ost90]. Ostrom proposes the individual choice model as a way to analyze and better understand which factors are of influence for individuals who are interacting with a Common-pool resource. The factors are internal norms, discount rate, expected benefits and expected costs. The invidual choice model is a general model, which is open to many particular specifications [Ost90]. Therefore it can be used not only to assess the likeliness of overuse enabling behavior, but also the likelihood of other incentive problems occuring as a result of individual's actions. When using the individual choice model, the focus should be on measurable and observable variables, for example, the internal subjective variables are hard to measure [OST90].

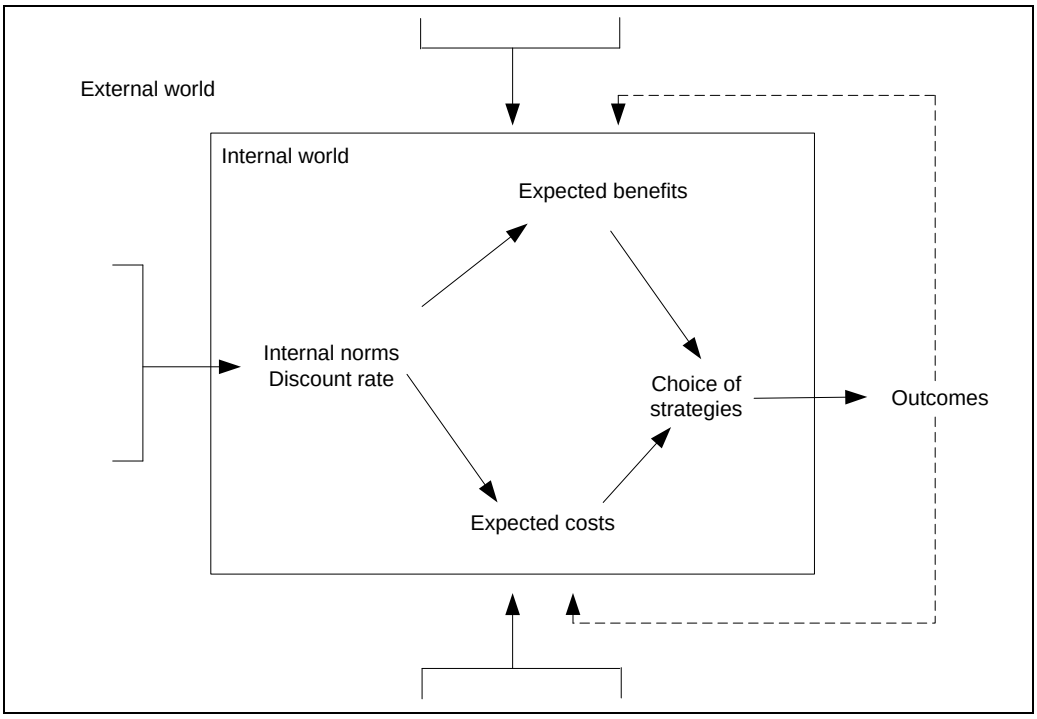


Figure 32. Individual choice model (adopted from [OST90])

Internal norms

Each individual has a set of norms in behavior that affect the way that individual perceives and weighs alternatives [Ost90]. The most important impact that the type and extent of shared norms will have on the strategies available to individuals has to do with the level of opportunistic behavior that appropriators can expect from other appropriators [Ost90]. When few individuals share norms about the impropriety of breaking promises, refusing to do one's share, etc in a certain setting. It is difficult to develop stable, long-term commitments (to reduce incentive problems such as overuse) [Ost90].

Because CPR settings extend over time, and individuals adopt internal norms, it is possible for individuals to utilize contingent strategies, not simply independent strategies in relating to one another. [OST90]

Discount rate

Individuals value benefits in the distant future less than those benefits expected in the immediate future, which is called the discount rate [Ost90]. How fast the discount rate is, depends on several factors. First of all, the expectance of reaping the benefits by the individuals themselves or their children [Ost90]. This factor relates to the trust base in the Commons, if people trust each other to behave in an honest way, the discount rate becomes higher, which leads the individual to be able to adopt strategies over time, rather than short-term opportunistic behavior. Secondly, opportunities that may have more rapid returns in other settings reduce the discount rate [Ost90]. This factor influences appropriators seeking for alternatives to the Common-pool resource, this results either in deviant behavior (promoting incentive problems) or looking for alternatives to the CPR. Thirdly there is the matter of physical and economic security: e.g. if a person is in need of food now, he is more likely to harvest now rather than having a chance of food next year. [OST90]

***E*xpected benefits**

These are the benefits an appropriator expects from complying with the set of rules as established within the common-resource pool [Ost90]. These benefits can be of a financial or social nature, depending on the nature of the institution. It is important to realize that trust in the institution is an important factor here, if people

Expected costs

These are the costs an appropriator expects to incur depending on his/her choice to either comply or default from the institution. The expected costs do not solely consist of financial costs, but also include faith in the skills of leaders.

Choice of strategies

The individual makes his choice for a strategy (either to comply to the institution's rules or not) based upon the internal norms, discount rate, expected benefits and costs. However, he does not make this choice one time, but every time he appropriates from the resource. Therefore individuals can use contingent strategies in which cooperation will have a greater chance of evolving and surviving. Individuals frequently are willing to forgo immediate returns in order to gain larger joint benefits when they observe many others following the same strategy. Changing the positive and negative inducements associated with particular actions and outcomes and the levels and types of information available can also encourage coordination of activities. [OST90]

Appendix I. Requirements levels

Requirements level	What is it?	Software house / vendor	Verification	Validation
Goal-level requirements	Business goal that can be verified, although only after some period of operation. Shows what the customer really wants.	Will likely not accept these requirements as it requires much more than a new IT product	Yes	Not applicable
Domain-level requirements	Outlines the tasks involved and requires support for these tasks.	Useful when software house has knowledge about the domain (meeting rooms), otherwise too risky for customer. Both commercial off-the-shelf (COTS) and developed from scratch are acceptable	Yes	There is a requirements intended to support the goal, but we cannot be sure that it is sufficient. Here the customer runs a risk, but it is the kind of risk he should handle and be responsible for
Product-level requirements	Here is specified what comes in and out of the product. Essentially the function or feature is identified without giving all the details	Could be given to Software house. Both Commercial off-the-shelf (COTS) and developing from scratch are acceptable	Yes, before delivery time	Same risk as with domain-level requirements. However there is an additional risk: we cannot be sure that the solution adequately supports the task.
Design-level requirements	The product interfaces are specified in detail. It doesn't show how to implement it inside the product	Could be given to software house, however: it forces you in a direction that is not necessarily the	Yes	Yes

		best way. The vendor might have a better solution		

Appendix J. Interview Microsoft

1. **Wat waren de uitgangspunten bij het inrichten van het kantoor als een flex werk plek? Waren er specifieke issues die men op wilde lossen? Welke voordelen werden er van de nieuwe werkwijze verwacht?**

Microsoft heeft een filosofie: Be, do, say. Eerst zijn om te kunnen doen, en daarna pas erover vertellen. In het geval van de flex werk plek wilde Microsoft voor zichzelf een omgeving creëeren die flexibel was, i.e. kunnen werken wanneer en waar medewerkers willen. Daarbij gebruik makend van software die Microsoft zelf ontwikkeld heeft.
Op dit moment zijn er rond de 850 medewerkers bij Microsoft NL. Er zijn 623 werkplekken in het gebouw.
B.v. Infopath wordt door Hospitality gebruikt om vergader kamer reserveringen aan te nemen. Een voordeel van de nieuwe werk wijze is dat het de work-life balance verbetert omdat werknemers zelf kunnen beslissen waar en wanneer ze werken.

2. **Waarom is er voor de huidige werk wijze wat betreft kamer reserveringen gekozen?**

Vanwege de filosie “be, do, say” wilde Microsoft technologie gebruiken die ze zelf al in house hadden. Daarom wordt Infopath gebruikt om reservering aanvragen naar Hospitality te sturen. CRM wordt gebruikt om reserveringen voor vergader kamers te op te slaan.

3. **Hoeveel vergader kamers zijn er in het Microsoft gebouw? Wat zijn de karakteristieken van deze kamers?**

Er zijn in totaal 18 vergader kamers, waarvan 10 in de community area. De community area is de verdieping in het Microsoft kantoor wat als een ontmoetingsplek dient, zowel tussen collega’s als tussen Microsoft medewerkers en externen.
Alle 18 vergader kamers zijn uniek en allemaal hebben ze hun eigen functie. Zo zijn er ruimtes die meer bedoeld zijn voor creatieve meetings, ruimtes die al seen huiskamer ingericht zijn, maar ook traditionelere setup voor b.v. het afsluiten van contracten.

4. **Wie mag deze vergader kamers reserveren?**

Elke werknemers binnen Microsoft mag gebruik maken van deze ruimtes.

5. **Welke stappen voert een Microsoft medewerker uit om een kamer te reserveren? Waarom is er voor deze werkwijze gekozen? Wat zijn de voordelen/nadelen van deze methode?**

Medewerkers vullen een Infopath formulier in waarin ze hun wensen voor de kamer en datum voor reservering aangeven. Vanaf hier neemt de Hospitality dienst het over.
Hospitality is de dienst binnen Microsoft die zorg draagt voor faciliteit management en ervoor zorgt dat de uitstraling van Microsoft naar bezoekers tip top in orde is. Hospitality managed het geheel van receptie, vergader kamer boekingen, catering, technische ondersteuning, schoonmaak diensten, security. Een aantal diensten als catering, schoonmaak en security wordt extern ingehuurd. In totaal zijn er 75 mensen betrokken bij de Hospitality dienst.
De mensen van hospitality bekijken of het mogelijk is de zaal voor die datum te reserveren en voeren de reservering door. Mocht een bepaalde ruimte op dat moment niet beschikbaar zijn, dan geven ze

alternatieve mogelijkheden aan de reserveerder. Als een kamer gereserveerd is krijgt de reserveerder een bevestiging via de mail.
Hospitality doet dus niet alleen een zaaltje plannen, maar let juist ook op dat bij vergaderingen met externen Microsoft de juiste uitstraling heeft voor die meeting. Hospitality zal dus ook aanbevelingen doen als ze van mening is dat een bepaalde meeting beter in een andere zaal gehouden kan worden.
Hospitality regelt voor een dergelijke meeting ook alle rand zaken als aanwezigheid lunch, toegangspasjes, parkeerplekken. Alles wat nodig is om bij de bezoeker een goede indruk van Microsoft achter te laten en de medewerker te helpen dit te realiseren.

6. **Zijn er mensen binnen Microsoft die voor andere medewerkers vergader kamers reserveren (b.v. secretaresses)?**

Ja, kan voorkomen, ook gewoon via infopath

7. **Zitten er restricties/voorwaarden aan het gebruik van vergader kamers?**

Nee, iedere werknemer mag zo vaak een zaal gebruiken als hij/zij denkt nodig te hebben. Er wordt wel op gelet dat werknemers netjes omgaan met de faciliteiten die aangeboden worden.

8. **Kunnen medewerkers gebruik maken van extra faciliteiten (b.v. beamer, lunch, koffie). Zo ja, wat voor faciliteiten en hoe wordt dit meegenomen bij een reservering?**

Ja, geven ze aan via het infopath formulier, Hospitality regelt de rest.

9. **Hoe lang is deze nieuwe manier van werken al in werking?**

April 2008

10. **Hoeveel gebruik wordt er gemaakt van de vergader kamers?**

Per week komen er 700 – 1000 gasten langs in het Microsoft hoofdkantoor, vergader ruimtes zijn in de regel tijdens kantoor uren in gebruik.

11. **Hoe wordt er omgegaan met kamers die wel gereserveerd zijn, maar waarvan de reserveerder niet op komt dagen?**

Als mensen het van te voren laten weten is dat prima. Het komt echter bijna niet voor. De mentaliteit is bij Microsoft dat iedereen respectvol met elkaar om gaat en daarom ook de moeite neemt om elkaar even op de hoogte te stellen als een vergadering niet doorgaat en de ruimte niet nodig is.

12. **Heeft de nieuwe manier van reserveren (verwachte) voordelen opgeleverd? In welke mate?**

Ja het flexibele werken heeft ervoor gezorgd dat mensen zelf beter kunnen bepalen wanneer en waar ze werken.
De nieuwe community area in combinatie met de hospitality dienst heeft ervoor gezorgd dat er kosten besparingen zijn omdat vergaderingen nu eerder in house worden gehouden, in plaats van in hotels of andere lokaties.
Ook kan dankzij de Hospitality dienst de uitstraling van Microsoft naar de buitenwereld beter worden

gemanaged.

13. **Wat vindt u op dit moment van de manier van reserveren van vergaderkamers? Wat is goed, en wat zou eventueel beter kunnen?**

Op dit moment goed: de persoonlijke aandacht die aan collega's gegeven wordt bij het reserveren, echt toegevoegde waarde bieden. Daarnaast zorgt Hospitality op deze manier ook dat Microsoft kwaliteit uitstraalt, door een goede verzorging en ontvangst van haar gasten.
Elk kwartaal word teen mystery visit gedaan om feedback te geven op hoe Hospitality draait. Daarin kwam naar voren dat de routing van de gasten beter zou kunnen.
Tatiana wil de cross charging van de kosten inzichtelijker maken zodat ze betere management informatie aan kan bieden

14. **Hoe zit het reservering systeem in elkaar?**

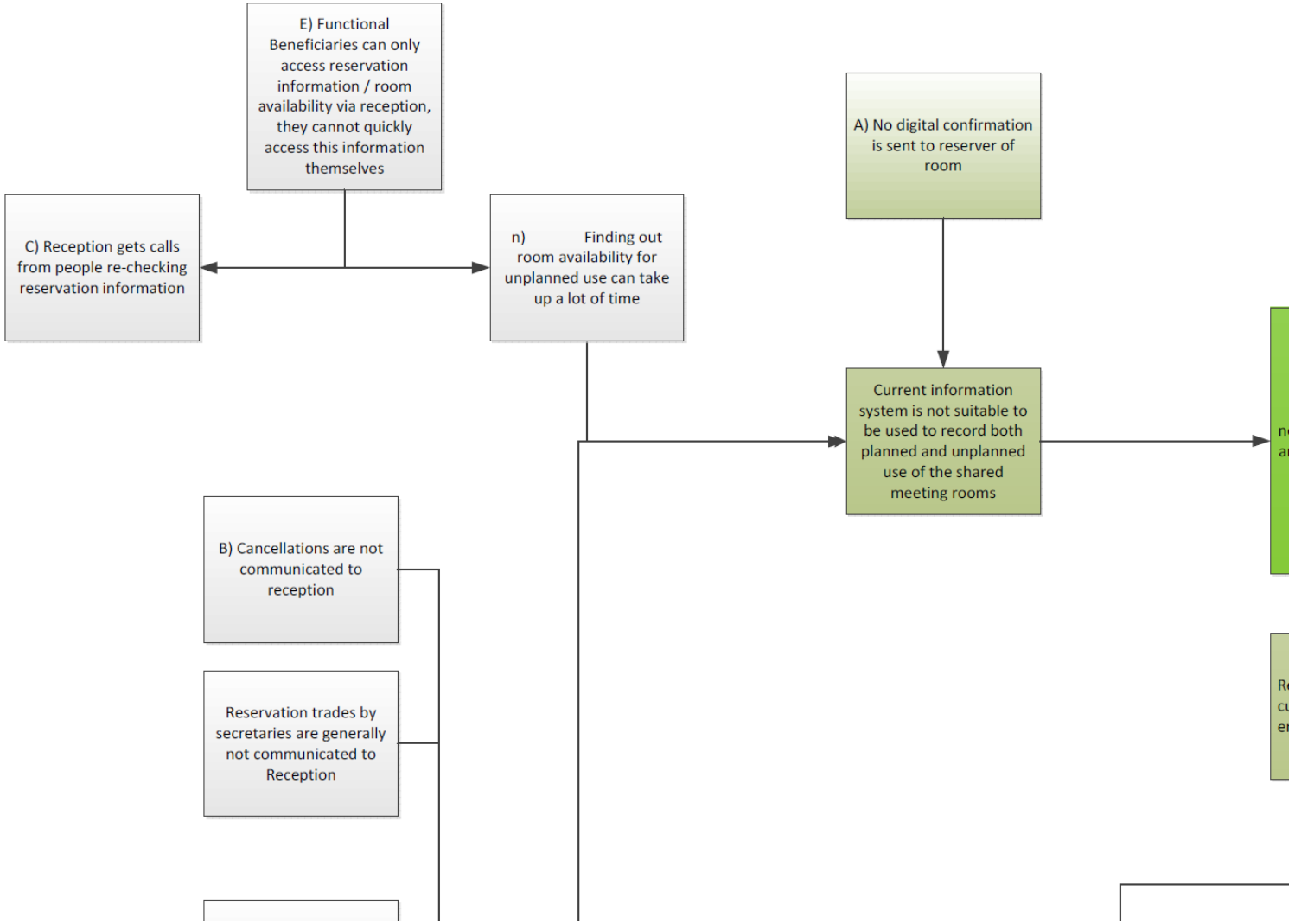
Je kan via touch screens zien wie op welk moment in de kamer zit, of hoort te zitten.

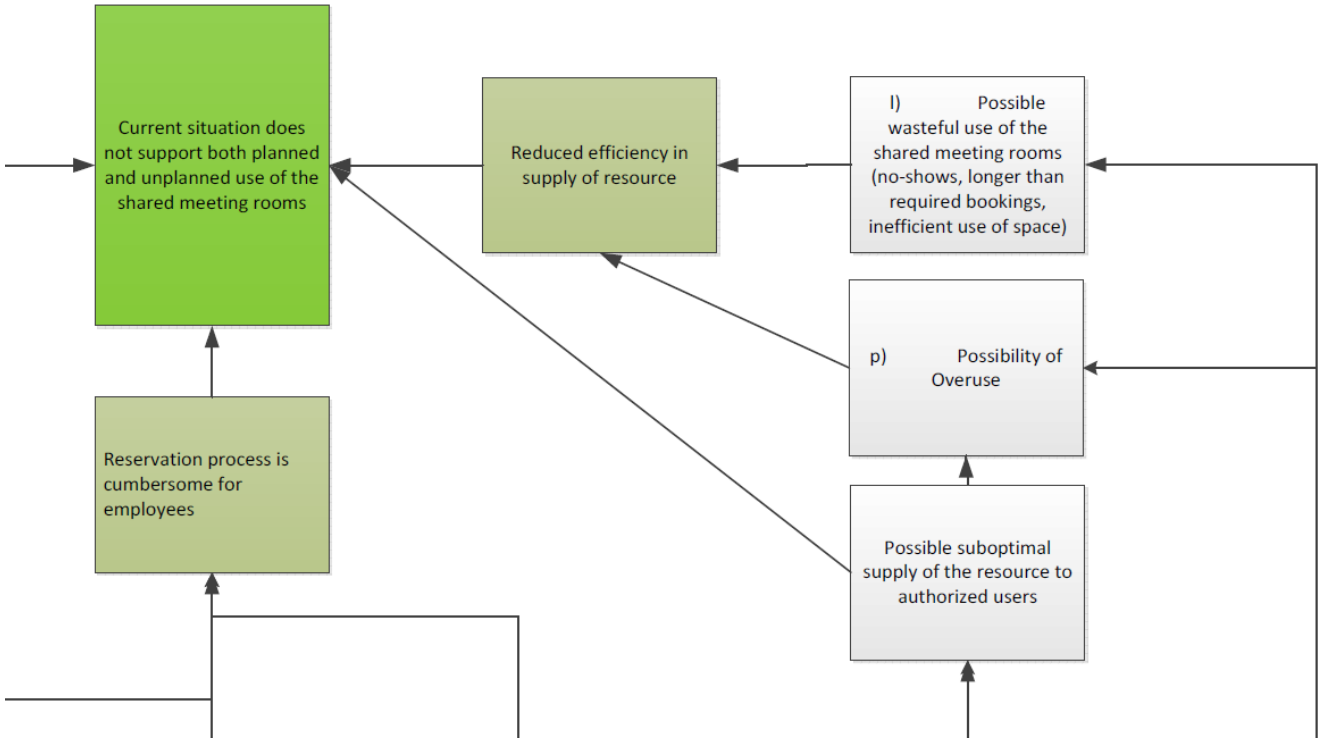
Mocht deze leeg zijn, dan kan je via touch screen "reserve now" drukken en kan je de kamer gebruiken.

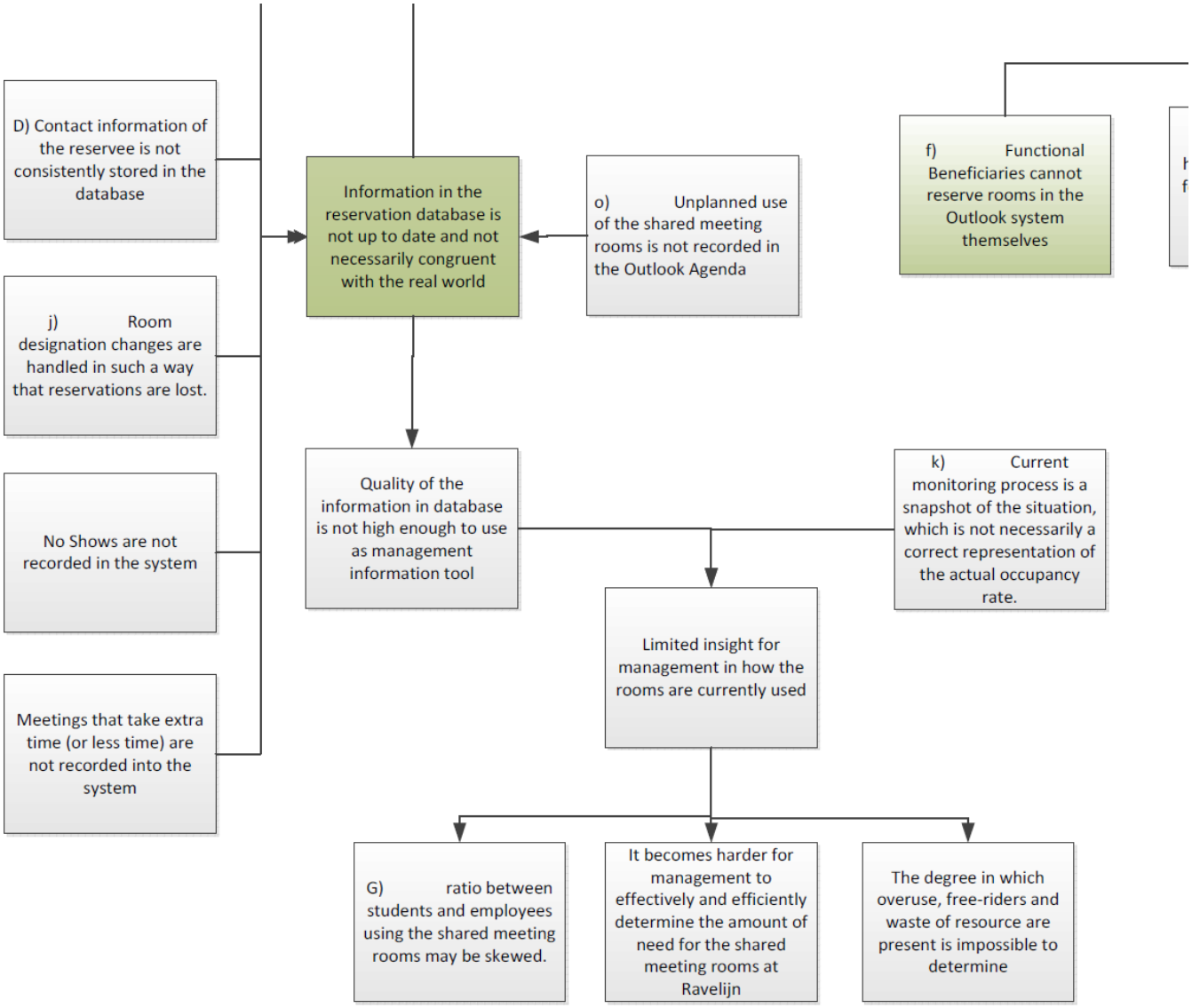
Het reservering systeem dat achter de vergader kamer boekingen zit heet CRM.

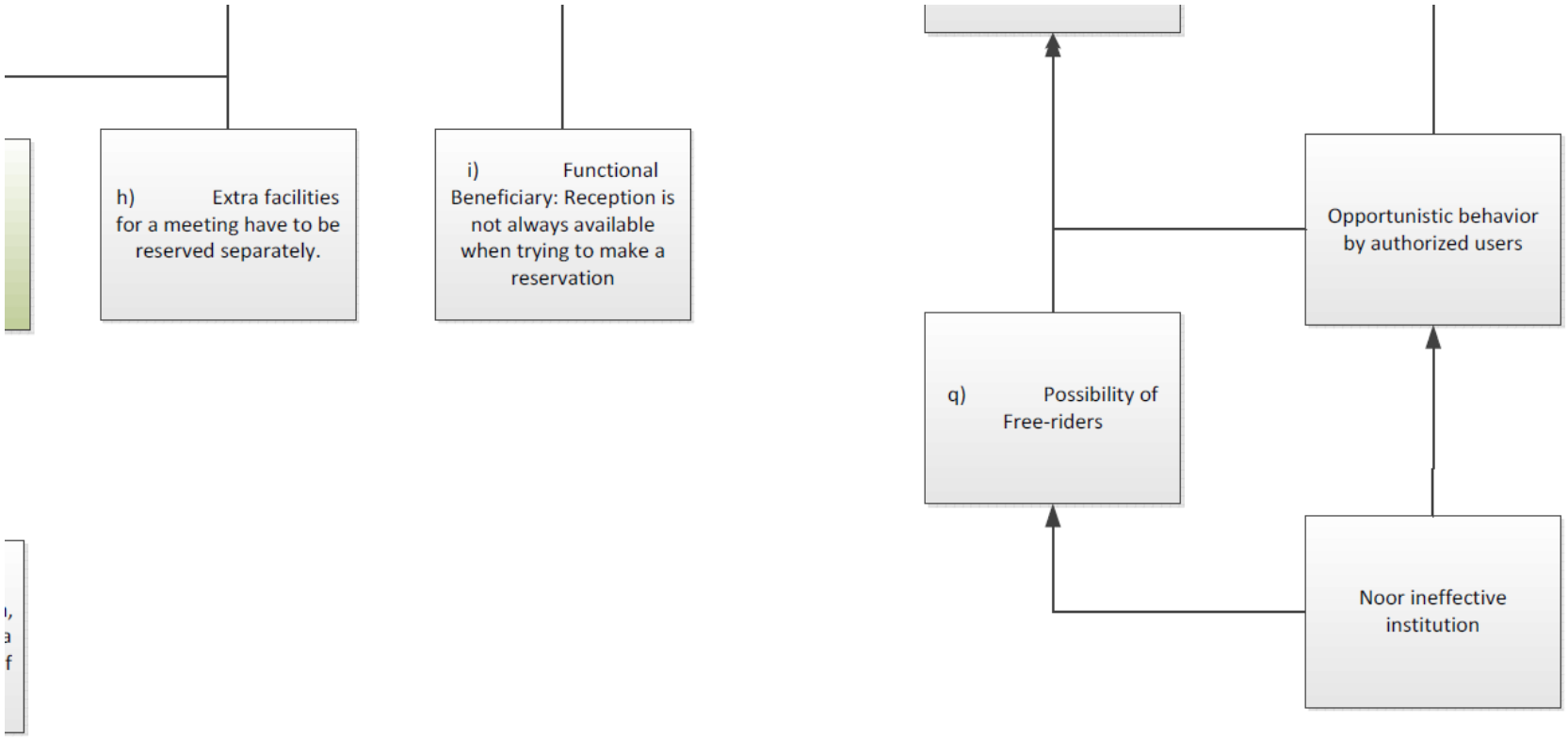
Appendix K. Problem Bundle

Split up in four pages for readability




Current situation does not support both planned and unplanned use of the shared meeting rooms
Reduced efficiency in supply of resource
l) Possible wasteful use of the shared meeting rooms (no-shows, longer than required bookings, inefficient use of space)
p) Possibility of Overuse
Possible suboptimal supply of the resource to authorized users
Reservation process is cumbersome for employees


D) Contact information of the reservee is not consistently stored in the database
j) Room designation changes are handled in such a way that reservations are lost.
No Shows are not recorded in the system
Meetings that take extra time (or less time) are not recorded into the system
Information in the reservation database is not up to date and not necessarily congruent with the real world
o) Unplanned use of the shared meeting rooms is not recorded in the Outlook Agenda
f) Functional Beneficiaries cannot reserve rooms in the Outlook system themselves
Quality of the information in database is not high enough to use as management information tool
k) Current monitoring process is a snapshot of the situation, which is not necessarily a correct representation of the actual occupancy rate.
Limited insight for management in how the rooms are currently used
G) ratio between students and employees using the shared meeting rooms may be skewed.
It becomes harder for management to effectively and efficiently determine the amount of need for the shared meeting rooms at Ravelijn
The degree in which overuse, free-riders and waste of resource are present is impossible to determine


h) Extra facilities for a meeting have to be reserved separately.
i) Functional Beneficiary: Reception is not always available when trying to make a reservation
Opportunistic behavior by authorized users
q) Possibility of Free-riders
Noor ineffective institution