

# Action research study of an initiated cross-industry collaboration

Assessing opportunities and project risks in a strategic alliance jointly developing energy solutions within commercial real estate

*Annah Håkansson & Andrea Pettersson*

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Division of Risk Management and Societal Safety  
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Environmental and Energy Systems Studies  
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LUNDS UNIVERSITET  
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# Action research study of an initiated cross-industry collaboration

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Annah Håkansson & Andrea Pettersson

Master's Thesis

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**Abstract**

This master's thesis is an assessment of opportunities and project risks within an initiated collaboration agreement between E.ON Sverige AB, ABB AB and Telefonaktiebolaget L M Ericsson. The aim of the cross-industry agreement is to jointly develop smart energy solutions and it has initiated a pilot project within the area commercial real estate. The master's thesis aimed to analyse and assess how opportunities and project risks was managed within the project. The thesis students carried out an iterative action research methodology in four phases and actively took part in the pilot study in relation to timing. The findings revealed that the concept internet of commercial buildings is interesting, but to initiate a pilot project may have been less suitable in order to test the concept. However, along with a collaboration model, the pilot project was useful for the companies to get to know each other and learn how to work together. The main conclusions within the master's thesis is that collaborations should be regarded as a unit of its own and focus on formulating its own common objectives to be able to handle opportunities and project risks, and to be able to measure success.

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## Titel

Aktionsforskningsstudie av ett initierat branschöverskridande samarbete – En utvärdering av möjligheter och projektrisker i en strategisk allians som utvecklar energilösningar inom kommersiella fastigheter

## Författare

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## Sammandrag

Detta examensarbete är en utvärdering av möjligheter och projektrisker i ett samarbete inlett mellan E.ON Sverige AB, ABB AB och Telefonaktiebolaget L M Ericsson. Syftet med det branschöverskridande samarbetet är att utveckla smarta energilösningar och det har även inlett ett pilotprojekt inom området kommersiella fastigheter. Examensarbetets syfte var att analysera och bedöma hur möjligheter och projektrisker hanterades inom detta projekt. Studenterna genomförde en iterativ aktionsforskning i fyra faser och påverkade aktivt pilotstudien i relation till tajming. Resultaten visade att konceptet internet of commercial buildings var intressant, men att initieringen av ett pilotprojekt möjligtvis var ett mindre lämpat sätt att testa detta koncept på. Men ihop med en samarbetsmodell var pilotprojektet framgångsrikt då företagen lärde känna varandra och lärde sig att arbeta tillsammans. Examensarbetets huvudsakliga slutsatser är att samarbeten bör ses som en egen enhet och att fokus bör ligga på att formulera gemensamma mål för att kunna arbeta med möjligheter och projektrisker, och för att på bästa sätt kunna mäta framgång.

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# Summary

In the digitalised world, facing climate change, companies need to adapt to rapid and disruptive markets. By collaborating, companies may discover ways to combine their capabilities and resources to find new energy solutions. Initiated by E.ON Sverige AB, a collaboration agreement was made public in October 2015 together with ABB AB and Telefonaktiebolaget L M Ericsson, with the aim to jointly develop smart energy solutions.

*Strategic alliances* have become increasingly popular, but roughly half of them fail. In order to become successful, the strategic alliance needs to handle the opportunities and project risks simultaneously.

A pilot project was initiated within the area commercial real estate by the cross-industry collaboration agreement. This master's thesis aims to analyse and assess how opportunities and project risks have been managed within this specific project. The thesis work was carried out with an iterative action research methodology with the thesis students actively taking part in the pilot study. Further to this, the student's aim was: to contribute to the development of the collaboration, to draw conclusions and to give recommendations for a future collaboration.

The pilot project aims to test a concept within the area commercial real estate and to learn how to collaborate. The thesis students were performing the research and carried out their project as on-site managers. Commercial real estate involves several stakeholders, which makes it harder to work with. The research focused on unbundling the interests and incentives of different stakeholders and to find out their needs, wishes and demands for a future concept of *Internet of commercial buildings (IoCB)* by following up on opportunities and project risks.

The action research was divided into four phases with objectives formulated from the pilot project status and the findings in the previous phase. The initial findings were that cross-industry collaborations are highly complex and that the pilot project was a technology push, which meant that the pilot project was initiated on the basis to try out technological resources and document the responses by potential customers. From interactions with occupants on-site, the findings showed a lack of interest in the pilot project, but that the concept of IoCB was interesting. Based on the findings within the thesis work, the students created a value proposition, directed towards the customer *an office tenant*, that consisted of three components: presence sensors, a cloud solution and an interface.

The pilot project may not have been the most suited way to test if the IoCB concept was valuable at an early stage, but it was useful for the companies to work with each other. The findings showed that a collaboration model was a useful tool to get to know each other and learn how to work together.

The main conclusion is that collaborations should focus on formulating their common objectives to be able to handle opportunities and project risks more efficiently. Another key success factor was timing of acting on opportunities and risk, and that the collaboration agreement should be regarded as a unit of its own.

In a future collaboration, the recommendations are to start in a less technology-based manner to try out new ideas. For a pilot project, internal communication, as well as defined objectives to fulfil, is very important in order to know if the pilot project was successful.



# Sammanfattning

Klimatförändringarna i kombination med en alltmer digitaliserad värld innebär att företag måste anpassa sig till snabbt förändrade marknader. Genom att samarbeta kan företag kombinera sina resurser och egenskaper för att hitta nya energilösningar. Initierat av E.ON Sverige AB, offentliggjordes ett samarbete tillsammans med ABB AB och Telefonaktiebolaget L M Ericsson i oktober 2015, med syfte att tillsammans skapa smarta energilösningar.

Strategiska allianser blir alltmer populära, men hälften misslyckas. För att bli framgångsrik måste den strategiska alliansen hantera både möjligheter och projektrisker.

Det branschöverskridande samarbetet initierade ett pilotprojekt inom området kommersiella fastigheter. Syftet med examensarbetet var att analysera och bedöma hur möjligheter och projektrisker hade hanterats inom detta specifika projekt. Examensarbetet baseras på en iterativ aktionsforskningsmetod där studenterna aktivt deltog i pilotstudien. Ytterligare syften med examensarbetet var: att bidra till hur samarbetet utvecklades, att dra slutsatser och att ge rekommendationer för framtida samarbeten.

Pilotprojektets mål var att testa ett koncept inom området kommersiella fastigheter och att lära sig samarbeta. Studenternas roll i pilotprojektet var att agera projektledande. Kommersiella fastigheter involverar flertalet intressenter vilket gör att området är komplext. Aktionsforskningen fokuserade på att reda ut de olika intressenternas behov, önskan och efterfrågan för att implementera en framtida *Internet of commercial buildings (IoCB)* lösning, genom att följa upp möjligheter och projektrisker.

Aktionsforskningen delades upp i fyra olika faser där målet för varje fas formulerades utifrån pilotprojektets status i relation till sina mål och resultaten från föregående fas. Resultaten från den inledande fasen var att branschöverskridande samarbeten är mycket komplexa och att pilotprojektet var en så kallad technology push. Begreppet innebär att en teknisk resurs testas genom att den introduceras till en potentiell kund. Via interaktioner med aktörer på plats visade det sig att intresset för att delta i pilotprojektet var lågt, trots att konceptet IoCB ansågs vara intressant. Baserat på resultaten från aktionsforskningen formulerade studenterna själva ett förslag på en lösning som riktade sig till kunden *en hyresgäst*. Förslaget innehöll tre olika delar: närvarosensorer, en molnlösning och ett gränssnitt.

Möjligtvis var inte pilotprojektet det mest lyckade sättet att testa värdet av konceptet IoCB i ett tidigt skede, men det var användbart i och med att företagen lärde sig att arbeta med varandra. Resultaten visade att en samsarbetsmodell var ett användbart verktyg för få företag att lära känna varandra och lära sig arbeta tillsammans.

Den huvudsakliga slutsatsen var att samarbeten bör fokusera på att formulera gemensamma mål för att kunna arbeta med möjligheter och projektrisker på bästa sätt. En ytterligare viktig faktor för framgång var tajming i relation till möjligheter och projektrisker, samt att samarbetet bör ses som en egen enhet.

I ett framtida samarbete där ett koncept ska testas rekommenderas det att inte introducera tekniken i ett tidigt stadie. För ett pilotprojekt är såväl intern kommunikation som väl definierade mål viktiga för att kunna ta reda på om pilotprojektet var framgångsrikt.

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Annah Håkansson & Andrea Pettersson  
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# Abbreviations

ABB	ASEA Brown Boveri
ASEA	Allmänna Svenska Aktiebolaget
ABW	Activity based working
BBC	Brown, Boveri & Cie
BMC	Business model canvas
ESG	Executive Steering Group
ESS	The European Spallation Source
EU	European Union
ICT	Information and communications technology
IEA	International Energy Agency
IoCB	Internet of commercial buildings
IoT	Internet of things
IPCC	Intergovernmental Panel on Climate Change
KPI	Key performance index
PMI	Project Management Institute
PSG	Project Steering Group
RES	Renewable Energy Sources
ROI	Return on investment
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change



# Glossary

9x effect	peoples irrational overvalue of own products by a factor of three and innovative companies overvalue of own innovations by a factor three, adding up to a mismatch of nine to one between what innovators believe the customers desire and what the customers want
Activity based working	a team-oriented approach of working where no employee has an assigned workstation, instead the workspace provides the employee activity areas allowing them to conduct specific tasks including learning, focusing, collaborating and socialising
Big data	large pools of data that can be communicated, aggregated and analysed
Business ecosystem	a metaphor for a span of industries with interacting organisations and individuals, comparing the organisms within the business world to an ecological ecosystem
Business model canvas	a strategic management tool allowing the business to create value by describing, designing, challenging and inventing the business model
Collaboration agreement	formed between organisations combining each other's competences and resources to create a shared value
Concept test	a stage in the product development process where a detailed description of the idea is presented to potential users, to assess their attitudes and intentions toward the product
Disruptive innovation	an innovation that introduces a new customer value and pushes the established market players aside, hence disrupts the market
Gamification	the application of game-design elements and game principles in non-game contexts
Industry 4.0	also known as the fourth industrial revolution, is a collective term for technologies and concepts of value chain organisations that implements automation, data exchange and internet of things

Internet of things	the network of physical objects that enables devices, such as sensors, electronics and software, to collect and exchange data
Key performance indicator	a performance measurement in order to evaluate the success of an organisation or of a particular activity
Lean startup	an approach to business development that is based on the principles of lean production; a manufacturing methodology that values a business ability to change quickly
Market pull	a search for a technology or a resource that can fulfil requirements for a value proposition designed to address a potential customer
Open innovation	the use of both inflows and outflows of knowledge to improve internal innovation and expand the markets for external exploitation of an innovation
Outsourcing	an arrangement in which one company hires another to perform a particular function on its behalf
Project risk	an obstacle with purely negative effect on reaching jointly defined objectives
Proof of concept	a demonstration of a prototype, with the purpose to verify that certain concepts or theories have the potential for real-world application (Techopedia, n.d)
Renewable energy sources	energy collected from resources that are naturally replenished on a human time scale, such as sunlight, wind and waves
Strategic alliance	two or more organisations share resources and activities to pursue a strategy
Sustaining innovation	an innovation developed on an existing market with better value, the opposite to disruptive innovation
Technology push	a way to investigate if a solution based on the technological resources matches with the expected customer segment
Use case	a list of actions or event types that defines the interactions between an actor; a human, an external system or time, and a system to achieve a goal (Jacobson, 1992)
Value proposition	describes the benefits that customers can expect from a company's products and services



# Introduction

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*This chapter introduces the actuality of this master's thesis while pointing out the pushing and pulling factors that impacts the Energy sector today. The purpose and the research questions of the thesis are stated, as well as the scope and a brief outline of the chapters in the thesis.*

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Today, markets change rapidly due to the increased influences of digitalisation. Climate change drives political initiatives and value driven legislations are affecting established strategies for energy utilities. This allows *disruptive technologies*<sup>1</sup> to enter the traditional markets. Thus, impact the power sector and threat the success of traditional business models. However, the influential concepts of *Internet of things (IoT)*<sup>2</sup> and *Big data*<sup>3</sup> allow new business models to emerge. Energy utilities need to adapt to the digitalisation. Their efforts in changing their strategies are reflected in the establishment of cross-industry collaborations in order to explore new fields conducting business. Yet, the answers to the questions remain: *Do they know what they are doing? Or, are they just stumbling in the dark?*

Changing markets pull companies to innovate and to interact with each other in order to speed up in-house innovation. Exploring new markets and finding customer's value is the key for traditional energy utilities to survive in an increasingly competitive environment. By forming a *strategic alliance*, two or more organisations can share resources to create more competitive products and services. Such strategic alliances have become increasingly popular with studies showing that the announcement of a new alliance boosts the stock price by 1 % and increases the company's market value (Dyer, Kale, & Singh, 2001). Despite the popularity of establishing alliances almost half of them fail (Mohr, Sengupta, & Slater, 2013). Successful alliances thereby understand the importance of handling, not only the factors related to opportunities and a fruitful relation, but also the factors related to risk and potential failure of the alliance (Mohr et al., 2013).

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<sup>1</sup>a technology that introduces a new customer value and pushes the established market players aside disrupting the market

<sup>2</sup>the network of physical objects that enables devices, such as sensors, electronics and software, to collect and exchange data

<sup>3</sup>large pools of data that can be communicated, aggregated and analysed

In October 2015, a cross-industry collaboration agreement between the companies ABB AB, E.ON Sverige AB and Telefonaktiebolaget L M Ericsson was announced. The press release stated that the aim of the collaboration was to increase the pace of innovation by jointly develop smart solutions that improve energy and operational efficiency within four selected focus areas: *commercial real estate*, *data centres*, *transportation* and *solar energy production*<sup>4</sup> (Ericsson, 2015a). The innovation company Brunnshög Energi AB, launched by E.ON Sverige AB, will meet the needs of the customers by delivering these jointly developed solutions.

At the same time as the announcement of the collaboration agreement, a pilot project within the area commercial real estate was initiated at the Ericsson facility in Lund. Focus is to improve the energy efficiency in the facility along with increased comfort and productivity of its occupants (Ericsson, 2015a). The aim of the pilot project was to assess the collaboration agreement in terms of the companies working together while realising a *concept test*<sup>5</sup>.

## 1.1 Purpose and Research Questions

The thesis work is carried out with an iterative action research methodology with the thesis students actively taking part in the pilot project at the Ericsson facility in Lund. The purpose of this master's thesis is to analyse and assess how opportunities and project risks can be handled within the project; a pilot installation within the area commercial real estate. In addition, the students aim to contribute to the development of the collaboration, to draw conclusions and to give recommendations for a future collaboration with the research questions:

- How can opportunities and project risks be managed within a cross-industry collaboration?
- What are specific and general success factors for a strategic alliance, in order to become successful in relation to opportunities and project risks?
- What is of interest while developing energy solutions within the focus area commercial real estate and how to proceed within this area of collaboration?

## 1.2 Scope

The thesis work did only assess project risks relating to the collaboration agreement, and did not focus on assessing company specific risks. The cross-industry collaboration covers several areas of collaboration, but the thesis was limited to only assess the area commercial real estate. Within the research, the possibility of implementing an Internet of Commercial Building (IoCB) solution was only covered in an activity based working (ABW) office. However, the thesis is not evaluating the suitability of the solution in the activity based offices in comparison to other office set-ups. Finally, the thesis work did not cover assessing the suitability or the functions of the technical systems of the pilot installation.

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<sup>4</sup>the focus areas transportation and solar energy production has been renamed into *mobility* and *microgrids*

<sup>5</sup>a stage in the product development process where a detailed description of the idea is presented to potential users, to assess their attitudes and intentions toward the product (Business Dictionary, n.d.)

## 1.3 Outline

- Chapter 1 This chapter is an introduction to the thesis work, and includes the purpose, problem statement and scope.
- Chapter 2 The background and the context of the thesis work is clarified in this chapter and includes the driving forces for the changing markets, the collaboration agreement and the area commercial real estate.
- Chapter 3 The theory required to understand the thesis work is included in this chapter: collaboration between companies, the concepts related to project risk and to business theory.
- Chapter 4 The action research methodology is explained along with a discussion of its credibility for this thesis work. The different methods used during the action research are explained briefly along with the approach towards opportunities and project risk.
- Chapter 5 Phase I: Before Pilot launch. The initial phase for the action research is an introduction to the pilot installation initiated by the collaboration agreement, and an assessment of the objectives of the collaboration agreement and of potential project risks.
- Chapter 6 Phase II: Before Pilot launch. Includes the first interactions with stakeholders and how the pilot project was received, as well as an assessment of the statistics that could be extracted from the pilot installation.
- Chapter 7 Phase III: Pilot outcome. The concept IoCB is researched on-site by interaction with stakeholders related to the pilot project.
- Chapter 8 Phase IV: Future Pilot Proposal. The concept IoCB is researched by assessing future possibilities for the concept and the collaboration agreement. The phase includes study visits to activity based working offices and a future IoCB concept is put into a business context. The collaboration agreement is discussed from a project risk perspective and in connection to a collaboration model.
- Chapter 9 This chapter provides a discussion of the findings and of the thesis work. Critically reviewed are the thesis student, the thesis work, the collaboration agreement, the methods and the findings. Also, the approach towards project risk assessment and the thesis relevance for the Energy Systems Studies are discussed.
- Chapter 10 The thesis work is concluded with an overall conclusion relating to the initial research questions. The focus can be interpreted as the thesis contribution to the academic context.
- Chapter 11 The recommendations to the collaboration agreement for the future are included in this chapter. The focus can be interpreted as the thesis contribution to the industrial context.
- Chapter 12 This chapter includes a final word for inspiring to further research within this field.

### 1.3.1 Structure of the Phases of the Action Research

The structure of the phases of the action research (Chapter 5-8) is recurrent and accordingly:

- *Status*

This is the relevant background and the status within each research phase. The status is described in terms of the identified opportunities and project risks.

- *Objectives*

The objectives of each phase are formulated to state what is to be researched by the students within the particular phase.

- *Intervention with Action Research*

This part describes and motivates the set-ups and the methods used within the phase to fulfil the phase's objectives.

- *Findings within Action Research*

These are the results from the methods used that were found in the phase.

- *Conclusions*

This is a description of what could be concluded from the findings and corresponds to the objectives of each phase.

- *Preliminary Generic Conclusions*

This should be considered as a summary of the preliminary generic conclusions from each phase and the most important outcomes of each phase from general perspective. It intends to wake the interest of the reader to dig deeper into specific details of the phase, and to highlight what could be potentially interesting in a future study.

# Background

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*This chapter explains the background to the collaboration agreement: the political influence on the energy market, digitalisation and market disruption. The chapter also includes a brief description of the collaboration agreement and its actors, along with an explanation of the focus area commercial real estate.*

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## 2.1 Changing Markets

Today, market conditions and traditional marketing strategies are challenged. The major trends and forces behind this are: the development of the digital age, the rate of globalisation, the call for more ethics and social responsibility, and the growth in not-for-profit marketing (Armstrong, Kotler, Harker, & Brennan, 2011). For energy companies, the main pushing and pulling factors are the political influence on the energy markets and the digitalisation of today's society.

## 2.2 Political Influence on Energy Market

The scientific evidence and the political recognition of climate change have caused global reactions. In 1992, countries joined an international treaty, the United Nations Framework Convention on Climate Change (UNFCCC), and in 1997 the yearly United Nations Climate Change conference was held in Kyoto. The outcome of the Kyoto conference was the Kyoto protocol. It legally bound several developed countries to emission reduction targets, and obligated them to reduce their emissions of greenhouse gases (UNFCCC, 2014).

In 2007, the European Union (EU) adopted climate change and energy objectives for year 2020 that set to reduce greenhouse gas emissions by 20%, to increase the share of renewable energy by 20% and to make a 20% improvement in energy efficiency (European Commission, 2011). The 2014 IPCC synthesis report, which stated that “Human influence on the climate system

is clear /.../ Recent climate changes have had widespread impacts on human and natural systems” (IPCC, 2014, p. 2), was followed by the United Nations Climate Change conference in Paris 2015. There, it was agreed upon new climate targets that implies a further reduction of all greenhouse gas emissions. The main aim is to keep a global temperature rise below 2 °C this century. Further to this, the aim is to drive efforts to limit the temperature increase to 1.5 °C above pre-industrial levels (Nuttall, 2015).

The European Commission implemented liberalisation directives that was adopted for the electricity market in 1996 and for the gas market in 1998, with the aim to gradually open up for competition (European Commission, 2012). The sale of electricity is today carried out in several markets: the day-ahead markets, the intra-day markets and the balancing markets. The renewable energy sources (RES) impact the different markets by being scheduled prior to the conventional power plant sources within the day-ahead market. This is due to the low short-run marginal costs<sup>1</sup> of the RES: a phenomena called the merit-order effect (Morales, Conejo, Madsen, Pinson, & Zugno, 2014).

The current status of the European energy sector has been affected by a series of events, in addition to the political involvement. The first event was the global financial crisis that started in 2007 and generated a dramatic impact on the energy market outlooks (IEA, 2009). Besides, the European energy utilities had over-invested in fossil fuel generating capacity during the 2000's, just before the financial crisis hit the demand. (The Economist, 2013). Another event was Germany's decision to close several nuclear reactors following the Fukushima nuclear disaster in 2011, along with Germany's aim to cut 80 percent of the 1990 levels of greenhouse gas emissions until year 2050 (The Economist, 2012a). New targets drive the introduction of RES technology. In 2013, prices of photovoltaic systems dropped rapidly and industrial experts expects that this trend will continue (Barbose et al., 2014). All in all, the main problem for the traditional European energy utilities is that their profit decreases while doing business as usual.

The political ambition to reach climate change mitigation has generated new policies, such as subsidies, emission trading and carbon taxes, together with new markets. In the future, the distribution and utilisation of electricity is predicted to have higher impact on the power system. For example, the flexibility of the demand for electricity may increase, enabled by smarter power grids as well as integration with other sectors such as the heat sector. (Åhman, 2016). This implies that market change will continue and have further consequences on the full-scaled energy system.

In particular, electricity utilities needs to adapt their business to the changing markets, and from industrial history there are lessons to learn. The events can be compared to what happened to the airline industry and the telecommunications industry in the 1970's. Changes for the airline industry related to regulatory actions, while the telecommunications industry was impacted by technological changes. The telecom companies did not register that the change would be as radical as it was, in terms of the services to be provided and the technologies to be deployed (Kind, 2013).

Today's society is in the middle of a revolutionary trend: digitalisation. (Terium, 2014). Digitalisation is taking place everywhere and it has changed the rules for doing business. Even

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<sup>1</sup>cost of generating one extra unit of energy

though it is still hard to foresee the future and the long term consequences of the digitalised world, the traditional energy companies need to adapt to it (Deloitte, n.d.).

## 2.3 Digitalisation and Market Disruption

The internet has revolutionised how companies create customer value and build relationships (Armstrong et al., 2011), and due to digitalisation a third industrial revolution is on the way, *Industry 4.0*<sup>2</sup> (The Economist, 2012b). Trends indicates that over 50 billion devices will be connected by year 2020 (Ericsson, 2015b). In addition, the technology de-commoditisation within the energy sector enables new business models, which for example means that utilities may focus on the emotional effects of lighting rather than the electrons provided for illumination of a room (Goldman Sachs, 2012).

Digitalisation has driven a transformation of the markets and disrupted economies and business models before. An example of such a disruption is within the music industry. The disruption started with the digital platforms that replaced the commodity CD, since the platforms provided the service to buy music online. Today, the platforms are challenged by the subscription to streaming services that can provide the experience of following a playlist according to current mood of the consumer (B. Ekelund, personal communication, March 1, 2016).

The risk of failing staying atop of an industry is present for any company, no matter how established and "good". Technology is a way to transform labour, capital, materials and information into products and services of greater value. Changing a technology is called innovation. There are challenges for managing innovations such as: technologies may be sustaining<sup>3</sup> or disruptive<sup>4</sup>, pace of technological progress may exceed the needs of markets, and already successful companies are coloured by their established financial structures and customers (C. M. Christensen, 1997). Disruptive technologies bring new value propositions to the market creating new markets that may become a source of failure for the traditional companies if they try to hold on to their traditional values (Bower & Christensen, 1995). An example of a disruptive technology is the personal computer (PC) that displaced the typewriter and thus changed how people work and communicate (Rouse, 2014). Disruptive technologies are generally cheaper, simpler, smaller and more convenient to use (C. M. Christensen, 1997).

How to survive in a market threatened by disruption? A too close focus on the high profitable customers and business, and too much effort on sustaining innovation may cause long-term failure. However, the solution for traditional companies may be to create disruptions to the markets themselves: taking advantage of and put their focus on disruptive technologies (C. Christensen & Reynor, 2015).

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<sup>2</sup>is a collective term for technologies and concepts of value chain organisations that implements automation, data exchange and internet of things

<sup>3</sup>improve performance of established products

<sup>4</sup>bring to markets a very different value proposition than had been available previously

## 2.4 Collaboration Agreement between E.ON, ABB and Ericsson

In Lund, Sweden, the new research facilities European Spallation Source (ESS) and Max IV Laboratory are under construction (see Figure A.1 for the Brunnshög city area location in Lund). One of the initial aims of constructing ESS is to make it the world's first CO<sub>2</sub>- and climate-neutral research facility (Malm, McFaul, Carlsson, Vettier, & Carlile, 2008). This aim is directly linked to the ESS commitment towards *responsibility*, that the facility use as little energy as possible, *renewability*, that all energy must derive from renewable sources, and *recyclability*, that as much surplus heat as possible is recycled (ESS, n.d.).

In relation to ESS and MAX IV Laboratory, a new city area is being built called Brunnshög, which Lund municipality aims to make a European model for sustainable urban planning. In addition, the city area aims to be the world's best setting for conducting research and innovation. Along with the ambitious goal of the Brunnshög city area, Lund municipality has set the long-term goal of Brunnshög to become a local power plant by producing 150 % local energy and that  $\frac{2}{3}$  of the transportation in the city area should be by foot or by public transportation (Dalman & Rundgren, 2012). This has generated opportunities and a need for new technologies and set-ups that have been identified by different companies.

Initiated by E.ON Sverige AB, a collaboration agreement was made public in October 2015 together with the two companies ABB AB and Telefonaktiebolaget L M Ericsson. The initial aim of the cross-industry collaboration agreement was to find solutions that meet the high demands and ambitions of the new city area Brunnshög. This has developed into finding new markets for their products by jointly develop solutions within the four focus areas *commercial real estate*, *transportation*, *microgrids* and *data centres*.

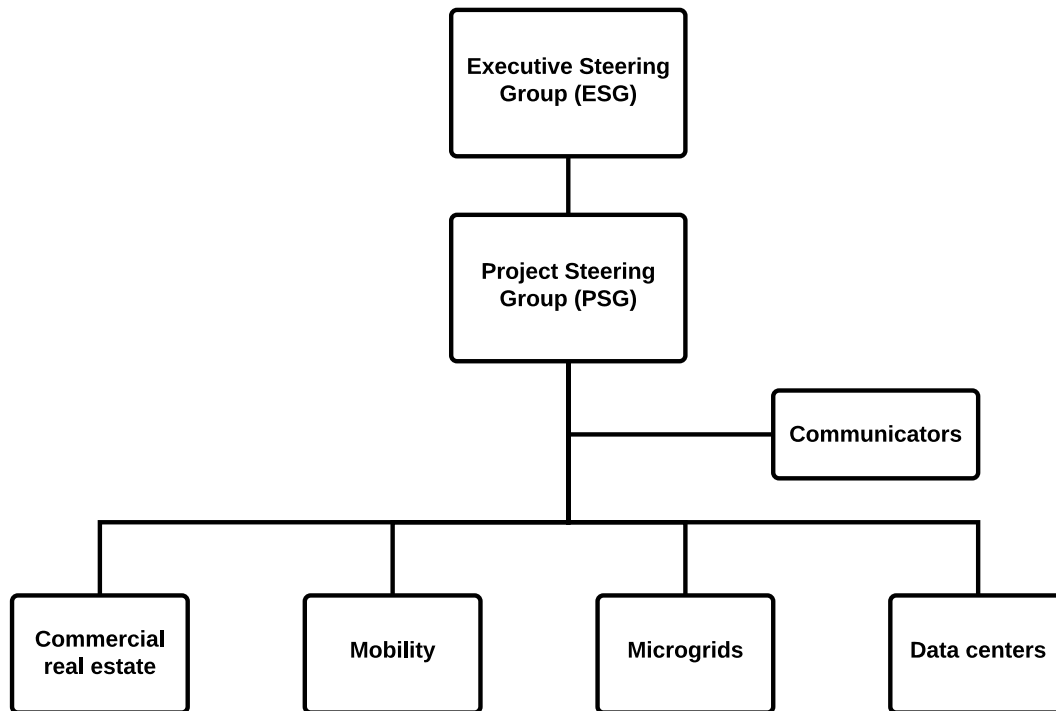
The Brunnshög city area will serve as a test bed for the collaboration agreement. The products created within the focus areas will be introduced and delivered to the market via the start-up company Brunnshög Energi AB. The vision of the collaboration agreement is “to create a world leading research and innovation environment and a European model for sustainable urban planning” (Ericsson, 2015a).

The organisation of the collaboration agreement is coordinated as in Figure 2.1. The executive steering group (ESG) consists of the top managers that make decision on how to precede with the four focus areas. The project steering group (PSG) is the link between the ESG and the four focus areas, and consists of PSG managers. The role of the managers within the PSG is thus to oversee the four work streams and to report upstream to the ESG. Organised intermediate to the PSG and the four focus areas are the communicators. Their role within the collaboration agreement is to coordinate information from the collaboration agreement both internally to the companies and externally to the public. In addition, the communicators contribute to the collaboration agreement with an understanding of recent trends within the marketplace.

### 2.4.1 E.ON Sverige AB

E.ON Sverige AB is a Swedish energy company and part of the German energy group E.ON AG. The company E.ON Sverige AB was until 2005 called Sydkraft, which was an energy company founded in the early 20<sup>th</sup> century in southern Sweden.





**Figure 2.1:** Organigram of the collaboration agreement.

In November 2014, the E.ON Group announced that the group will split itself up by forming a new company, Uniper, which will include the conventional power generation units like nuclear and fossil fuels. E.ON itself keeps the renewable energy production units and focuses on electricity production from solar and wind, distribution, and creating values from “customer solutions” by moving downstream towards the customers (The Economist, 2014). “With E.ON’s new strategy *Improving People’s Lives*, we put the customer in focus and help drive the transition towards a sustainable society”, says Fredrik Rosenqvist, Director Business Innovation (Ericsson, 2015a). This can be interpreted as a result of the reformation of the energy sector and that the company is taking a step in the direction towards becoming a leading actor in the transformational process and in the future energy system. The initiation of the collaboration agreement with the technology companies ABB and Ericsson is thus in line with the new E.ON strategy.

#### 2.4.2 ABB AB

ABB AB (ASEA Brown Boveri) is a Swiss technology company operating in power and automation. The company was formed in 1988 from the merging of the Swedish corporation Allmänna Svenska Elektriska Aktiebolaget (ASEA), founded in 1883 as a manufacturer of electrical lighting and generators, and the Swiss company Brown, Boveri & Cie (BBC), founded in 1891 and the first company to transmit high-voltage power (ABB, n.d.-a).

The products and solutions of ABB all focus on improving performance and minimising environmental impacts within the fields of energy, industry, transportation and infrastructure. The company is organised into four divisions; *electrification products*, *discrete automation and motion*, *process automation*, and *power grids*, which in turn are made up of specific business

units focused on particular industries and product categories, that focuses on power and automation (ABB, n.d.-b).

In 2014, the ABB Group announced a new strategy, *the Next Level strategy*, with the focus of accelerating sustainable value creation and profitable organic growth by strengthening competitiveness and lowering risk (ABB, 2014). In the press release, following the announcement of the collaboration agreement ABB signed with E.ON and Ericsson, the CEO of ABB Sweden, Johan Söderström, referred back to the ABB Next Level strategy to emphasise the importance of collaborating in order to achieve sustainable growth (Ericsson, 2015a).

### 2.4.3 Telefonaktiebolaget L M Ericsson

Telefonaktiebolaget L M Ericsson is a Swedish communications technology company that provides equipment, software and services to enable transformation through mobility. The company was founded in 1876 as a telegraph repair workshop. Today the company operates in the information and communications technology (ICT) sector.

Ericsson uses the term *The Network Society* to describe the future connected ecosystem that drives change for individuals and communities. Ericsson's services, software and infrastructure enables the telecom industry and other sectors to be a part of the Network Society by increasing efficiency, improve user experience and do better business to create a more sustainable future (Ericsson, 2015b). Head of Region Northern Europe and Central Asia at Ericsson, Charlotta Sund, says that collaborating with E.ON and ABB supports the Ericsson vision and values and that "we see our goal in helping other industries to grasp new opportunities that the Networked Society offers to deliver economic and social benefits" (Ericsson, 2015a).

## 2.5 Focus Area Commercial Real Estate

An important matter of the cross-industry collaboration agreement was to find focus areas where all three companies could collaborate. The focus areas where only two of the three companies found a potential collaboration were not considered of interest to proceed with. At the time of the public announcement of the collaboration agreement the work within the focus area commercial real estate was the most mature in terms of realisation.

The definition of *commercial real estate* is a facility used for business, such as an office or a warehouse, with the business leasing the space within the estate (Investopedia, 2015). In the thesis work *commercial building* is used as an equivalent to the definition of a commercial real estate.

Traditionally the real estate industry has lagged behind other sectors thus making it hard to introduce technological advancements, but trends indicate an interest of investing in productivity improvements, developing awareness of technological advancements and to have the ability to respond to improvements (Deloitte, 2016). Additionally urbanisation and global consumption trends may redefine how and where people live, work and play in the future. Trends indicate several factors for significant disruption in the commercial real estate indus-

try over the next decade. Predictions are that the real estate companies need to increase their flexibility in order to keep up with their competitors (Deloitte, 2016).

### 2.5.1 Internet of Commercial Buildings

*Internet of things (IoT)* is defined as a system that relies on autonomic communication of a group of physical objects (Espada, Yager, & Guo, 2014). Within the thesis the *internet of commercial buildings (IoCB)* is defined as the communication of things, services, stakeholders and activities within a commercial building.

The idea behind the IoCB concept is a holistic mind-set of assessing the building and the people within the facility as a single unit, and not as separate parts. *Things* may be coffee machines, printers or workplaces. *Services* may be lighting, indoor climate or alarms, in case of fire. *Stakeholders* may be occupants, visitors or maintenance workers. *Activities* may be meetings, phone calls or renovation.

For companies striding towards increased workplace productivity there are incentives of working with traditional space- and cost-reduction strategies. The collaboration agreement assumes a willingness to pay for a complement to these traditional space- and cost-reduction strategies (L. Ekener Mägi, personal communication, November 26, 2015).

### 2.5.2 Internet of Commercial Buildings Pilot Project

Within the area internet of commercial buildings, the collaboration agreement has initiated a pilot project at the Ericsson facility in Lund, running from the beginning of November 2015 until spring 2016. The pilot project will be a concept test of an IoCB solution, and a test of the collaboration agreement in terms of exchanging ideas, cooperating and learning from each other.

### 2.5.3 Use Cases in Internet of Commercial Buildings Pilot Project

Use cases are defined as a list of actions or event types that defines the interactions between an actor, such as a human, an external system or time, and a system to achieve a goal (Jacobson, 1992). Within the pilot installation four *use cases* were to be tested at the Ericsson facility.

#### Occupant Feedback

The actions and events that defines the interaction between the occupant of the commercial building, the cloud and the physical environment. The aim of the use case is to offer a possibility to give feedback on the perceived indoor climate via a smartphone application. The submitted information contains a time stamp and a position.

### Free Space Location

The actions and events that defines the interaction between the occupant of the commercial building, the cloud and the physical environment. The aim of the use case is to list the available non reservation meeting rooms via a smartphone application.

### Sustainability Visualisation

The actions and events that defines the interaction between the facility manager, the cloud and the energy system of the commercial building. The aim of the use case is to visualise the current energy flows and settings to the facility manager via a web based dashboard.

### Time Channel Optimisation

The actions and events that defines the interaction between the facility manager, the cloud and the energy system of the commercial building. The aim of the use case is to provide the possibility to adjust the facility indoor climate settings

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*This chapter explains the theory in the thesis work related to strategic alliances and the main sources for opportunities and risks with collaborations. An extra effort is put on the description of project risk, as it is essential for understanding the thesis work. The chapter also explains relevant business theory associated with the work, as that is required to fully understand the methods and findings within the thesis.*

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### 3.1 Strategic Collaboration

A strategic alliance is where “two or more organisations share resources and activities to pursue a strategy” (Johnson, Scholes, & Whittington, 2009, p. 233). The strategic aspect of forming an alliance is to obtain resources and competences that the organisation needs but lack internally. By forming an alliance, the companies can pool resources and competences, but can also merge risks and share the mechanisms of cooperation. Due to these advantages, alliances have become increasingly popular, and at the start of year 2000 the top 500 global companies had had an average of 60 alliances each (Johnson et al., 2009). Successful alliances understand the importance of both dealing with the factors related to opportunities and to risk (Mohr et al., 2013). This implies the topicality of assessing both factors in a strategic alliance.

There are many different types of collaboration arrangements, but there are similarities in how the collaborations are organised and on the considered time frame. A difference exists between the strategic collaboration type of *partnerships* and of *alliances*. Partnerships are often non-value based and involves short termed relations, while an alliance involve deeper and longer lasting relations (Mohr et al., 2013).

#### 3.1.1 Partnership

Companies form partnerships with each other for short term projects, often around a particular project for mutual benefits, though recent trends indicates that partnerships becomes

more and more long termed, since companies form long termed relations rather than short termed (Edgren & Skärvad, 2014). These relations can be formed at all levels of the supply chain, and can be either vertically or horizontally oriented between buyers and suppliers or between competitors (Mohr et al., 2013).

*Vertical Partnerships* are formed between companies that operate at different levels of the supply chain, and are also referred to as buyer-supplier relationships. Vertical partnerships may be formed when a company chooses to outsource one or more aspects of the business and then chooses to bring in that competence from another source (Mohr et al., 2013). Such a partnership could result between a supplier of raw materials (the upstream partner) and a distribution company (the customer buying goods from the supplier) that distributes the finished product to the customer. Another example is between a company and its most important end customer.

Vertical partnerships often lasts for a very long time and provides the opportunity to generate long-termed revenue as well as customised product categories (Mohr et al., 2013). This type of partnership has proven to be particularly important in high-technology markets, such as in the telecom market. An example is a long termed partnership between chip manufacturers and mobile phone companies in order to develop the next-generation mobile phone.

The opposite to a vertical partnership is a *horizontal partnership*, which is between firms operating at the same level of the supply chain, that provide either jointly used and/or complementary products or that are pure competitors (Mohr et al., 2013). Complementary horizontal partnerships are formed between firms that provide different components to an end product and complements each other (Mohr et al., 2013). An example is Apple that partner with a car manufacturer in order to ensure that the Apple products are compatible with the car. On the other hand, competitive horizontal partnerships are formed between companies that compete at the same level of the supply chain, but choose to collaborate in other market domains. This type of partnering often occurs in the industry to form industry-wide standards or to be a stronger force towards the larger competitors (Mohr et al., 2013).

### 3.1.2 Alliance

As with partnerships, the reason for forming an alliance may differ significantly between different actors. The deeper and longer lasting collaboration form of alliances can be either formalised interorganisational relationships, *ownership based alliances*, or loose arrangements only sharing information without shareholding or owning, *contract based alliances* (Edgren & Skärvad, 2014). The ownership based alliance is built upon a common addition of venture capital and a common ownership of the alliance, while the contract based alliance is organised from a collaboration agreement point of view between the partners (Edgren & Skärvad, 2014).

A *collaboration Agreement* is formed between established companies wanting to combine their competences to create a shared value and contributing to each other's success. It can also be formed between a young and resource limited startup company and established companies (Edgren & Skärvad, 2014). In the first case, the collaboration agreement between the established actors could be formed with the intention of collaborating in new business areas or to combine each other's competences to develop a better and more competitive product. In the

second case, the startup is dependent on networking and collaborating with different actors in order to generate profit at an early stage in its business development.

*Licensing* is formed between one partner, that has legally protected rights reserved of any kind, and another partner that gets the right to use the rights reserved against payment. The licensor thus gives the licensee the rights to use the license in its business, and is very common in technology based collaborations (Edgren & Skärvad, 2014).

A *joint venture* is a formalised alliance where the partners set up a newly formed organisation, often an independent corporation, that is jointly owned by the companies (Johnson et al., 2009). Joint ventures may be formed between established companies wanting to enter a new market in a new geographical area and a local company, in order to overcome legal boundaries and local challenges.

A *consortia* involves two or more partners in a joint venture like arrangement, but more focused on a specific project or venture and is dissolved after the project is finished (Johnson et al., 2009). This type of arrangement is common in business areas where the established working method is project-based.

*Networks* exists between competitors in highly competitive industries, are less formal, and generates mutual advantage by collaborating and sharing without having a cross ownership arrangement or formal contracts (Johnson et al., 2009).

### 3.1.3 Collaboration Agreement: E.ON, ABB and Ericsson

The collaboration agreement between ABB, E.ON and Ericsson is a strategic alliance, since the collaboration agreement aims to have deep and long lasting objectives rather than short-termed projects. The companies want to create a shared value, collaborate in new business areas, and combine each other's competences while contributing to each other's success. In addition, the collaboration agreement E.ON, ABB and Ericsson is based on a contract.

The collaboration agreement has characteristics from other forms of alliances, such as from joint venture. This is due to the newly formed organisation Brunnshög Energi AB will act as the sales channels of the collaboration agreement and handle customer relations, despite the fact that it is solely a subsidiary of the energy company E.ON. The collaboration agreement also has the characteristics of a network, but it is more formal due to the contract based collaboration format.

## 3.2 Opportunities with Collaboration

Companies engage in collaborations for a variety of reasons. In general, entering collaboration is cost-efficient since it provides firm access to resources and skills that would be costly in terms of time or money if it had to be developed in isolation. Mohr, Sengupta and Slater (2014) describe strategic collaborations as *the panacea for success*, which means that working together with another part under given conditions is today the main method to gain success in the

business environment. The authors lists the following ten reasons why companies collaborate in Table 3.1.

**Table 3.1:** *Reasons for establishing a strategic collaboration (Mohr et al., 2013)*

1	To access resources and skills
2	To gain cost efficiencies
3	To speed time to market
4	To access new markets
5	To define industry standards
6	To develop innovations and new products
7	To develop complementary products
8	To gain market clout
9	To maintain focus on core competences
10	To learn from partners

From Table 3.1, three main types of motives, or needs, to why companies form strategic alliances are recognised: *critical mass*, *co-specialisation* and *learning* (Johnson et al., 2009). The first motive, critical mass, is the need of specific resources or products. By forming an alliance or a partnership with either competitors or providers of resources this may lead to cost reductions and an improved customer offering. By forming an alliance based on the second motive, co-specialisation, each partner of the alliance is allowed to concentrate on the activities that best suits their competences. Another type of motive for forming an alliance is that it makes it possible for the companies to learn from each other at an early stage. Then at a later stage of the alliance the company may bringing the skills in-house and develop them further internally (Johnson et al., 2009).

### 3.3 Risk

According to recent studies, successful alliances understands the importance of handling factors related to risk, since "many risks are inherent to partnering efforts" (Mohr et al., 2013, p. 151). The concept of risk can be defined as "a representation of potential negative deviations in any variable or set of variables representing what human beings value from its preferred expected development over time" (Becker, 2014, pp.133).

The definition of risk implies that risk is highly perceptual and differs from people to people, which is a concept known as risk perception (Coppola, 2011). Risk perception implies that there are no objective risks and some sources go so far as to state that there is no such thing as real risks or objective risks (Slovic, 2001). Instead, Slovic (2011) argues that humans have invented the concept of risk to help in understanding the world around them and that risk is socially constructed and depends upon values and preferences. The role of risk perception in risk management is also pointed out by Renn (1998), stating that "risks are always men-



tal representations of threats that are capable of claiming real losses” (Renn, 1998, pp. 49). Renn claims, in line with Slovic, that different backgrounds and point of views create different kinds of risk perception, but by communicating about risks in a decision process continuously, people are able to redefine their risk perception.

### 3.3.1 Risks with Collaboration

Although there are many reasons to why companies choose to collaborate, the majority of the collaborations fail to meet the objectives set up by at least one of the partners. This indicates the importance of addressing the factors of risk related to collaboration. Mohr, Sengupta and Slater (2013) lists the following risks of collaborating in Table 3.2.

**Table 3.2:** *Risks of collaborating (Mohr et al., 2013)*

1	Increased project complexity
2	Loss of autonomy and control
3	Loss of trade secrets
4	Dilution of competitive advantage
5	Legal issues and antitrust concerns
6	Failure to achieve objectives

According to Mohr, Senupta and Slater (2013), the largest risk of the alliance or partnership is the failure to achieve the common objective. Reasons that hinder this may be due to; incompatible cultures between the companies, lack of attention and resources allocated to the ongoing management of the relationship, lack of trust in the other actor’s motives or the inability to deliver the agreed part of the agreement.

In collaborations, the level of complexity is higher due to an increased amount of people involved in the processes. For the members of the collaboration this may give rise to a feeling of loss of autonomy and control. The decisions that are made within the collaboration needs to be made jointly between the partners and the success of the collaboration become dependent on the efforts of others. Alliances and partnerships may fail since the single partners cannot give in to a sharing of decision-making, which might be very difficult for many companies. Also, there is always the possibility that information and secrets are leaked between the companies, and that one part may exploit the other part. In order to avoid such risks, while maximising effectiveness and efficiency of the collaboration, it is crucial to distinguish between the company and the collaboration, while maintaining a high level of integrity. In addition, legal issues and antitrust problems are other matters that may face the alliances and partnerships. All in all, the risks of collaborating brings the need to understand the factors that contributes to the potential success and viability of the partnership (Mohr et al., 2013).

### 3.4 Project Risk

Projects are temporary, along with main objectives, scope and limited amounts of resources (Fontaine, 2016). The limitation in resources may create a competition among the demands, which may be reflected in decision making and prioritising. Keeping in mind the idea of risk perception, decision making within projects are highly subjective and taken based on values and preferences of the decision maker.

The project management institute (PMI) (2000) defines a *project risk* as the uncertain event or condition that, if it occurs, has a positive or negative effect on the project objective (PMI, 2000). That implies the importance of having clear objectives within the collaboration in order to be able to work with project risks, as the common objectives enables the project risks to be identified and assessed.

In this thesis work, the project risks of collaborating are seen as the opposite to the opportunities with collaborating. The definition of a project risk is thus modified from the PMI definition into the following definition:

*A project risk is an obstacle, with purely negative effect, to reach the jointly defined objectives of the collaboration agreement.*

#### Project Risk Management

According to Fontaine (2016), risks within a project are either technical risks or project risks. The *technical risks* are associated with technical design and takes place after the objectives of the project are fulfilled. Technical risks may be temperature extremes, electrical conditions or miscellaneous conditions (Fontaine, 2016). An example of a technical risk would be the failure in operation of a heat pump due to the bolts being too weak in construction. The objective to install a suitable device is fulfilled, but the heat pump does not operate successfully since the bolts break shortly after the device is installed due to construction failure.

In contrast to technical risks, *project risks* occur during the execution of the project and are often related to a direct threat of the project time schedule. Project risks may be related to economic resources, communication or human resources. An example of a project risk in the case of installing a heat pump at a specific date would be if the device is not delivered on time. The time objective is not fulfilled and the late delivery of the device is thus the project risk.

The main aim of project risk management is to help with decision-making within the project, due to the lack of resources that otherwise may create a competition between the internal demands (Fontaine, 2016). According to O'Donnell, effective risk management identifies particular events that could evolve into risks already at an early stage (O'Donnell, 2005). This is done by adopting a holistic and systems-thinking approach that makes it possible to analyse the project as an entity that has single units that affect each other. By identifying potential project risks already at an early stage in the project execution, many of the potential project risks may be avoided. Also some of the technical risks may be prevented, since a few of the technical risks are consequences that develop from project risks that have not been mitigated.

## 3.5 Business Strategy

Business strategy is the long-term direction of an organisation. The objective is to achieve advantages in the business environment by using its resources and competences to meet the expectations of stakeholders (Johnson et al., 2009). The business strategy theory is important in order to understand the management of the collaboration agreement.

### 3.5.1 Business Model

A business model is a way to describe the elements and relationships within a business and a conceptual link between: strategy, business organisation and systems. The business model implementation is the translation into something concrete and that may be: business structure, business processes, infrastructure and systems (Osterwalder, Pigneur, & Tucci, 2005).

#### Business Model Canvas

The Business Model Canvas (BMC) is a strategic management and lean startup tool that allows the business to create value by describing, designing, challenging and inventing a business model (Osterwalder, Pigneur, Bernarda, & Smith, 2014). The BMC is used as a tool within the collaboration agreement. It contains nine different building blocks, see Table 3.3, that describes the infrastructure (key activities, key resources and key partners), the offering (value propositions), the customers (customer segments, channels and customer relationships) and the finances (cost structure and revenue streams), thus the formal description of the business becomes the building blocks for its activities (see Figure A.2 for the arrangement of the BMC building blocks). The expected profit of the BMC is the revenues minus the costs, as in basic economic theory.

### 3.5.2 Value Proposition

A value proposition is a bundle of products and services that are based on a customer segment. The definition of a value proposition is that it “describes the benefits customers can expect from your products and services” (Osterwalder et al., 2014, p. 6). According to Armstrong, Kotler Harker and Brennan (2011) companies “must design strong value propositions that gives them the greatest advantage in their target markets” (Armstrong et al., 2011, p. 12).

A customer may have a wish, need or demand for a product. There are basic needs and more shallow needs, and they are non-dependent of the companies or the products. A wish is generated when a need is directed towards a specific product or solution, and may include a company or a specific product. The demand for a product is a wish combined with the ability to pay for it (Armstrong et al., 2011). An innovation should be a product that the customer easily can embrace as their wish, within their cultural and social context. The more basic the addressed need is, the more likely it is that the innovation will be prioritised within the customer’s budget (O. Alexandersson, personal communication, February 18, 2016).

**Table 3.3:** *A brief explanation of the nine building blocks of the business model canvas*

<b>Building block</b>	<b>Description</b>
Key Activities	The most important activities that has to be done in order to execute the value proposition. It can for example be to initiate effective supply chains in order to decrease costs.
Key Resources	The resources that are needed to create value for the customer, and to sustain and support the business. They are considered an asset to the business and can be financial, physical and intellectual.
Key Partners	Businesses usually establish different relationships with other partners and/or businesses in order to optimise operations and reduce risks. The key partner thus helps the business with implementing the value proposition to the customer.
Value Propositions	The collection of products and services that the business offers to meet the needs of the customer. This is what distinguishes the business from its competitors.
Customer Segments	The customer that the business tries to serve and create value for. It can be people, organisations or other businesses.
Channels	It describes how the business should reach the customer, and how to deliver the value proposition to them. Effective channels distribute the products and services fast, efficient and cost-effective.
Customer Relationships	The type of relationships that the business wants to create with its customer in order to survive on the market.
Cost Structure	It describes all the costs that are to operate in a business model. The cost structure can be either value-driven or cost-driven with the characteristics of fixed cost/variable costs, economies of scale or economies of scope.
Revenue Streams	This is how the business intends to make income from the customer. Revenue can be generated for example via subscription fees, licensing or advertising.

## Technology Push and Market Pull

There are different starting points and strategies on how to search for value propositions, which are viable depending on preferences and context. A technology push is when the actor pushes a solution in search for a problem, while a market pull is a problem-based search for a solution (Osterwalder et al., 2014). *The technology push* is basically a way to investigate if a solution based on the technological resources matches with the expected customer segment. By formulating a prototype from the technological resources the solution can be tested on the customer segment. The prototype then generates insights, a value proposition and outlines a customer profile that leads to the creation of a new business model (Osterwalder et al., 2014).

A *market pull*, on the other hand, starts with manifesting the problem and the customer's *jobs* (the tasks to be done), *pains* (the barriers that prevent or make it difficult to get a job done) and *gains* (the concrete outcome the customer wants to achieve or avoid). Then outline a value proposition prototype that is designed as a solution with the aim of finding out the resources and requirements need to address the specific problems identified (Osterwalder et al., 2014).

### 3.5.3 Business Realisation

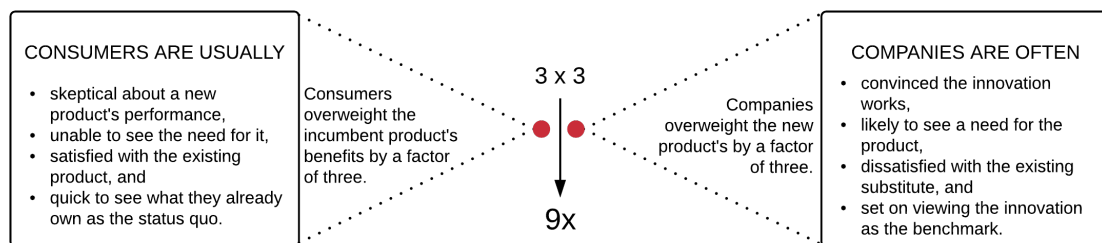
As important as the business model itself is marketing, in which the company can identify, anticipate and satisfy a customer's requirements (Jones, 2006). A market is the set of buyers of a product. Marketing is the process by which companies create value for customers and build strong customer relationships in order to capture value from customers in return (Armstrong et al., 2011). For a product, there are different stages of product diffusion: Innovators and Early adopters, Early majority, Late Majority and Laggards (Jones, 2006). In the thesis, we address the Innovators and Early adopters: enthusiasts.

The societal marketing concept distinguishes between consumer's and society's well-being and aims to join and maintain or improve both. Further to this, companies should balance their marketing strategies between company profits, consumer needs and society's interest (Armstrong et al., 2011). According to Kotler and Kartajaya (2010) marketing today aims to touch the consumer's mind and heart and it is being addressed by a customer-centric approach, but the society has entered the new marketing era of Marketing 3.0 or "the values-driven era" (Kotler, Kartajaya, & Setiawan, 2010). Today's marketers are being called on to take greater responsibility for the social and environmental impact (Armstrong et al., 2011). Thus, instead of treating people simply as consumers, marketers approach them as consumers looking for solutions to their anxieties about making the world a better place.

In order to introduce an innovation to the market it is important to understand the factors associated with potential success or failure. According to marketing theory, the answer to if the innovation will succeed or fail lies within its value proposition. This theory suggests that if the innovation offers the user increased benefits to the equal or less price of the incumbent option, then the innovation will be successful and replace the existing one (Gourville, 2006). Though this approach fails to explain why innovations fail at an almost 50% rate. In order to generate a successful innovation, the companies need to take into account the psychological costs associated with behavioural changes, such as transaction costs and risk aversion.

### 3.5.4 The 9x Effect

Studies have shown that people irrationally overvalue the advantages of their own products by a factor close to three (Gourville, 2006). At the same time, the innovative companies overvalue the benefits of their innovations by a factor three, since they see the value of the product and are unable to ignore what they already know. Unaware of each other's biases, this sums up to a mismatch of nine to one between what innovators believe that the customers desire, and what the customers actually want, see Figure 3.1. This 9x effect unawareness of psychological biases is the main reason why innovations fail at the rate of between 40% to 90% (Gourville, 2006).



**Figure 3.1:** *The problem that result when companies wants to introduce an innovation to the market without being aware of the 9x effect. This results in a mismatch of nine to one between what innovators believe that the consumers want and what consumers desire. Image based on (Gourville, 2006).*

In order to avoid a failure when innovating, and later on introduce the new product to the market, the company needs to understand the nature and the extent of change in the behaviour of the customer embodied by the innovation (Gourville, 2006). Once this is known, the underlying resistance to change can be managed or proactively minimised.

# Methods

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*This chapter explains what an action research methodology is and why it is suitable. The different methods used to obtain the findings within the thesis are described and motivated. In addition, there is a brief discussion of the credibility of choosing to perform an action research in relation to the thesis project.*

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### 4.1 Action Research Methodology

The overall methodology chosen for the thesis work is that of action research. Action research is traditionally used in social science and challenges other scientific research methods by actively taking part in the ongoing research process in order to solve a particular problem or to produce guidelines for best practice while conducting the research (Stringer, 2007).

The idea behind action research can be explained as a systematic approach to investigate a certain issue, problem or task while focusing on the specific situations to create localised solutions (Stringer, 2007). Action research is thus the contrary to traditional experimental and scientific research that focus on generalised explanations that may be applied to all contexts. The proposition is that generalised solutions may not fit particular contexts and in the majority of use it has to be modified and adapted in order to fit the particular context.

Action research “provides the means to systematically investigate issues in diverse context” (Stringer, 2007, p. 6), since the primary purpose of action research is to engage in the investigation while designing the most “appropriate way of accomplishing a desired goal and to evaluate its effectiveness” (Stringer, 2007, p. 6). In relation to the thesis work, this means that the students will take an active part in the thesis study and the pilot project process while examining the outcome of the intervention. This also means that the interference with the study due to the specific nature of the action study methodology may change or severely alter the outcomes of the study.

### 4.1.1 Reliability and Credibility of Action Research

The structure of an action research makes it suitable to apply to the purpose of the thesis work: to analyse and assess opportunities and risks within the collaboration agreement and the pilot project, and then to draw conclusions and give recommendations. The action research methodology makes it possible to iterate the thesis work in order to design the most appropriate way of collecting data from the pilot installation while it is ongoing. The methodology is appropriate since it allows the students to actively take part in the pilot project.

The action research methodology gives access to further knowledge of the collaboration's tactics and strategic thinking, and an opportunity to co-create the findings with different actors within the collaboration agreement. Though, the action research methodology also presents a disadvantage in terms of loss of autonomy and critical viewing, since the thesis students and the stakeholders within the collaboration agreement are on the same team. Therefore, it can be argued for that another methodology should be used to be able to draw fully unbiased conclusions. However, since the students are aware of these drawbacks, it strengthens their critical thinking and generates credibility to the thesis work.

The credibility of the action research methodology is of primary importance to the thesis work. The outcome of the pilot installation and the lessons learnt by the collaboration agreement, in terms of value proposition and handling project risks and unexpected scenarios, are of second nature. The main objective of the thesis is to fulfil the thesis' research questions, and the action research methodology is considered as the most promising way in order to do that.

## 4.2 Methods used within the Action Research

This section describes the general set-up and information regarding the methods used within the action research methodology. A more detailed description of the methods used, along with potential attachments, can be found in the appendix for each phase.

### 4.2.1 Observations

The observations include the studying and documenting of events that appeared during the action research. Further to this, the observations are done by interacting and documenting the results of our own actions. The disadvantage of applying this approach was that we had no model or common approach of handling the observations, but only to note what we found interesting or potentially critical in terms of fulfilling the objectives of the thesis, collaboration or pilot installation.

### 4.2.2 Study Visits

The observational events of going on study visits were used to get insights on specific locations and to gain information from external parts working with the area of activity based working offices. The focus of the study visits was to have interactive conversations in order to clarify,



follow-up and address surprising and unexpected insights. The expected benefit of visiting new environments physically and meeting external stakeholders was to give valuable insights for the future in developing the concept IoCB.

### 4.2.3 Interviews

The interviews took part with ten Ericsson employees and the set-up was a mix of open and more structured questions in a relaxed environment. The purpose of the set-up and structure of the questions was to get descriptive and explanatory answers. Before interviewing the employees, the questions were sent out the same morning. The interviews ended with an open discussion and the opportunity to ask questions back to the interviewer. The reason for choosing this approach was due to it was motivated by the opportunity to get more input and ideas.

### 4.2.4 Surveys

Two different kinds of surveys were used. The first survey, which we choose to call the Barista test since it involve handing out coffee as a reward to the participants, involved collecting data in person. The direct reward of participating aimed to increase the incentives to take part in survey. The second survey, the so called occupant survey, was sent out electronically. Surveys were chosen since it was the only way to get quantitative answers on the research questions within the study.

### 4.2.5 Data Collection from Application Usage

Data and statistics on the number of download and the usage of the smart phone application, IoCB pilot application, was collected and generated with Python programming language. The data was compiled and analysed using Microsoft excel. The benefit of the data collection was that it was quantitative. The disadvantage was that data on demographics, such as gender and age, were missing as well as knowledge on the number of individuals that provided data. This was due to that the data that was collected from the application usage is registered anonymously in a database.

### 4.2.6 Workshops

Two different of workshops were held. The idea with the workshops was to generate ideas in collaboration with others, connected either to the work of a facility manager or to a newly formulated value proposition addressing an office tenant. In the facility manager workshop the ideas were generated together with potential users. In the project steering group workshop (PSG workshop) the ideas generated from the facility manager workshop were evaluated and further developed with actors within the collaboration. The method was chosen since it gave a research opportunity through cooperation and co-learning.

### 4.3 Opportunities and Project Risks

Risk is often defined as probability that an event will occur in relation to the consequence of that event being realised. Commonly risks are assessed based on the weighing of probability and consequence, and actions are taken upon them according to that. In this thesis, the handling of the outcomes and consequences of opportunities and project risks were registered in relation to the timing. This is motivated by the research methodology of action research and the role of the thesis students within the pilot project.

In this thesis, timing is considered as the urgency of handling any project risk or opportunity. For example, a project risk that must be handled immediately to prevent its consequence is considered very urgent. An opportunity that may disappear if it is not acted upon directly is also seen as very urgent.

A project risk, or opportunity, in this thesis that is neither urgent nor highly prioritised would be for example if a lot of information regarding the matter is still being collected, or if it is depending on an interaction that is not possible yet.

An example is parking your car and paying for the parking ticket. If you arrive after the parking ticket has expired this may result in you getting a parking fine. Realising that you will run late, you may either refill the parking ticket directly or just before the timing of the expiry. The urgency is higher the closer you get to the expiry time.

In other words, actions were taken on what, according to the students, potentially could interfere, either in a positive or negative way, with the objectives of the collaboration or pilot project in near time. The positive interference with the pilot project objectives was stated as opportunities, while the negative interference of the pilot project objectives was addressed as project risks.

### 4.4 Four Phases of Action Research

In the thesis work, the action research is divided into four phases, related to the time of launch of the pilot project in November 2015. The method for identifying and recognising opportunities and project risks was an iterative method that was intertwined with the action research.

#### Phase I: Before Pilot Launch

The first phase starts with the planning and preparation for the pilot project. Our work was to outline the collaboration agreement and why the pilot project was initiated and the outcome explains the essential concepts related to the pilot project. The objectives are:

- To understand the collaboration and the roles of the actors
- To understand the collaboration's objectives linked to collaboration, to the area of commercial real estate and the pilot project
- To research the opportunities and project risks for phase II

### Phase II: Pilot in Operation

In the second phase our focus was to explain the pilot installation and the technological solutions involved. It was also to explain the Barista test, why it was initiated and the outcome. The objectives are:

- To help with implementing the pilot project by acting as on-site project managers
- To collect data from the pilot installation and analyse it
- To analyse the interest of the IoCB solution by interacting with occupants
- To research the opportunities and project risks for phase III

### Phase III: Pilot Outcome

The third phase of the action research leaves the pilot installation. This phase contains interviews with employees, surveys, workshops and study visits relating to the IoCB concept. The objectives are:

- To unbundle stakeholder relationships within the commercial real estate area by on-site interactions
- To research how to improve communications within a pilot project
- To get customer insight and generate ideas for a future IoCB concept
- To research the opportunities and project risks for phase IV

### Phase IV: Future Pilot Proposal

In the fourth phase, we analyse and explore the future for the collaboration agreement within the area of commercial real estate. The objectives are:

- To design a value proposition for a IoCB solution connected to one key-stakeholder seen as the potential customer
- To evaluate the design of value proposition in relations to opportunities and project risks with the objective of a business realisation
- To pinpoint the best opportunities for and the greatest project risks with the area of commercial real estate
- To assess and generate ideas on how to proceed with the collaboration



## Phase I: Before Pilot Launch

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*This phase starts with a presentation of the background to the first intervention with action research, the opportunities and project risks that we have found by interaction and observation as they initiated their research project. The timing decided what to act upon and the findings within phase I are based on interviews with actors within the PSG. The findings include the aims of the collaboration agreement and identified, but not realised, project risks. The timing of the phase is before the pilot project was launched and the conclusions, as well as the timing for initiating the actual pilot project, are the reasons for continuing with the next phase.*

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### 5.1 Status Phase I

The opportunities and project risks are based on observation and interaction between the project steering group (PSG) and us.

#### 5.1.1 Opportunities Phase I: Collaboration Model

Prior to the start of the thesis work and the launch of the pilot project, within the focus area commercial real estate, the PSG initiated the work with a *collaboration model*. The work was led by, for the PSG, an external actor employed at one of the companies. We were invited to meet with the actor at an early stage of the thesis work and therefore got informed about the reason of why the PSG had decided to start working with a collaboration model.

The main reason for the initiation of the collaboration model was an internal wish from the companies to engage in a highly qualitative collaboration. This may be achieved through a collaboration model that aims to give guidance and help the members of the collaboration to continuously work with their internal relations (P. Wall, personal communication, November 25, 2015).

Close to the time of the launch of the pilot project in October 2015, the work with the collaboration model led to a creation of a collaboration's platform. The platform included a discussion of principles and measurements and identification of possible pitfalls in order to learn and improve. From the platform the PSG will categorise the performance of the collaboration agreement in terms of: equality, operations, innovation, investments and communication (P. Wall, personal communication, November 25, 2015).

Opportunities with the collaboration model, which was identified by us, were that it may increase the efficiency of the collaboration and improve their way of working. Further to this, we were asked to contribute to the work of the PSG by presenting their findings. This was considered an opportunity for the action research and created the incentives to research *how* the collaboration agreement was carried out in terms of: the objectives of collaborating, the organisation and the roles of the actors within the collaboration agreement.

We agreed with the actor to follow up on the creation of the collaboration model at a later stage in the thesis work.

### 5.1.2 Project Risks Phase I

The prerequisite to carry out a project risk assessment is an agreement of a common definition of the concept of risk. Therefore before the pilot project was launched, we tried to understand if there was a common agreement on the definition of risk and/or if a common project risk assessment has been conducted. The first impression was namely that none of these issues seemed to have been agreed upon, even though we were told that this was important matters by the PSG. We also tried to understand the common aim with conducting a pilot project, as the greatest project risk according to theory (see Section 3.3.1) was failure to achieve common objectives.

We interpreted the consequences of not agreeing upon a common definition of risk and/or carry out a common project risk assessment may lead to misunderstandings and decision difficulties. While the consequence of not agreeing upon a common aim of the pilot project could lead to different actors trying to achieve different things.

At an early stage we recognised a potential lack of commitment from the PSG, which turned out to be due to a lack of time of the PSG members. However, this meant that, from our point of view, the positions and project management within the pilot installation was not clear. This was interpreted by us as if no one was in charge of the pilot project. The consequence was that we confused information and realised that the complexity of information sharing was a major project risk for the collaboration agreement. To have no one in charge of the pilot project could result in further confusion of information, by us, but also from additional stakeholders linked to the pilot project.

The pilot installation, at the Ericsson facility in Lund, was initially set to launch in October, but due to technical difficulties it was delayed until the midst of November. The consequences of a delay could both result in loss of results and in loss of trust from actors within the collaboration. To be able to contribute to the project and to avoid obstacles that potentially could interfere with the pilot project objectives, we decided to prioritise their focus on project risks in relation to timing during their action research.

## 5.2 Objectives with Phase I

- To understand the collaboration's organisation and the roles of the actors
- To understand the collaboration's objectives linked to collaboration, to the area of commercial real estate and the pilot project
- To research the opportunities and project risks for phase II

## 5.3 Intervention with Action Research Phase I

The realisation of the pilot project involved many different actors, such as a third party company that developed a smartphone application and another company that performed that hardware configuration on site. Thus, the thesis workers first intervention within the action research was to try to sort out information. It was done by asking for information from the different stakeholders and informing other stakeholders that potentially would be important when the pilot installation was up and running. The communication was non-structured and the timing decided what actor to contact.

We found it important to understand the concept of risk in relation to the collaboration agreement. This involved conducting a survey and interviewing the actors within the PSG and the communicators of each of the company. We decided to avoid distinguishing between the three companies, even though the theory relating to the Risks of collaborating (see Section 3.3.1) was interpreted based on a one-part perspective. Therefore, the focus was put on researching if the actors with different roles answered in a similar fashion, rather than research the different companies' perspectives. The reason for this was our neutral role as students and that the objectives that we wanted to contribute to, during our thesis work, were the common objectives of the collaboration agreement.

### Collaboration Agreement Actor Survey and Interview

A short survey with questions related to risks, project risks and the aim of the collaboration agreement was conducted and sent out to the two focus groups; the managers within the PSG and the communicators of each company, that worked with the collaboration agreement (see Appendix C).

One person from each focus group from each one of the three companies was picked, thus six persons in total. The questions were sent out beforehand and the answers were collected in script, by personal appointments or telephone interview. The actors were asked to think from a perspective where project risks are jointly-owned within the collaboration agreement.

### On-site Project Management

From an action research point of view, our role evolved into the role of on-site project managers. The role involved helping to breaking down the objectives and common goals with the particular pilot project. Further to this, to work pro-actively to avoid obstacles that may inter-

ferred with the stated aims of the pilot project. That included taking action as well as providing information for decision-making within the PSG.

## 5.4 Findings within Action Research Phase I

The main results from the surveys and interviews of the two focus groups; managers and communicators, are presented below (see Table C.1 for aims, Table C.2 for project risks and Table C.3 for different answers).

### 5.4.1 Aims Collaboration Agreement

From the survey and the additional interview with the actors, managers of the PSG and communicators, the overall aims were identified. The aims of the cross-industry collaboration agreement, the focus area *internet of commercial buildings* and the pilot project, according to the managers of the PSG and the communicators are presented in Table 5.1.

**Table 5.1:** *The aims of the cross-industry collaboration agreement, the focus area internet of commercial buildings and the pilot project, according to the managers of the PSG and the communicators.*

Area	Identified aim
Cross-industry collaboration agreement	To enable highly ambitious energy systems solutions by collaborating across industry borders
Internet of commercial buildings	Add value to the real estate market by jointly developed solutions
Pilot project	Test the cross-industry collaboration and test of an internet of commercial building concept

### 5.4.2 Project Risks

The project risks stated by the actors relates to their perception of risk as they were asked to first define objectives and then mention what could be the obstacles of reaching those, from their point of view as managers or communicators. While asking them to come up with project risks we explained our definition within the thesis as we wanted them to hold on to this. However, what they came up with relates to their own idea of our definition of project risk and their own definitions of the objectives.

By mind mapping the answers collected from the surveys and interviews of the managers and communicators, certain patterns appeared among identified the project risks. These patterns, along with clusters and deviations, were defined and documented by us. In addition, a relation to the theory was looked upon.



Five categories relating to project risk that were common for both focus groups were identified by us. These categories were: *company goals and visions*, *company culture*, *management*, *commercialisation* and *market understanding* (see Table C.2). The identified categories that were common for both focus groups were related to the theory of risks with collaboration (see Section 3.3.1). However, there were also different answers on the same questions from the two focus groups (see Table C.3).

#### Company Goals and Visions

Different perspectives and idea of objective. These are obstacles that may occur if the involved actors are trying to achieve different things. The consequences could be that objectives are not fulfilled, or that resources are wasted. From the theory it relates to point 6 *Failure to achieve objectives* in Table 3.2.

#### Company Culture

Difference in dealing with certain issue, for example time and communication. The risks are categorised from a point of view that they are originating in the fact that three different companies are collaborating and are used to different in-house environments. The consequences could be that they are looking at the same things differently, and that may decrease the efficiency. The category relates to point 1 *Increased project complexity* in Table 3.2, but it is more specific than that.

#### Management

Different expectations on, for example, deliveries, planning and learning. The categorisation is done since these identified risks relates to how resources and functions are coordinated. It may result in trying to do the same thing differently within the collaboration agreement and that would be a waste of resources. The category is related to point 1 *Increased project complexity* and point 6 *Failure to achieve objectives* in Table 3.2.

#### Commercialisation

Creating something the customers are willing to pay for. The category includes the risks that relates to obstacles of realising the businesses opportunities that the collaboration agreement may find. The category is related to point 6 *Failure to achieve objectives* in Table 3.2.

#### Market Understanding

Creating something the customers do not value. The project risk category includes the obstacles of finding values anchored in the market, the needs, wishes and demands for potential customers. Again, it relates to point 6 *Failure to achieve objectives* in Table 3.2.

Some project risks were unique for each focus group. The managers mentioned the expectations from higher divisions. The consequences relating to these kinds of risks are that any of the companies would not be willing to continue or that not enough resources are provided for the collaboration agreement.

The communicators pointed out the project risks relating to a lack of integration of communications on different levels. The consequence of that may be that the communication is left out both internally and externally, and a lack of understanding in-between different actors, stakeholders and the market. A lack of communication may have quite severe effect and relates to all of the common categories mentioned above. Therefore, the project risk of lack of integration of communications is considered as crucial to follow-up by us.

## 5.5 Conclusions Phase I

Reasons to collaborate within the field of internet of commercial real estate are to learn from each other in terms of collaborating, combining competences and building a stronger brand by taking a greater share of the market.

The results from the surveys and interviews gave an insight from the different perspectives of managers and communicators within the steering group. And it can be concluded that different roles within the PSG may give different input for identifying project risks. Thus, it is important for the collaboration actors to share their risk perceptions within the collaboration agreement in line with the former presented theory of project risk management.

Looking at project risks from the collaboration agreement's point of view, the jointly-owned risks relating to the theory that were identified was linked to: increased project complexity the failure to achieve objectives. But the other risks of collaborating, according to theory, loss of autonomy and control, loss of trade secrets, dilution of competitive advantage and legal issues and antitrust concerns were either not thought of or are more likely related to the point of view as a single company within a collaboration agreement. The conclusion is that each company should do their own risk assessment themselves, if they also wish to identify all of their non-jointly owned risks of collaborating.

We identified different company cultures as the main factor for the delay, meaning that it was not clear what commitments each company had due to the different ways of handling the obstacles. This resulted in frustration and could lead to a lack of trust between the different actors in the collaboration agreement. The conclusion is that scoping<sup>1</sup> is important to avoid lack of internal trust within the collaboration agreement.

The pilot project that has been initiated by the collaboration agreement at the Ericsson facility in Lund is both a technology push and a market pull, but with the main focus on technology push. It is also a set-up to try out the collaboration in practise.

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<sup>1</sup>assess project issues at an early stage

## 5.6 Preliminary Generic Conclusions of Phase I

- A cross-industry collaboration may progress by creating a partnership model. It may help them collaborate better by focusing on their relationships. It is interesting to follow-up the partnership model further during the action research.
- A cross-industry collaboration may be highly complex, but different actors can contribute to a common and holistic project risk perspective.
- In a technology push, a pilot project should be launched so that the technological resources are used by potential customers. In the action research it is of interest to investigate if the potential customer segment is using the technological resources in the pilot installation.



## Phase II: Pilot in Operation

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*This phase starts with a background describing the opportunities and project risks partly based on the finding from Phase I, partly based on further interactions with the PSG and with the on-site stakeholders as the pilot project was launched. Due to timing, the focus within this phase is within the pilot project in operation. Intervention with action research objectives and methods concerns an initial study of the installation, a first interaction with the occupants in the facility and an interpretation of data that could be collected with the pilot installation.*

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### 6.1 Status Phase II

The opportunities and project risks are based on interaction with managers within the PSG, former documentation from the PSG, interactions on-site with some commercial building stakeholders and the results and conclusions from phase I. The interactions were directed in order to get the possibility of evaluating the pilot project and act within the role as on-site managers.

#### 6.1.1 Opportunities Phase II: The Pilot Installation

In order for the companies to test the collaboration agreement the pilot installation has been running at the Ericsson facility in Lund from November 2015 until spring 2016. The pilot project is both a test of the collaboration agreement and a test of concept of an internet of commercial buildings solution. Four use cases were identified and supposed to be tested in the pilot project: *occupant feedback, free space location, sustainability visualisation and time channel optimisation* (see Section 2.5.3). Four stakeholders were addressed within the pilot project: *occupants, tenants, facility managers and facility owners*.

## Pilot Project Stakeholders

- *Occupant*  
Is the actual user of the building and is employed by the tenant, the employer of the occupant. In the pilot installation the occupants are the Ericsson employees.
- *Tenant*  
Is renting the space within the commercial building, and is the manager and/or the administrator of the occupants. In the pilot installation the tenant is Ericsson.
- *Facility Manager*  
Is taking care of the facility and makes sure the facility is in order.
- *Facility Owner*  
Is the legal owner of the facility and rents the area to the tenant.

## Technical System of the Internet of Commercial Building Pilot Project

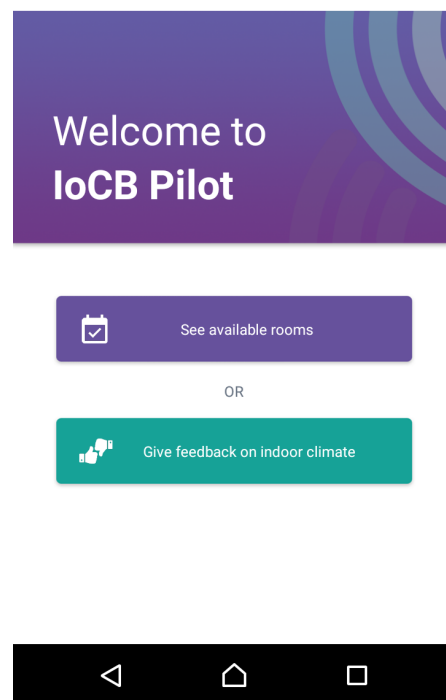
The technical installation consists of a doGate, a Cloud solution, and two interfaces: an Android smartphone application, named the Internet of Commercial Buildings pilot application (IoCB pilot application), and a web-based energy visualisation dashboard, named Energidirigenten IoCB pilot visualisation (Energidirigenten pilot). The technical system together is presented in Appendix D together with an overall sketch of the technical system installed at the facility (see Figure D.1).

The IoCB pilot application has two functions: *See available rooms* and *Give feedback on indoor climate*. It is developed by the department Business Innovation at E.ON Sverige AB and follows the graphical profile of Brunshög Energi AB. Figure 6.1a shows the greeter of the smartphone the application, and Figure 6.1b shows the menu where the user can choose between the features *See available rooms* and *Give feedback on indoor climate*.

The web dashboard Energidirigenten pilot is purely an analytical tool. Figure 6.2 shows the greeter of the smartphone application. The view includes some initial information regarding the pilot project and some visualisations of energy flows and presence. It is interesting for the facility manager as it visualises temperature and presence over time. It is also possible to see certain graphs and heat maps based on real-time data from the Ericsson building.



(a) Greeter of the loCB pilot application



(b) Menu of the loCB pilot application

**Figure 6.1:** Snapshots of the loCB pilot smartphone application, developed by the department Business Innovation at E.ON Sverige AB. The graphical profile follows that of Brunshög Energi AB and the application is only available for Android devices.



**Figure 6.2:** The web dashboard interface for Energidirigenten pilot. The view includes some initial information regarding the pilot project and some visualisations of energy flows and presence. The graphical profile follows the existing interface of Energidirigenten developed by E.ON.



### 6.1.2 Project Risks Phase II

Information regarding launching the pilot project had been sent out by the PSG to one of the focus groups, which was the workers at the Ericsson facility that were supposed to try the smartphone application. In Phase I, the project risk "lack of integration of communication" was identified as important to follow-up. Therefore, it was decided to research if the information had reached out as it was supposed to and what the consequences were of the communication that had been done.

The IoCB pilot application was only developed for Android units, but was not uploaded to Google Playstore. This meant that it was harder to access and install the application, and while talking to stakeholders on-site initially the trustworthiness was questioned due to security reasons. The workers thus had to open the application via the computer and then try to figure out how to get it to the smartphone. It was identified as a project risk that if no one installed the application there would be no possibility to reach the objective of the pilot project. And therefore, the number of installations was of interest for the action research from a project risk point of view. The timing was really important, as the on-site manager role gave the possibility to mitigate this project risk as well.

At the time of the launch of the pilot project, we got the impression that the objectives with the pilot project was a bit unclear, and that no definition of key performance indicators (KPI) had been established. The project risk was that the collaboration actors did not know what to test and measure, and that was an obstacle of reaching the objective of proving or trying out the concept IoCB, which could lead to the consequence of a project failure. Timing enabled this project risk to be mitigated, since we tried to break down the objectives to find potentially relevant KPIs.

## 6.2 Objectives Phase II

- To help with implementing the pilot project by acting as on-site project managers
- To collect data from the pilot installation and analyse it
- To research the interest of the IoCB solution by interacting with occupants
- To research the opportunities and project risks for phase III

## 6.3 Intervention with Action Research Phase II

After the pilot project had been launched in November and information regarding the IoCB pilot application had been sent out, we participated in a stand-up meeting at the Ericsson facility. The aim of the stand-up was to increase the interest in the pilot project and the collaboration agreement.

### 6.3.1 Barista Test

In order to raise an interest of the IoCB pilot application and to increase the amounts of downloads of the smartphone application, we initiated a survey. We also wanted to investigate the interest in the features of the IoCB pilot application and find new use cases related to a future IoCB solution. The survey was called call *the Barista test* since it involve handing out coffee as a reward to the participants while collecting data in person (see Appendix D for the Barista test questions).

The Barista test was conducted during three different weekdays around lunchtime outside the entrance to the occupant's workplace corridors. The time was chosen since it was estimated to be around that time most occupants went out from and came back to the workplace corridor, hence passing by the entrance, in order to eat lunch in the lunch restaurant. The occupants were at the entrance asked to fill in the quick survey and as a reward get a freshly brewed cup of coffee.

The main drawback with the survey was that we did not collect the demographics, since there had been no questions regarding that. It would have been interesting to be able to draw conclusions about the group that filled in the survey.

### 6.3.2 Assistance with Implementation of Technical Resources

The technical system involved presence sensors in the meeting rooms. The sensors did not respond quick enough, which meant that the rooms was listed as available in the smartphone application even if the rooms was occupied. We proposed to the PSG to decrease the time interval of presence registration from 5 to 1 minute.

In January we found out that there had been technical difficulties with the smartphone application. According to information from an occupant, the IoCB pilot application malfunctioned and he were unable to send feedback.

In order for a meeting room to be listed as available, in the smartphone application, the door to the room had to be closed, since the sensors were heat detecting infrared sensors. If the door was left open the sensors then detected people outside the room and unlisted the available room. Consequently, there was a need to change the behaviour of the occupants. This does not seem as a reasonable approach, and instead the technical system ought to be altered in order to fit the behaviour of the occupants.

Technical alterations were handled continuously and we forwarded the message to the PSG that took action accordingly.

### 6.3.3 Statistics

We realised the importance of collecting statistics regarding the number of downloads of the smartphone application and its use. The statistics that was collected concerned feedback on the indoor climate that had been generated from the IoCB pilot application feature *Give feedback*

on indoor climate and the number of downloads of the IoCB pilot application (see Tables D.3 and D.4).

However, the ability to download statistics on the number of downloads from the application was not implemented from the start. When the PSG was informed of this matter the PSG took action and created a ticket for the IT department to implement this feature half-way through the pilot project.

The statistic was important to collect in order to accurately know if the concept was of interest from the focus group, the occupants, and to know how many single individuals that had downloaded and used the application, in order to understand the spread of usage. The statistics give a quantitative result and confirm or deny the previous findings from the Barista test. Statistics also give the possibility to find interesting matters to conduct further research on in terms of an open innovation concept<sup>1</sup>.

## 6.4 Findings within Action Research Phase II

The findings from the Barista test and statistics from the smartphone application were as described below.

### 6.4.1 Results from Barista Test

All relevant results from the Barista Test can be found in Appendix D. Out of the 154 occupants that participated in the Barista test 126 worked where the pilot project had been installed. 32 of the 126 occupants had installed the IoCB pilot application. Of the 32 occupants that had installed the application, 24 had installed it either directly after the release in November or just before Christmas, but only 6 occupants used any of the features within the application more than a couple of times each month (see Figure D.5).

16 of the 32 occupants that had downloaded the application thought that the feature *See available rooms* was a useful tool. The most frequent comment on the main advantage was the ability to grab a room for a last-minute or ad-hoc meeting. The most frequent comment on how to improve it was that it should be possible to book rooms through the application.

20 of the 32 occupants that had downloaded the application thought that the feature *Give feedback on indoor climate* was a useful feature. The most frequent comment on its advantage was that it could be used to adjust temperature and that the system could display the common opinions.

One of the aims with the Barista test was to find suggestions on new use cases. The Barista test found 22 information categories and 10 feedback categories for suggested new use cases (see Table D.1 and D.2).

The information and conclusions from the Barista test were distributed directly to the PSG by email and presented at a following meeting. The main message was that action needed to be

<sup>1</sup>the use of both inflows and outflows of knowledge to improve internal innovation and expand the markets for external exploitation of an innovation

taken to get more occupants involved within the pilot project. The action taken from the PSG was to send out an email to the occupants with information regarding the Energidirigenten pilot, in order to increase the interest of the pilot project.

#### 6.4.2 Statistics from feature *Give Feedback on Indoor Climate*

When the occupant selected one of the three alternatives; too hot, perfect or too cold, in the IoCB pilot application, it is stored in a database with the room id and the current date and time. This data was analysed at the end of the thesis work (see Section D.1.3).

##### General Opinion

In total, there were 280 votes on the indoor climate in five months, including testing by pilot project actors and by us (see Table D.3). The most frequent voting period was in November. It was not possible to see the number of unique voters. This may give rise to the risk of accepting one person's opinion as a general opinion.

##### Mini-meeting Rooms

Data on perceived indoor climate during the time period October 2015 to February 2016 was collected for the mini-meeting rooms to find out if there was any possibility to track a specific opinion on a certain room. Two rooms were considered of particular interest, due to having a large number of votes, Room 1671 (35 votes) and 3607 (28 votes). The average score in room 1671 was 1.0, indicating the general opinion of the temperature being just perfect. In room 3607 the average opinion was 1.3, indicating that the temperature was a bit too cold. For complete list of data see Appendix Table D.4.

##### Retrieved Statistics from the IoCB Pilot Application Usage

The results from downloading statistics of the IoCB pilot application usage, which was available from the 11<sup>th</sup> of February, showed that the application was downloaded 26 times during the period 11<sup>th</sup> of February to 7<sup>th</sup> of March (see Figure D.11). The data indicated that for each time the PSG and/or we interfered with the pilot project, via the Barista test or via email, the amounts of downloads of the IoCB pilot application increased.

## 6.5 Conclusions Phase II

The pilot project lack definitions of key performance indicators (KPI). It should be researched how the workforce efficiency can be measured, since it is of high interest to the pilot project.

### 6.5.1 Conclusions from Barista Test

Only a few persons installed the application after the launch of the pilot project, most of them immediately after the release in November. There was a need for action to increase the number of users. Only a few occupants that downloaded it used the application regularly. Give feedback on indoor climate is slightly more used. And there is a need for action to increase the frequency of usage. The majority of the users confirmed that current application functions were interesting however several suggestions for improvement came up. Thus it can be concluded that it is interesting to precede with development of the current use cases. The result includes a lot of suggestions on new use cases, thus a test like the Barista test is a suitable method to generate a lot of new ideas fast within a pilot project.

### 6.5.2 Conclusions from Collected Data

The conclusion from collected data is that the IoCB technology could be used for collecting the general opinion and that it is a way to see and quantify if people think it is too cold or too warm within a commercial building. In addition, it was possible to get an average opinion on certain mini-meeting rooms. The downloading of the IoCB pilot application went up while interacting and communicating with the occupants. Thus, communication seems to be important for involving people in a pilot installation. For a future study it should be considered planning on collecting all data from the beginning which could be a starting point for regulations in a future study.

## 6.6 Preliminary Generic Conclusions of Phase II

- Implementing a technical system and the progress of an initial pilot project may be complicated for a cross-industry collaboration and there should be resources for a continuous action taking on technical issues
- Interacting with people and internal communication may increase participation within a pilot project
- The planning on collecting data and statistics should be made before any technical launch since it can be hard to know what data will be useful in the end
- Demographics are interesting while collecting opinions and data to be able to draw more accurate conclusions and should be included in future action research
- In the future action research there is a need to learn more about a value proposition within the field of internet of commercial buildings
- Research and documentations on learnings on how to implement a pilot project within the Internet of Commercial buildings area of collaboration
- Focus on getting a broader customer insight for further idea generation related to IoCB



# Phase III: Pilot Outcome

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*This phase starts with describing the opportunities and project risks that are relevant for the further action research, mainly originating from Phase II and related to Business strategy in Section 3.5. Intervention with the action research in this phase has the overall objectives of looking for value within the area of commercial real estate, using interactive methods. Within this phase, several methods are used including occupant interviews, an occupant survey, and an idea generation workshop with the facility managers. The findings were quite wide ranged but related to the on-spot limitations.*

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## 7.1 Status Phase III

The opportunities and project risks, in which the background to the action research in this phase originates, are generated from the conclusions in the previous phase, from further interaction with the PSG and from on-site project management by us. The opportunities within this phase are related to business theory (see Section 3.5).

### 7.1.1 Opportunities Phase III

In order to focus on how to further investigate the concept of IoCB within a pilot project, we aimed to involve the occupants twice during this phase: interviews for getting a qualitative opinion and a survey for a quantified opinion. The prioritisations of the opportunities are related to timing in terms of having access to the stakeholders while being on-site at the pilot facility.

Parts of the research focused on how to improve the pilot project participation for the sake of project learnings. The opportunity of doing so seemed important as the pilot project had not been successful in terms of participation.

The access to stakeholders within the pilot facility gave the opportunity to learn directly from potential customers of a future IoCB solution. Therefore, an idea generation workshop was planned involving facility managers in order to investigate the use case sustainability visualisation. The timing and access to the building and stakeholders allowed this opportunity to take place.

### 7.1.2 Project Risks Phase III

All in all, the pilot project was not proceeding well in terms of enabling potential customers access to the technological resources, which relates to the procedure of a technology push (see Section 3.5.2). Observations on-site and findings from the Barista test indicated a project risk being that the pilot project might not give any new insights within the focus area of commercial real estate. Even though the collaboration agreement was learning to collaborate, the consequence would have been a waste of resources in terms of finding new business. To mitigate the obstacle of reaching the objective of finding value and getting customer insights, the action researches was directed towards this matter with help from business theory and successfully coincide with the identified opportunities.

Most of the focus of the pilot project had been directed towards the use cases *Occupant feedback* and *Free space location*, which both apply to the occupants. The project risk arise that the set-up and pilot installation may miss to investigate the additional two use cases: *Sustainability visualisation* and *Time channel optimisation*. The consequences would be to not being able to address all the stakeholders and miss important insights.

## 7.2 Objectives with Phase III

- Unbundle stakeholder relations within commercial real estate by on-site interactions
- Research how to improve communications within a pilot project
- Get customer insight and generate ideas for a future IoCB concept
- To research the opportunities and project risks for phase IV

## 7.3 Intervention with Action Research Phase III

In order to fulfil the objectives, the following intervention with action research took place:

### 7.3.1 Occupant Interview

During the Barista test it was possible for the occupants to sign up for an interview, of which all who signed up received an email invitation. The aim of the occupant interviews was to deeper investigate the interest of the features in the IoCB pilot application, to find additional new use cases and to figure out how to get the occupants involved in the pilot project. An additional aim with the interviews was to figure out if the pilot project was actually testing what it was supposed to test from the opinions of the occupants. The email invitation resulted



in ten persons signing up for the interview. All of them were men aged 32-51 years old working with simulations, testing or development.

The method of choice was semi structured interviews in order to understand the individual's experience and feelings regarding the IoCB pilot concept. The set-up was a mix of open and more structured questions in a relaxed environment. The purpose of the chosen method was to get descriptive and explanatory answers. The questions were sent out the same morning (see Appendix E).

The interviews then started with a small introduction to the context by us following a couple of introductory questions that took the interview to the main questions. The interviews ended with an open discussion regarding questions relating to the pilot project and the thesis work.

### 7.3.2 Occupant Survey

The interviews with the occupants generated the assumptions that in order for the occupants to get involved in the pilot project they needed a reward and the IoCB solution had to be essential in their working environment. Together with the need to validate and develop the findings from the occupant interviews this resulted in the creation of a survey directed towards the occupants. The objectives of the occupant survey was to investigate in how to conduct a successful pilot project and an interesting IoCB solution, what future use cases may be of greatest interest, and if there was a willingness to pay for an IoCB solution among the occupants.

The survey was conducted as a *Google form* and available to fill in online from the 29<sup>th</sup> of February until the 8<sup>th</sup> of March (see Appendix E). There were some technical problems during the period due to the survey tool was not applicable with the web browser *Internet Explorer*. Information concerning this issue and a kind reminder to answer the survey was sent out on the 2<sup>nd</sup> of March.

### 7.3.3 Facility Manager Workshop

In order to generate ideas and clarify what the stakeholder *Facility manager* within a commercial real estate needs, wishes and demands of an IoCB solution, an idea generation workshop was conducted. The workshop was divided into two sessions: a customer profile creation session and a roller coaster session. The participants of the workshop were asked to act from a facility manager's perspective, while we were acting as moderators of the workshop.

#### Customer Profile Creation

The method used for the customer profile creation session was based on the ideas from the book *Value Proposition Design* (Osterwalder et al., 2014), and included a brainstorming session, a categorisation and a prioritisation of how to create value by address the root of what the facility managers were facing in their work (see Appendix E.1.1).

## Roller Coaster Session

The aim of the session was to test the use case *Sustainability visualisation* concerning four different visualisations from the Energidirigenten pilot. The method was invented by us based on the metaphor of a roller coaster cart going down the hill and going up the hill. Going downhill represent the goals the participant wants to achieve from the addressing a given objective. Going uphill represents the obstacles and limitations with the current situation that prevent fulfilling the goals created going downhill (see Appendix E.1.2).

## 7.4 Findings of Action Research Phase III

The results from the occupant interviews, the occupant survey and the facility manager workshop are stated below. In addition, the findings from working with the use case Time channel optimisation is explained.

### 7.4.1 Results from Occupant Interviews

All relevant results from the Occupant Interviews can be found in Appendix E. The features *See available rooms* and *Give feedback on indoor climate* were considered as useful in the IoCB pilot application. Though the feature *See available rooms* is not considered necessary for the mini-meeting rooms, since there are plenty of mini-meeting rooms at the Ericsson facility that are easy to find and access. The feature *Give feedback on indoor climate* was considered useful since there was a perceived feeling of that the indoor climate was cold and dry, and they would like to know other peoples opinion on this matter.

In order to raise the interest of the feature *See available rooms* among the occupants, it should be able to synchronise with other systems, such as Outlook for booking overview of conference rooms. An identified wish among the occupants with the feature was to be able to book rooms and overview the booking schedule real time.

The occupants appreciated the possibility to express their opinions regarding the indoor climate in the feature *Give feedback on indoor climate*. The occupants wished to receive feedback on their inputs on the indoor climate in order to know if any actions had been taken based on their opinions.

For the occupants to participate in a pilot project, the most important issue for them to participate would be that the line manager or another person with authority gave them their permission to take part in the pilot project, and clearly communicated this. Email was seen as the best channel for information distribution. The occupants suggested using the most eager persons at an early stage in the pilot project to try out the idea and then use their feedback to alter the pilot project to capture the less eager one's opinions.

The interest for environmental sustainability matters was identified as half-hearted, but the occupants believed a change in behaviour would be probable if their performance and potential improvements could be visualised. The occupants were also asked if their employer

should pay for an IoCB solution. The general answer was a yes, if the employer was able to see a potential saving or an actual improvement.

### 7.4.2 Results from Occupant Survey

In total 38 persons answered the survey of which 34 were male (see Figure E.6). All relevant results from the Occupant Survey can be found in Appendix E.

The result from ranking eleven use cases (see Table E.3) relating to an IoCB solution was that three of them were considered essential (see Figure E.9). Those were: *Possibility to report on broken items*, *Find available rooms/space* and *Ability to book a room in real time*.

The willingness to pay for an IoCB solution, containing information data about the workplace, and used by the occupant employer and facility manager in order to improve the workplace, among the occupants was nearly nothing (see Figure E.11). The majority of the occupants answered that they were not willing to pay at all for the solution, although a few were willing to pay a small fee each month.

By stating the importance of their workplace elements, the results from analysing how to best integrate and make an IoCB solution essential was collected, showed that the computers and work desks were the most essential items. The preferred communication channels for receiving information regarding the workplace or updates on a pilot project was by email, and a suitable reward for participating in a pilot project was to receive a cup of coffee.

### 7.4.3 Results from Facility Manager Workshop

The idea generation workshop was carried out with two on-site facility managers and two line managers, which was well informed within the field of commercial real estate.

#### Results Customer Profile Creation: Facility Manager

It was possible to find several pains and gains of the facility manger. A summarised customer profile, of a facility manager within a commercial building, that was created during the first session of the workshop is stated in Table 7.1. More detailed lists of the *pains*<sup>1</sup> with their relative perception of severity, and the *gains*<sup>2</sup> and their relevance are presented in Tables E.4 and E.5.

<sup>1</sup>the barriers that prevent or make it difficult to get a job done

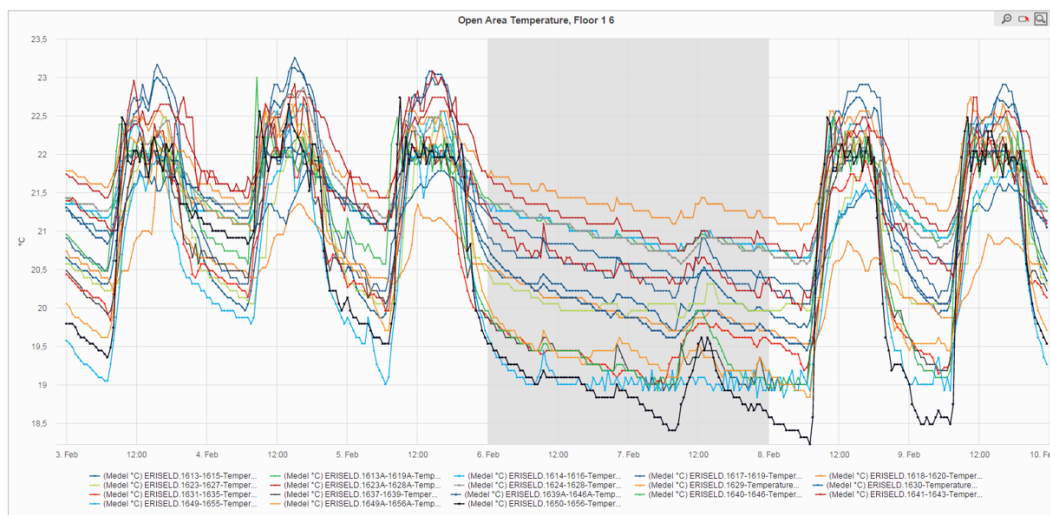
<sup>2</sup>the concrete outcome the customer wants to achieve or avoid

**Table 7.1:** A summarised customer profile of a facility manager within a commercial building created during the first session of the Facility Manager Workshop.

Customer profile: Facility manager		
Jobs	Pains	Gains
<ul style="list-style-type: none"> <li>• Maintenance</li> <li>• Contracts</li> <li>• Communicates</li> </ul>	<ul style="list-style-type: none"> <li>• Indoor climate regulations</li> <li>• Economical incentives for improvement</li> <li>• Lack of facility information</li> <li>• Lack of proactivity</li> <li>• Lack of trust from the occupants</li> </ul>	<ul style="list-style-type: none"> <li>• Find investments (ROI)</li> <li>• Entrepreneurs</li> <li>• Proactive work</li> <li>• Utilisation count</li> <li>• Access to the people</li> <li>• Proud of the office</li> </ul>

Results Visualisation: Temperature Variations

With the visualisation *Temperature variations*, Figure 7.1, the facility managers noticed the temperature peaks and variations over time, especially during weekends, and identified a potential usage of it for deviation reports. They also identified a possibility to follow up on regulations over time, which would generate potential energy savings, and the ability to inform the occupants and the tenants of the actual indoor temperature.



**Figure 7.1:** Temperature variations over time within the pilot facility. The figure is taken as a snap-shot from the web based visualisations tool *Energidirigenten pilot*.

## Results Visualisation: Heat Map

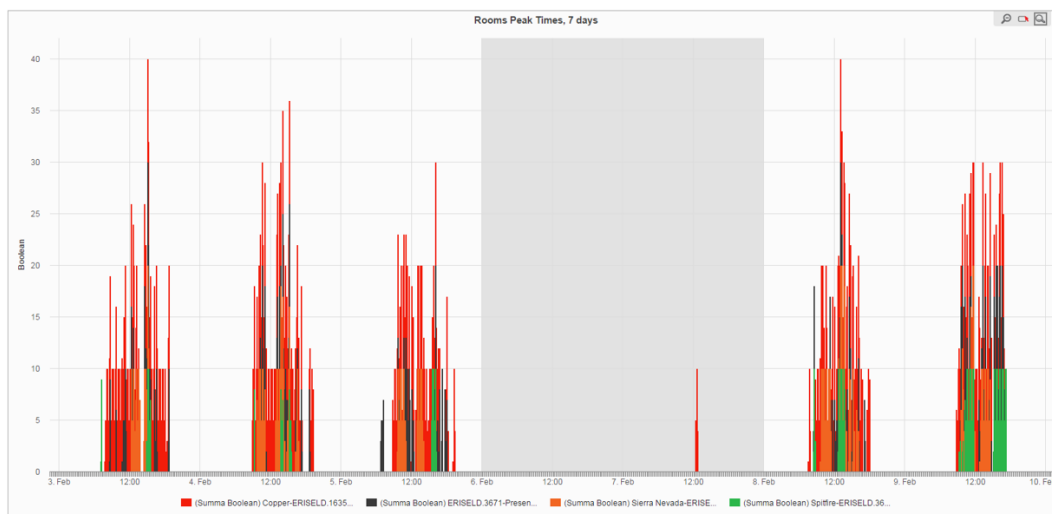
With the visualisation *Heat map*, Figure 7.2, the facility managers noticed the difference in temperatures as deviations from default settings. An identified potential usage was found as a complementary deviation report tool, and an indication of where to start implementing improvements. An additional usage of the diagram identified was the possibility to visualise, to the occupants and the tenants, where it is suitable to be placed depending on temperature preference.



**Figure 7.2:** Heat map within the pilot facility showing different temperature at different areas within the Ericsson facility. The figure is taken as a snap-shot from the web based visualisations tool *Energidirigenten pilot*.

## Results Visualisation: Presence Peaks

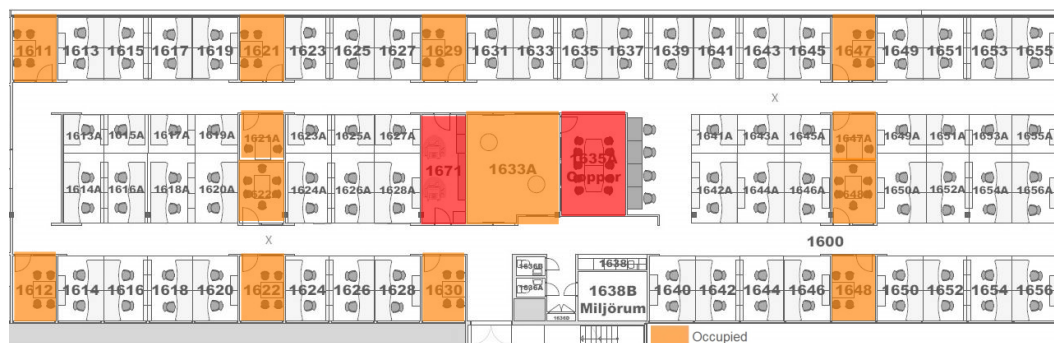
The visualisation *Presence peaks* is presented in Figure 7.3. According to the facility managers it is helpful to know presence within the facility. Usage for this type of visualisation was identified to occupancy in areas and suggested reorganisation. But according to the facility managers, the diagram did not fulfil the wish, since it does not give any information about room bookings.



**Figure 7.3:** Presence peak visualisation shows the presence within certain rooms within the Ericsson facility at different time points..

## Results Visualisation: Presence Map

The visualisation Presence map is presented in Figure 7.4. According to the facility managers, usability of a presence map would be to see available space in real time. But the current set-up does not give any historical usage values and therefore the visualisation is not so useful in the current setting.



**Figure 7.4:** Presence map, shows the presence within certain areas in the Ericsson facility. The different colouring in the map shows the presence. The figure is taken as a snap-shot from the web based visualisations tool *Energidirigenten pilot*.

## 7.5 Use Case *Time Channel Optimisation*

To figure out if the use case *Time channel optimisation* could be tested by us, an analysis of the facility was done by interviewing anonymous stakeholders working within the building.

The building automation system, a TAC Vista system, includes chilling beams on the roof and radiators by the windows in each room of the office areas. In the pilot installation there are communicating presence sensors that indicate when the system should reach the setpoint values. During work hours, the setpoint temperatures are 21° C except for some open areas that have a setpoint temperature of 18° C. The temperature control systems, placed within the office, are turned off in the current setting. Instead, the airflow controls are centralised in order to reduce cost.

At the moment the office tenant pays a fixed amount for the energy they are using. To be able to test any regulation of the buildings energy systems we would have to motivate that to the facility owner. That is not within the scope of the action research study and therefore we could not try the use case *Time channel optimisation*.

### Sub-optimisation

Within the use case *Time Channel Optimisation* we identify a project risk that the IoCB system may cause sub-optimisation<sup>3</sup> linked to the objective of optimising energy flows, and it

<sup>3</sup>situation where a system yields less than the best possible outcome or output, caused by a lack of best possible coordination between different parts

needs to be further researched as the collaboration agreement aims to create sustainable energy solutions. This is because the IoCB pilot only analyses parts of the building, and time channel optimisation of those parts does not guarantee an optimisation of the flows within the building or the city area as a whole. The insight is left for further studies, as it is beyond the scope of the thesis to describe how sub-optimisation can be avoided by the cross-industry collaboration.

## 7.6 Conclusions Phase III

Depending on actions outside of the scope of the thesis work, the use case *Time Channel Optimisation* will not be assessed in the action research.

### 7.6.1 Conclusion Occupant Interviews

The functionality of seeing available rooms in general is a good idea. However, there is no interest for the feature *See available rooms* in the current set-up. There is a definite interest in the feature *Give feedback indoor climate*. Additional use cases were identified, both regarding occupants receiving information and the occupants providing feedback.

There is a lot of improvement to be done in order to involve the occupants in a pilot project, for example, to involve people with authority and to improve communication with the occupants.

The interest for environmental matters is half-hearted in this building. The concept is considered as something useful, but the actual wish/need/demand for it is vague.

### 7.6.2 Conclusion Occupant Survey

The most interesting use cases for a future implementation are *Possibility to report on broken items*, *Find available rooms/spaces* and *Ability to book a room in real time*. A future IoCB solution should be available at the occupants computers and their own work desks, since those are the most essential things within the occupant workplace.

The majority of the occupants do not seem to be willing to pay for an IoCB solution. Other options should therefore be preferred within a future business model.

The occupants prefer the communication channel e-mail and about half of the participants in the occupant survey answered that a cup of coffee is a sufficient reward for them to help out with a pilot project. The conclusion is that the PSG already used the right communication channel to reach the occupants and should continue doing so.

### 7.6.3 Conclusion Idea Generation Workshop

The conclusion from the customer profile creation was that the greatest pains in the facility managers work was climate related issues, lack of facility owner incentives and utilisa-

tion levels. The greatest gains in the facility managers work was good investments, skilled entrepreneurs and contractors, and proactive work.

Regarding the use case *Sustainability Visualisation*, the idea of using temperature data over time seems promising and fully possible with existing tools, data and knowledge. The creation of these type of diagrams is nothing new, therefore the interesting finding is that it has not been done. It would be interesting to research if a smarter diagram would increase the usability.

The visualisation of presence peaks should be done differently than the current setting within Energidirigent pilot, since it is not considered interesting or useful.

The presence map seems useful from a facility manager's point of view, however it can only be created if there are communicating sensors.

## 7.7 Preliminary Generic Conclusions of Phase III

- Interviewing stakeholders can give new ideas and inspiration during the development of a new concept and it is possible to figure out the priorities among alternatives by a quantitative study such as a survey
- Energy management within commercial real estate is hard due to the one paying is not always the one benefiting for an improved climate and vice versa.
- To find a value proposition for the created customer profiles. The value proposition should be linked to insights from the interviews, survey, workshop and study visit and future workplace must be imagined to mitigate the risk of market failure.
- Lessons learnt during the pilot project could be further researched and presented to the collaboration agreement
- Commercial real estate market involves several stakeholders and the unbundling of their internal relationships and who is paying for what may be facility specific. It should always be researched within the area of commercial real estate.



## Pilot IV: Future Pilot Proposal

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*This phase starts within the opportunities and project risks identified so far and are put in a context beyond the pilot project. The intervention with action research includes a description of study visits to ABW offices, a value proposition design and a PSG workshop. In addition, the collaboration model is analysed based on the action research. Phase IV marks the end of the action research.*

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### 8.1 Status Phase IV

The opportunities within this phase originate from the findings from the previous phase in terms of investigating what the occupants would like to have in an IoCB solution, and the outcomes of the facility manager workshop. On the other hand, the project risks relate back to the beginning of the action research and the initiation of the collaboration model.

#### 8.1.1 Opportunities Phase IV

To be able to create a value proposition with a broad mind-set, we went on study visits to three ABW offices sizing small, medium and large. In order to get a deeper understanding of trends and ideas connected the future workplace we talked to an expert within the field.

By formulating a list of requirements for an IoCB solution based on the customer insights from the action research, we created a value proposition for the customer, *the office tenant*. A workshop was held with the PSG in order to test the value proposition to find a new business model.

### 8.1.2 Project Risks Phase IV

Our belief was that project risks can be identified at initial stages, and that this was something that the PSG needs to work with in a potential future pilot project. In order to capture and highlight the project risks related to a commercialisation of an IoCB solution, the workshop with the PSG also contained an identification of project risks.

We also returned to the collaboration model that had been initiated prior to the start of the thesis work and the launch of the pilot project (see Section 5.1.1). This was in order to assess how the work with the collaboration model had proceeded and if the work with the collaboration model had generated any new insights to the PSG and their way of working. The belief was that the assessment could give valuable insights from a more general perspective about the outcomes of working with a collaboration model in another time and context.

## 8.2 Objectives of Action Research Phase IV

- Design a value proposition for a IoCB solution connected to one key-stakeholder seen as the potential customer
- Evaluate the value proposition in relations to opportunities and project risks with the objective of a business realisation
- Pinpoint some of the best opportunities and greatest project risks within the area of collaboration commercial real estate
- Assess and generate ideas on how to proceed with the collaboration.

## 8.3 Intervention with Action Research Phase IV

To fulfil the objectives the following intervention with action research took place:

### 8.3.1 Study Visits

In order to explore the possibilities with an IoCB solution along with the input from the occupants, we decided to visit three external activity based working (ABW) offices. The ABW office is a team-oriented approach of working based on the premises that no employee has an assigned workstation. Instead the workspace provides the employee activity areas that allow the employees to conduct specific tasks that includes learning, focusing, collaborating and socialising (Malkoski, 2012). The choice of visiting ABW offices was due to current trends indicating that organisations are moving towards this kind of office organisation.

According to Malkoski (2012), ABW offices are not for everyone. In order for an ABW office to become successful it has to be of relevance to the work and activities of the employees. The concept is thus better suited for a workplace that is mobile and for employees that frequently are out of office, such as account managers.

The aim of the study visits was to get a customer insight and to generate ideas for a future IoCB solution. Our approach during the study visit was to observe and to ask questions, either during or after the tour of the ABW office. Three ABW offices was visited; a small 10 employee office, a large ABW office and an ABW commercial building, in order to get different perspectives on the set-up.

### 8.3.2 The Value Proposition

The objective of the value proposition was to find a value for the collaboration agreement, in accordance with Section 8.4.2. Our objective of the value proposition was to focus on what to continue with for an IoCB solution. By formulating a value proposition linked to one of the potential customers a next step in the process could be identified. The customer chosen was *the office tenant*, based on the previous findings.

### 8.3.3 The PSG Workshop

In order to test the idea of the value proposition created by us on more experienced business managers, a workshop with the PSG was initiated; the PSG workshop. The objective of the workshop was to test if the value proposition was possible and of interest by letting the participants of the workshop place the value proposition within a BMC<sup>1</sup>. An additional objective with the workshop was to identify the major project risks for the commercialisation part of the proposed value proposition that we had created.

All three companies were represented in the workshop which was formulated as *a three stage rocket* where the participants should think in three different ways (see Section F.1). The approach of the workshop was for the managers to create their own BMCs (see Section 3.5.1), based on the value proposition presented by us. The BMC concept was chosen to work with due to it was a familiar concept of the PSG to work with in connection to value proposition design. The workshop ended with an open discussion on what would be the most severe project risks with commercialisation of the IoCB solution.

### 8.3.4 The Collaboration Model

In the end of the action research there was a follow-up on the work with the PSG's work with a collaboration model. The results were followed up by an interview with the manager responsible for the collaboration model. In spite of the fact that the collaboration model was still under construction during the end of the action research, we got access to the current model. From analysing the collaboration model we formulated project risks that were then put in relation to the theory.

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<sup>1</sup>a strategic management tool that allows the business to create value by describing, designing, challenging and inventing the business model

## 8.4 Findings of Action Research Phase IV

The study visits, a value proposition, the PSG Workshop and researching the work with the Collaboration Model generated the following findings:

### 8.4.1 Study Visits

Three study visits were conducted to: a small scale, a medium scale and a large scale office. All offices were ABW offices with the employees moving into them during 2015.

#### Small ABW office

The small scale ABW office hosted around 10 employees and belonged to E.ON Fastigheter Sverige AB. According to L. Palac the main drivers of implementing ABW was to improve cooperation, to get an enjoyable and creative workplace, and to learn all the benefits and disadvantages with ABW offices (personal communication, November 24, 2016). The office was divided into three different zones: the active zone, the medium-active zone and the concentration zone. Each zone had the characteristics of different activities, desired sound levels and level of interaction.

In the small scale ABW office, there were certain storage lockers containing personal toolkits for the employees to carry with them for their workplace of choice. The office was designed to challenge the workers to move as much as possible and stand up as they were working, which was motivated as better from a health perspective.

The organisation follows up on their office activities every month and they used a common digital list for bringing up issues anonymously. But they have not been able to measure their change in efficiency since they started working within an ABW office. Their perceived experience was that they had a better workplace (L. Palac, personal communication, November 24, 2015).

#### Medium ABW office

The medium scale ABW office was developed for ABB Corporate in Sweden and sales for the Power divisions and management of Power System division (Håkansson, 2015). The office was organised into points and activities instead of areas, since the term area may create invisible walls, according to the line manager (M. Beijbom, personal communication, February 9, 2016).

According to M. Beijbom, the management of the workforce within an ABW office is just as important as the actual design of the office (personal communication, February 9, 2016). The driving force of the implementation of the ABW office was increased employer proudness and to attract future young professionals. In addition, to create a workplace where the employees felt comfortable and wanted to be.

The employees experienced an increase in workforce efficiency within the office. According to the line manager, this perceived feeling was due to that the ABW office better fulfilled the needs of the employees, for example every workplace desk was equipped with two screens and an easy to use multi-adaptor. However, the improvements in workforce efficiency had not been measured. When asked by us, the line manager expressed that a tool for measuring workforce efficiency could be useful, though a gut feeling may be just as important as counting actual numbers (M. Beijbom, personal communication, February 9, 2016).

#### Large ABW office

The large scale ABW office was a several floor newly built commercial real estate, IKEA Hub-hult, a global meeting place. The office hosts about 1100 employees and has around 200 guests visiting every day. It was built in order to fulfil the vision of IKEA to create an office that was easy to visit and travel to. According to the strategic communicator, in an earlier office set-up the company had noticed  $\frac{2}{3}$  of the work desks being empty on a daily basis due to business travelling and meetings (D. Lewin, personal communication, March 18, 2016). Furthermore, the company wanted to increase their employee brand to attract future value driven young professionals.

In the office building, where meetings are supposed to be the focus activity, the occupants are able to work wherever they like within several floors, though belonging to a specific base camp. The facility solution is designed to create a campus feeling with open spaces, rooms and different meeting areas and equipment (D. Lewin, personal communication, March 18, 2016). The owner of the facility is within the IKEA group. The occupants are IKEA employees, consultants and outside guests that come there to work or to have meetings for a shorter period of time.

At the first floor there was a start box with greeters welcoming the employees, and the possibility to see the meeting room bookings. It was also possible to view the bookings directly outside the meeting rooms on monitors. However, there was currently no communications solution to see the presence within the different office areas.

According to the strategic communicator, the amount of mini-meeting rooms was considered over-dimensioned (personal communication, March 18, 2016). This is due to that in the previous office set-up there was a deficit of mini-meeting rooms, which was noticed by the designers. Therefore in the current office set-up the amount of mini-meeting rooms has been increased along with areas fulfilling the needs of mini-meeting rooms.

For the energy management, the company IKEA is striding towards the most sustainable solutions to create a stronger and value driven brand. In line with the company brand, IKEA Hub-hult strive towards fulfilling requirements for Environmental certifications, such as BREEAM Outstanding (IKEA, 2015). The indoor climate is regulated with presence sensors, and the lighting is also depending on the outdoor light settings. The occupants had access to the radiator and indoor climate controls. While visiting, we observed these radiator controls being set on maximum.

Initially, a study had been made to analyse the occupants' wishes for their new workplace. A follow-up will be conducted in spring 2016, and it will also be based on an occupant survey. The usage of different spaces and areas were based on observations. The project group

responsible for the ABW office had noticed an increase in productivity (D. Lewin, personal communication, March 18, 2016).

#### 8.4.2 Value Proposition

Based on the learnings and experiences from the action research we designed a value proposition and the settings, the customer, the requirements, and the fit is described below.

##### The Future Workplace

The young generation today are expected to be more willing to change employer compared to their older colleagues, and base their choices on a more value driven basis (J. Blomström, personal communication, February 26, 2016). Therefore, the expectations will be higher on the future workplace, and the employer needs to meet the expectations if they want to keep their workforce.

In a future workplace the individual should be put in focus and every individual needs something different for their activity. Parts of a future workplace may be virtual and that will allow the workers to be more movable and flexible (J. Blomström, personal communication, 2016). Therefore, the needs within the future workplace may differ a lot from today's workplace and be more dependent on employer, workforce and technical set-up.

We had identified that there may be a need to measure workforce efficiency to be able to show an increase and motivate an IoCB solution. According to J. Blomström, the measure of workforce efficiency is complex (personal communication, 26 February, 2016). To measure the efficiency of a workforce there is a need to get an overall view of the performance of the workforce related to performance related objectives. The growth and profits from quarterly earnings could be used to measure workforce efficiency in monetary terms, however that may not include the long-term thinking (J. Blomström, personal communication, February 26, 2016). A metaphor is that the winner of a Marathon race is not necessarily the first one crossing the half-distance mark.

##### The Customer

In order to know what customer to address in an IoCB solution, a customer profile needs to be generated describing a key stakeholder within a commercial building. We generated customer profiles for the stakeholders within the pilot project using our knowledge from the action research (see Tables 7.1, F.1, F.2 and F.3). Further to this, the customer needs to have incentives for investing in the solution. The customer that was chosen by us was *an office tenant*.

The jobs that the office tenant has are to handle the workforce within the office building. The tenant needs to communicate and organise the workers within the workplace. The tenant may also have an internal facility manager that handles the internal facilities.

An impending problem is how the tenant should inform and organise the occupants according to their needs and activities. There may be a lack of utilisation rate data, especially after internal reorganisation. The office tenant wants to obtain high workforce efficiency and a strong employer branding. For example, the office tenant needs to co-organise the occupants, the internal facility managers and the maintenance personnel to get an efficient workplace.

### Requirements of a Future IoCB Solution

The future IoCB solution should be a disruptive innovation that is applicable everywhere, uses data from utilisation and is an essential part of the future workplace.

The applicability of the IoCB solution is based on the findings from the action research. Different stakeholders have different willingness to pay for improvement depending on budget terms and interests. The motivation for the office tenant to have a movable and independent IoCB solution is that it does not have to involve the facility owner.

It is important to log data from utilisation since the findings from the action research is that stakeholders lack data on space usage but are interested in it. Further to this, the results from the occupant survey were that the most essential proposed use cases were: *Be able to report on broken things i real time*, *Book a room in real time* and *Find available space in real time*. Therefore, the solution should include any of those use cases.

The findings from interviewing the occupants was that there is no wish for another "nice to have"-solution at their workplace. Our idea is that the IoCB solution should be a part of the workplace for it to become essential.

### The Value Proposal

The value proposal that we formulated is built on the customer and the requirements and consists of three things: sensors, an IT-solution and a visual interface (see Figure F.1).

Firstly, the solution includes cheap communicating presence sensors, that are moveable and easy to put anywhere within the office.

Secondly, the IT-solution is a cloud solution that logs data and is connected to all the sensors, registers utilisation and presence. The office tenant can register the office building areas in the IT-solution in order to customise it for their specific workplace. The amounts of details are decided by the needs and wishes of the customer.

Thirdly, the IoCB solution has a visual interface consisting of a map. The map is available as a widget for the computer, as an application for the smartphone and as a visualisation for the monitor screens within the office. The map shows presence in real time and it is possible to log on with different user profiles. Different users may put notes with coloured dots that give a message and a timestamp to the other users.

### 8.4.3 The PSG Workshop: New Business Model and Project Risks

The PSG managers understood the presented value proposition that we created, and created four BMCs in the second part of the workshop (see Figures F.2, F.3, F.4 and F.5). From the BMCs and an open discussion regarding project risks, relating to a commercialisation of the IoCB solution, the managers considered the following three risks as the most severe:

*Willingness to pay* - knowledge about customers willingness to pay<sup>2</sup> is missing. It means that it is not possible to foresee the potential incomes from such a solution. This information is important as it must be more than the potential costs of providing the solution for it to be profitable.

*Hard to reach out to the customers* - the value cannot be communicated. If the values cannot be communicated the customer will not be willing to buy the solution, as they will not understand the benefit of doing so. The communication of a value is really important for being able to sell a product or solution, since if the customer does not understand the benefits with buying the solution they are most likely not going to do so.

*Maintenance and operation is considered too costly and troublesome* - This risk would mean that the customer would not consider the solution due to the fact that they think it will be too costly to maintain and operate it. In order to avoid this obstacle a low cost for the maintenance and operation must be ensured. In addition, and most importantly, it must also be possible to communicate to the customer that the maintenance and operation costs are low.

### 8.4.4 Findings from the Collaboration Model

During the first phase of the action research, the collaboration agreement had brought forward certain action points that they wanted to focus on to improve the way of collaborating. Those were: *alignment, principles, approach, agreement, measurement, follow-up* and *coordination* (P.Wall, personal communication, March 7, 2016).

According to the actors, the collaboration model had shifted their focus from what the collaboration was doing to how they were doing it. The collaboration model could offer a way to evaluate and develop the internal relationships on a deeper level. By working with the model, the actors themselves had been able to come up with certain needs for improvements related to relationships and communication. A crucial point, that the actors had identified, was a need to find a way to measure their performance. There had been no follow-up on project risks related to collaboration, but they were still of interest (P.Wall, personal communication, March 7, 2016).

The collaborative project risks that we could identify by analysing what the collaboration model were trying to address are listed in Table 8.1. It should be noticed that those are only potential project risks and not realised.

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<sup>2</sup>the willingness to pay is what the customer would be willing to sacrifice to procure a good or avoid something undesirable



**Table 8.1:** *The collaborative project risks that we could identify. Note that they are potential obstacles and not realised, as with the definition of project risk.*

	Potential risks	Potential outcome
1	Focus	That the focus will be only on business within the collaboration and that internal relationships are forgotten
2	Continuous work	That internal commitments and agreements are not continuously followed-up
3	Commitment	Lack of commitment to the collaboration from higher division
4	Recognition	The internal-organisations does not recognise the collaboration
5	Trust	Companies do not share their view regarding motives and driving forces
6	Expectations	Different parts and actors have different expectations
7	Conflicts	Severe discussions and non-constructive problem solving may arise if issues are not taken care of at early stage
8	Unbalanced evaluation of possibilities	No balance between long-term visions and actual business within collaboration
9	Structure	Lack of structure within the work of the collaboration
10	Common language	Different actors use different terminology and do not understand each other
11	Models	Collaborating actors do not understand each other's models, such as BMCs
12	Flexibility	The collaboration miss out on a framework and the possibility to adapt to specific projects
13	"Quick-wins"	Lack of "quick-wins" that reassures the actors that the collaboration is on the right track

#### 8.4.5 Project Risk Assessment using Collaboration Model Findings

A direct assessment of project risks are discussed in this section based on insights and experience from the action research as a whole.

It seems like the PSG are getting to know each other and they are sharing social activities as having informal lunch together during their gatherings. We think that the relationships are relating to a continuous work and therefore that the actual risk comes with introducing new individuals to the group. We have observed a continuous follow-up of opportunities. But we did not experience any follow-up on the project risk that we identified in the beginning of our action study. We think that a missing within the continuous work is continuous status reports put in one place. The higher division seems interested of the collaboration and has steering group meetings continuously.

We noticed that a lot of internal workers asking us about the collaboration, and thought that is was highly interesting. We think that more work could be done to improve the internal marketing to spread information about the collaboration. But in general, the internal-organisations seem very positive.

We experience that the communication has been very open between the different companies along the way of this study. But we think that some individuals may need to see some long-term results to really trust each other. There could be an improvement on how to prepare for a pilot project. The structure of meetings and follow-up as the collaboration model seems functional.

Some project risks could have been avoided by discussing the different cultures and ways of scoping projects beforehand. But it seems like those differences were good findings for the collaboration. We did not experience any severe conflicts or non-constructive problem solving. There is still no commercialisation within the internet of commercial buildings. We think that the next step being commercial would help to balance the collaboration possibilities.

We experience an openness within the PSG and that prevents misunderstanding. The PSG has adopted the BMC method and it is beneficial that they can join their forces using one tool. A project specification model has been written regarding the next phase, and we hope that the specification will become a useful tool.

### 8.5 Conclusions Phase IV

A main driver for implementing ABW offices is to attract future young professionals. The organisations using the ABW offices are proud of their offices and content of the results that reorganisation brought them. It seems to be hard to follow up on this kind of reorganisation and to show proofs of the improvements. None of the ABW offices that were visited had an IoCB solution today.

The process used within the action research for finding a value proposition was successful in theory but it does not prove the concept. However, it can serve as a part of the process within a proof of concept as it offers a new standing point for future business development within the area commercial real estate.

### 8.5.1 Conclusion from the PSG Workshop

The conclusion from the PSG workshop is that the value proposition that was found during the action research can be put in a theoretical business model. It is also possible to map project risks relating to commercialisation, by creating a new BMC and have discussions around its shortcomings.

After getting feedback during the PSG workshop, we formulated suggestions on a further study for the commercialisation of an IoCB solution:

- Give a tool to know and measure space usage. As a suggestion the usage could be related to the activities and measured as  $\frac{\text{area}}{(\text{activity} \cdot \text{time})}$
- Test if people are using the IoCB solution tool: when, in what manner and how often?
- Visualise the usage on the preferred interface: monitor screens, computers, smartphone
- Customise the solution depending on the organisational structure
- Research the willingness to pay by the tenant
- Research how the value can be communicated to the customer
- Research how technological risks can be reduced and how these mitigated risks can be communicated to the customer

### 8.5.2 Conclusion from the Collaboration Model

The greatest benefit of using a collaboration model in an initial state of a collaboration is that it enables a shift in focus from *what* to *how* related to the objectives of a project and a collaboration agreement.

## 8.6 Key Findings and Future Studies

- ABW offices generate an increase in office attractiveness, a factor that we call "proudness of the office". And there seems to be a trend towards the ABW office organisation. Thus, our finding is that there seems to be an incentive to invest in things within the workplace that increases this factor. Therefore, we motivate the potential incentive for investing in an IoCB solution if it can contribute even more to the "proudness of the office".
- It is possible to create new business models for energy solutions with the BMC method: using a customer profile, a value proposal and a list of requirements
- The project risks related to a business model could be a suitable base for identifying what the focus for a future study should be while creating new energy solutions
- A collaboration model is a useful tool for a cross-industry collaboration and it is suitable for ensuring that opportunities and project risks are followed-up.



# Discussion

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*In this chapter a discussion of the benefits, shortcomings and limitations of the thesis students, collaboration agreement and the pilot project takes place. Also, the used methods and the findings from them are reviewed. Finally, the way of assessing project risk is discussed in order to explain and review the interpretation and work with risks within the thesis.*

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## 9.1 Reliability and Credibility

The suitability of the Action research methodology was confirmed during our research, as it was possible to fulfil the objectives of the thesis, and we think that interacting with people, contributing to the pilot project objectives and using an agile approach was helpful and successful for the thesis research. The methodology was really flexible and we think that contributed to deeper insights.

The drawback of the Action research methodology was loss in objectivity, since it turned out to be hard to stay unbiased and critical within this research project. We were not fully objective while conducting our action research, since we wanted to contribute to the project, and even though our awareness of this it may have affected the results and conclusions. It is important to be aware of that while interpreting the thesis results and conclusions. In a different scenario, we could for example have focused more on why people were not engaged in the pilot project rather than help to engage them. While conducting action research, and interacting with people, the establishment of relationships with actors also bias the outcomes of the research. For example, the direction of research actions may have been biased, as we unconsciously may have directed actions towards helping actors that we got to know better.

The bias may affect our way of handling project risks as we took action in relation to timing, even though being aware of that and trying to stay as objective as possible. However, identifying and discussing the expected consequences in relation to project risks can be considered less biased as it was easier to stay objective doing that.

### 9.1.1 Thesis Work and Thesis Students

We had no prior knowledge to this field of research or company loyalty. Therefore, as on-site managers for the pilot project we were not blinded by any preconceptions from the companies and did not know beforehand what to expect. The action research method was well suited since it made possible to observe the pilot project in an independent manner. Although, a senior employee might have dealt with similar tasks before and would thereby be comfortable in directly approaching this kind of matter more efficiently.

In the early stage of the action research, conclusions regarding the collaboration and the pilot installation were based on the first unbiased experiences with the project. At an early stage, we realised that there was no attribute project manager for the pilot project and that information did not seem to fully transfer between the different actors in the project. Looking back, it turned out to that we carried out a lot of duplication of the work that had already been done. In a future study, we recommend that there would be an information handover from the previous project manager to the on-site managers in order to avoid information losses.

### 9.1.2 Collaboration Agreement

In order to maintain a holistic approach when assessing the proceedings of the collaboration agreement, we choose to assess the collaboration agreement as a single unit. By choosing this way of assessing the collaboration agreement the different company cultures and influences from single individuals in the collaboration agreement contributes to less bias of the final findings. Although, the results and the conclusions may have been different if we had grouped the stakeholders based on company affiliation.

The findings from the work with the collaboration model gave us the insight that the collaboration agreement was still at an early stage and thus working with internal relationships and organisational structures. This motivates why it was important to try to dig into the collaboration agreement and how they were testing their ideas, instead of just looking at the IoCB concept.

#### Suitability of Technology Push

The suitability to initiate a technology push was discussed in accordance with the collaboration agreement's objectives. We did not put the suitability in relation to the technology readiness level, neither in relation to the direction of the push within the market fields. Those parameters may have been interesting for further analysing the suitability of the technology push, thus this is a shortcoming of how we motivate our conclusions regarding it.

The pilot project was both a technology push and a market pull, although the main focus was towards technology push and the pilot project is thus assessed in terms of a technology push. Initiating a technology push is one way to test how to collaborate. The opposite would be to initiate a market pull, which might be more suitable in this context. However, one of the main objectives of initiating the pilot project was to learn how to collaborate. For that purpose a technology push may be more suitable as it requires both action taking and technical implementation that is dependent on each other.

### 9.1.3 The Pilot Project

An initial time plan had been outlined for the pilot project, but it was not followed, and we took the role of on-site managers. Our advantage was that we were up to date and eager to start working with the pilot project, but our disadvantage was that we were not aware of the long term strategies or the objectives of the collaboration agreement at an early stage. This could have evolved into that we took action and studied irrelevant issues that the PSG and the collaboration agreement saw no interest in.

## 9.2 Methods and Findings

The methods and the findings are hereby reviewed in order to assess the thesis work.

### 9.2.1 Barista Test

The Barista test was a suitable concept for getting attention from the occupants. The set-up was placed on three different floors during the different days and therefore the distribution of participants may have been influenced by the circumstances. We could have improved on internal marketing to get even more attention during the first day, for example to put physical note on the door or introducing themselves to the occupants in person during their morning meeting the same day.

The conclusion from the Barista test was quite robust since it gave 126 relevant answers in total, which approximately was half of the workforce. The test gave a good indicator of the general opinion. What we missed was to document was the demographics of the participants, such as gender and age. This weakens the results since the findings may not be comparable with other workplaces. However, it was noticed by us and therefore noticed both in the occupant interviews and the occupant survey. In future studies, we suggest to always note the demographics during interactions with groups of individuals (gender, age, level of education, profession etc.).

A criticism directed against a method that offers a reward for participation is that people tend to be less objective or that a reward attracts a specific group of individuals. Therefore, it was motivate to complement the Barista test with other methods.

### 9.2.2 Retrieved Statistics from the loCB Pilot Application Usage

The data, from the use of the smartphone application, was not logged from the beginning and that resulted in shortcomings to the results and conclusions. This could have been avoided if documentation had taken place from the start. In a future action research we suggest making sure all data is logged from the beginning, since it is hard to know what the need will be further on within an action research.

The data on give feedback on indoor climate only showed a few votes on the alternative *just perfect*, which makes it hard to tell if only the persons that are not satisfied with the indoor climate votes or if this applies to everyone. This may be a great challenge for a future IoCB solution to deal with. A possibility would be to have only two alternatives: too hot or too cold, or to install an element of gamification that would increase the incentives to vote or give feedback. An element of gamification would for example be if the number of votes or times a person gives feedback is equivalent with point that he or she could switch for a cup of coffee.

Another aspect that could be discussed is the event of users accidentally pushing the wrong alternative as the buttons are placed side by side. Neither, is there a way to see if users votes for something randomly just to be able to see the temperature as that is displayed only after providing a vote.

### 9.2.3 Occupant Interviews

Conducting interviews was a good method to generate ideas with enthusiastic stakeholders within the Ericsson facility. The interaction enabled openness and there were space for new points of views. The shortcomings of the interviews were that the group was homogeneous and their opinions must be seen as not covering the whole spectra of office occupants. The consequence of this could be that conclusions are too optimistic or pessimistic when it comes to a new solution. For example, the occupants were all working within ICT, thus may be more enthusiastic when it comes to ICT solutions. On the contrary, they were not so interested in sustainability matters while in another office this may be very interesting for the workers. To be able to get a lever effect on any ideas, interviews needs a complementary method in order to generate a just result.

### 9.2.4 Occupant Survey

The survey was an effective way of fast getting quantified opinions. The tool that we used, Google forms, was not compatible with the default web browser Internet Explorer, which created a lot of extra work for the occupants. This is a potential source of errors since the survey was sent out to approximately 300 people, but roughly 50 answered. Also one of the aims of the survey was to identify the opinions of the really sceptical occupants, which we may have been missed since they potentially did not answer the survey due to the technical difficulties. In order to avoid failures with incompatible web browsers, we should have tested the survey on the default web browser before sending out the invitation to the occupants.

### 9.2.5 Facility Manager Workshop

It is hard to draw any general conclusions of the workshop since the participants had experience from a few facilities and there is the possibility that the findings are very specific for the Ericsson facilities. In order to get a more general result, similar workshops should be carried out in a wider context with facility managers from other commercial buildings.



### 9.2.6 PSG Workshop

The workshop had only four participants and therefore we decided that the work should be carried out individually. The outcome of the workshop may have been differently if the managers had worked in groups since the original idea was to try to find a lever effect by grouping different skills.

The outcome of the workshop was four different but complementary business model canvases. In order to develop the workshop concept, the final part of the session could be for the participants to generate a final joint business model canvas. Then the participants would first generate their own business model canvas and then compare that with the ideas of the other participants, to then generating a more complete idea. Also the risks identified in the business model canvas might not be risks anymore in the complete versions or they could more easily be spotted and thereby dealt with on an initial level.

## 9.3 Project Risk Assessment

The assessment of project risks in this thesis work is described in relation to timing and plausible consequences. This was a successful approach within the role as on-site managers for the pilot project. We think that the alternative way of handling project risks, weighting probability and consequence, may have been more motivated if we had been asked by the PSG to deal with more long-termed objectives of the collaboration.

Many of the identified project risks were based on observations and our own intuition when we were acting as on-site project managers. This approach of handling project risks relates to timing. This is a potential shortcoming of the project risk assessment, since the results and outcomes were biased by our actions.

The handling of project risks, based on the weighting of probability and consequence, could be seen as a more systematic and well-founded approach. But as interacting with the PSG and to take their efforts and decisions into account, we think that timing was more suitable as that allowed fast and flexible action taking. And that relates to the motivation for choosing action research as our methodology. Therefore, the assessment was based on what we thought applicable, in terms of the timing and the possible consequences, also while making priorities among actions.

The probability would have been very hard to estimate within this particular thesis project as the collaboration agreement is newly initiated, the pilot project is their first project and IoCB is a new concept. For a future pilot project, probability of project risk could be estimated using the documentation from this pilot project. It is however plausible that the outcome of the project risk assessment would have been the same even if the prioritisation would have been according to probability, as the urgency somewhat relates to the probability as well.

The starting point of the thesis was that successful alliances need to work with both opportunities and project risks in order to become successful. It turned out to be successful while conducting the research and both identification of project risks and opportunities contributed to the secondary results, such as the value proposition and customer insights. Thereby, we motivate our recommendations to the collaboration on the approach were both opportunities

and project risks are continuously put in relation to a cross-industry collaboration's common objectives.

Our initial feeling, while initiating the thesis project, was that the collaboration agreement did not proceed well. But that was due to the initial perception that the PSG were expecting results from a commercial point of view from their pilot project. As we found out that it was a concept test our perception changed. That motivates why it is really important to understand the objectives at an early stage, for all actors within a collaboration. As that supports the understanding and possibility to work with actual project risks, not based on just a feeling or perception.

## 9.4 Thesis Relevance for the Energy Systems Studies

The thesis describes the current strategic movement of key-actors within the Swedish energy sector. Issues connected with management and product development within the cross-industry collaboration are both relevant, as it contributes to the understanding of a potential future development of the Swedish energy sector. Further to this, the relevance of this topic within the Energy Systems Studies is connected to the driving forces for the energy company E.ON Sverige AB to initiate the strategic alliance. In addition, the aim of the collaboration linked to the ambitious sustainability goals in Lund motivates the relevance for the topic within Environmental and Energy Systems Studies.

### 9.4.1 Criticism and Shortcomings

Even though the objective of the pilot project was to test all four use cases, the sustainability visualisation and time channel optimisation use case were about to be missed. There were no clear objectives connected to these two use cases, and it was hard to understand their purposes and how to realise them in the pilot project. The most suited ideas generated by us were to use operations research<sup>1</sup> and a power signature analysis<sup>2</sup>. In order to test time channel optimisation, a suggestion is to simulate the facility in a simulations program. But neither of the most suited ideas were considered fitting into the time frame or scope of the thesis.

Thus, the most important use cases in connection to Environmental and Energy systems studies became a smaller part of the research than first expected.

### 9.4.2 Sub-optimisation

To critically review an IoCB system from an energy systems perspective is important, as the consequence of sub-optimisation could be a negative effect when it comes to energy efficiency. The system addressed in this thesis is the whole IoCB solution, and if indoor climate is improved from the office worker's perspective that may even increase the energy usage. To be

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<sup>1</sup>advanced analytical methods to help make better decisions

<sup>2</sup>analysis of operating schedule of energy loads in a target system

aware of the dilemma is important; as the collaboration agreement may need to prioritise between improving indoor climate and reduce energy usage.

While managing parts of a commercial building, the facility manager is looking at a single part of a large energy system. It is important to discuss the system boundaries and how that relates to a bigger picture. Within sustainable energy management, actions for optimising energy flows should always relate to a larger system in order to avoid sub-optimisation. For example, while looking at heat maps of certain floors and regulating accordingly, there is a risk of missing out on what is the optimal condition for the whole building or even city area. The risk of sub-optimisation while using the Energidirigent Pilot was identified during the facility manager workshop, as the discussion were concerning the certain workspace areas visualised without anyone commenting on the bigger picture.

For the use case *Time channel optimisation* it is important to apply a systems thinking, and it is not for certain that the optimal energy management for an efficient workspace environment is the same thing as the optimal energy management from an environmental sustainability perspective. The priority among options and decision-making needs to relate to the objective of the use case, thus within the current scope an increased return of investment. That also implies that the IoCB system should give an increased energy efficiency, but that may not be compatible with acting according with the occupants feedback on indoor climate in the current setting.



## Conclusions

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*This chapter includes the conclusions that were made after completing the four phases of action research. The conclusions relate to the problem statement (see Section 1.1). The focus of the conclusions can be interpreted as the thesis contribution within an academic context.*

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The cross-industry collaboration, searching for new business opportunities within the area commercial real estate, is acting in a newly initiated and open collaboration environment where they are trying to learn how to collaborate efficiently. They have tried out a new concept by performing a technology push, which means that they combined their resources and researched in a pilot project if potential customers would be interested. Further to this, they are using a collaboration model to improve their way of working together.

Concept testing in a pilot project turned out to be hard since few of the stakeholders within the commercial building got involved, even though the concept in itself was considered interesting by them. The action research enabled the continuous work with opportunities and project risk for the thesis students that were acting as on-site project managers for the pilot project. The focus was often directed towards stakeholder interaction and priorities within the action research were driven by timing.

The main conclusion from the action research was that common objectives are extremely important for the process of working within cross-industry collaboration in order to manage opportunities and project risk. In the pilot project, opportunities appeared at all times and common objectives help to prioritise them. Clear common objectives are also important from a project risks point of view. With clear common objectives it is easier to discover a potential project risk since it is easier to detect what objective may be hindered by the project risk and then to prevent the project risk to occur. Thus, common objectives are concluded as the main key success factor.

A key factor for successfully assessing project risks and opportunities within cross-industry collaboration was to work in relation to timing. Also important was the manageability of different opportunities and project risks, as some could only be handled on-site or via the right communication channels.

A key factor for success of a strategic alliance is that it should be seen as one unit where ideas and resources are jointly owned. That enables a holistic point of view and increases the possibility to handle project risks and opportunities in connection to the *common* objectives. In addition, transparency and openness can help with deriving the common objectives. It would be beneficial if the success could be measured by defining KPI's, but the objectives of collaborating are more important. An evaluation relating to the objectives gives a possibility to know the progress and work of the collaboration agreement.

As the collaboration should be seen as a single unit while collaborating, the role of an actor is the most important attribute and not the company belonging. The different roles, for example "manager" or "communicator", generate different perspectives to the collaboration agreement and thereby enables the holistic view on the collaboration agreements opportunities and project risks.

A cross-industry collaboration can learn a lot about how to collaborate by initiating a technology push. For the development of new energy solutions, a technology push demands on-site management and comprehensive communicational efforts. But it may be a slow and costly way of testing a concept. However, the method gives access to potential customers and therefore opens up the opportunities to co-generate ideas with them. Focusing on the customer is important while testing a concept in order to find value proposals, new business opportunities and avoid the 9x effect. In addition, any concept testing depends on objectives, either stated before or generated along the way, in order to avoid wasting time and money without getting anything in return.

On-site interaction is a great way of getting customer insight and a perception of the interest for a new concept fast. It is important that a pilot project is appealing and fulfil the right end-user expectations that it is supposed to address even if the pilot project is small scaled. Internal communication is very important for the success of a pilot installation. A pilot project could be a perfect opportunity to find ambassadors and enthusiasts for marketing a new idea both internally and externally.

Organisations within office buildings are quite complex and stakeholder unbundling is important as they are influenced by different budgets and incentives for investments. The technical possibilities seems to be almost unlimited for a future internet of commercial buildings solution, but for designing a successful IoCB concept the thesis students think that the focus should be directed towards finding the "killer use case", really desired and essential for the customers.

For example, an internet of commercial buildings solution should be an integral part of the future workplace and adding value to the customer by addressing the actual needs that they have in their office. Preferably, the IoCB solution is a disruptive innovation rather than an improvement or add-on to an already existing technology within the area commercial real estate.

An internet of commercial buildings solution suggested for an office tenant should focus on workplace improvements rather than energy management, since the office tenant in many cases does not seem to benefit from energy management adjustments. Sustainability visualisation can be used as an important tool in order to raise awareness and to improve the status of the workplace. It is important since there are incentives among tenants to improve the employer branding to attract value driven professionals.

## Recommendations

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*In this chapter the recommendations for the collaboration agreement and the focus area internet of commercial buildings is stated. The recommendations are formulated from our point of view, motivated by their experience working within the collaboration. The focus of the recommendation can be interpreted as the thesis contribution within an industrial context, as it is directed towards the particular collaboration agreement researched within the thesis work.*

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### 11.1 Recommendations to the Collaboration Agreement

We think that the collaboration agreement should be addressed as a unit of its own. The objectives of the collaboration agreement should be long-termed but flexible, so that directions and working methods is allowed to change direction if necessary. We suggest that the long term objectives should be well-defined, agreed upon and that new recruits and outside members working the collaboration agreement are able to understand these objectives.

#### 11.1.1 The Real Estate Market

The collaboration agreement takes a risk by combining the companies' knowledge and resources while entering this market without a partner company specialised in real estate. An alternative way would be to collaborate with a fourth actor in this area that is a facility actor with more hands-on knowledge of commercial buildings. Also, by testing the ideas and concepts on this fourth actor, the collaboration agreement might get a quicker response on the commercial value of the concept.

### 11.1.2 Information

In general, both we and the PSG sent out information to the occupants without having conducted a previous testing of the information interface first. The internal marketing of the pilot project was missing both from the PSG and from us. In the future work of the collaboration agreement, the way of communicating should be discussed profoundly beforehand with the communicators, since they play an important part for success. By involving the communicators to help out with internal marketing already at an early stage this could generate a high impact on the outcome of the pilot installation, such as more data.

### 11.1.3 Project Risks

The importance of handling project risks, even in small scale projects, lies within learning about project risks and how to handle such issues. Therefore by having a common discussion on and defining projects risks already in small scale projects this mind-set becomes a natural part of the work of the collaboration in any project. Even though it is an important issue to deal with, it should not be overdone since it is at risk of losing importance. A recommendation would be to always have a discussion of project risks and project risk assessment, but to have a smaller and less detailed plan of working with project risks in small scale projects, while there are more comprehensive discussions in larger scale projects.

### 11.1.4 Installation of a Project Manager

We suggest that a collaboration agreement should install a project manager that would be fully dedicated to any area of collaboration. For example, in order to avoid issues such as information loss, miscommunication, duplication of work, technical issues and scoping. We think that a fully dedicated project manager could handle, deal and follow-up with unclear matters dynamically. In addition, it would help to keep track of time and budget and know when to prioritise project utility versus cost reduction. Also, a dedicated project manager may help with preventing putting project close to severe delay.

We suggest having a project manager for certain projects, such as a pilot project, not necessarily the same person as the project manager for the area of collaboration. The role should be to make sure that there are objectives and that the opportunities and risks are handled and prioritised accordingly. In addition, to ensure internal communications and well organised documentations in each project.

### 11.1.5 Test New Ideas within the Collaboration Agreement

External market research and trend spotting may lead to a blind alley. Therefore we suggest that the collaboration agreement, after it has stated the potential customer, goes ahead and ask the customers first what they need before trusting the external sources.

Interviews are good for getting analytical reflections of ideas and to build upon them. We believe that it is beneficial for the collaboration to find the enthusiasts first since they have a



lot to offer in an initial phase. Ideas may be confirmed quantitatively by sending out forms and surveys. It is possible to get a lever effect by making sure that the opinions from sceptics are captured. We think it is better to start without a technical installation since that makes the creative process faster.

In general, when it comes to concept testing our suggestion is to prioritise the utility of a project rather than to solely focus on cost efficiency, as that may be more long termed. A suggestion for a seven step procedure, while searching for new solutions within an area of collaboration, can be found within Appendix B.1. A suggestion on how to break down objectives is to formulate lists of requirements of a solution or event, and update and iterate those requirements continuously while getting more and more customer insight.

## 11.2 An Internet of Commercial Buildings Solution

A potential customer for an internet of commercial buildings solution is an office tenant, which is expected to give its workers, occupants and internal facility managers, access to the system. Our recommendations for a first solution directed towards the office tenant are: possibility to report none default settings with equipment and things, to visualise utilisation rates, to synchronise with the booking systems and to be able to book rooms in real time. An ideal case would be a customer that is restructuring or reorganising the workplace and that is lacking a method to follow-up on utilisation rates.

In order for the internet of commercial buildings solution to be desired it should be cost-efficient and easy to use. We think that it needs to have an appealing design, a user friendly interface and additionally an element of gamification.

Sustainability visualisation creates value for the workplace manager since it could improve the ability to collect feedback and information in real time regarding utilisation rates and informational updates. The complexity lies within the employer of the workplace manager being either the tenant or the owner of the building having different incentives and willingness of pay.

Sustainability visualisation is very interesting from a tenant's point of view as we have noticed a willingness to improve employer branding. We suggest conducting a research of a way to realise sustainability visualisation directed towards the objective of creating an increase of employer branding. In addition, gamification may be an interesting starting point for sustainability visualisation as well.

Finally, identified opportunities within the area commercial real estate imply that future work streams may be to find business cases directed to all kinds of facility stakeholders. That indicates an interest in energy efficiency as well as workforce efficiency, depending on the customer. We think that the solution designed for comprehensive energy management should be further studied in another country where the energy prices are currently higher, compared to Sweden, thus investments in energy management is plausible to give higher returns of investment.



## Final words

### 12.1 Push and Pull Drivers for Energy Revolution

The drivers for energy companies to innovate and create new energy solutions seem to be both pushing and pulling drivers. For the case within this thesis work the pushing forces were described as the background to the thesis work: the political decisions and the value driven legislations. In addition, the pulling factors were identified as digitalisation and Industry 4.0.

However, the pulling opportunities with cross-industry collaboration and new innovation platforms that were planned for the Brunnshög city area, in relation to its highly ambitious sustainability goals, were explored within the thesis. During the thesis work Sweden agreed upon zero emissions until 2045 and thus adding an additional pushing factor that we have not seen the consequences of yet.

The push and the pull effects seem to have an impact on the energy companies striving against new fields of conducting business. It is hard to foresee the general consequences, or the final direction of today's energy companies, but the thesis work is proof of the current movement within the energy sector.

Increased value based customer demand strengthens the market pull for sustainable solutions. We believe that this matter is an interesting area for further research, as the possibility to fit these value based customer demands imply a possibility for companies to contribute to a sustainable future and a better world.



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## Appendix A

# Figures



**Figure A.1:** Map of Lund and the location of ESS and MAX IV Laboratory in relation to the Brunshög city area, named Centrala Brunshög (Dalman & Rundgren, 2012).

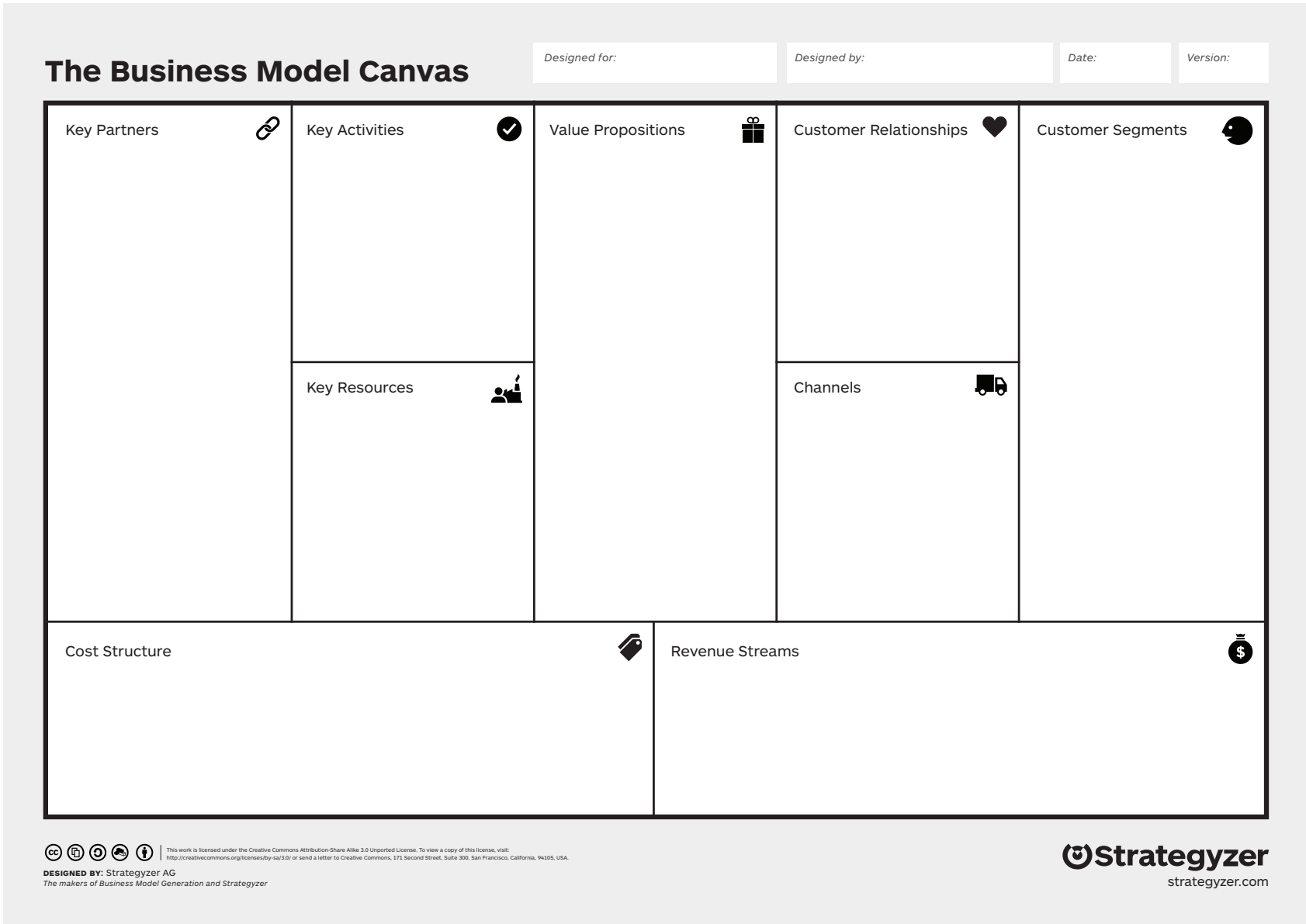


Figure A.2: Business Model Canvas (Osterwalder et al., 2010).

## Tables

**Table B.1:** *Steps for an Idea generation procedure within an area of collaboration*

<b>1 Formulate the overall objectives</b>
Ideation and research by approaching a general crowd. It could be done by a Barista test or by interacting on-site with potential customers. Assess opportunities and project risks. Revise and break down the objectives.
<b>2 Ideate Develop and analyse the ideas with the most enthusiastic people</b>
Find the enthusiasts and let them help. Interact with them and co-ideate. Assess opportunities and project risks. Revise and break down the objectives.
<b>3 Confirm the ideas with a general crowd</b>
Include the sceptic people and quantify the opinions from a more general point of view. Search for a lever effect. Assess opportunities and project risks. Revise and break down the objectives.
<b>4 Design the solutions and build requirements upon insights</b>
Use technical insights to fulfil requirements. Assess opportunities and project risks. Revise and break down the objectives.
<b>5 Implement the solution and make sure it is functional</b>
Include an appealing interface and ensure the accessibility. Assess opportunities and project risks. Revise and break down the objectives.
<b>6 Collect feedback and procedure with internal marketing</b>
Spread the word and interact with the people on-site. Assess opportunities and project risks. Revise and break down the objectives.
<b>7 Show-off to external parts</b>
Use the collected feedback as examples for communicating customer value. Assess opportunities and project risks. Revise and break down the objectives.



## Attachments Phase I

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*This appendix contains the details from phase I of the action research. It contains the interview questions to the managers of the PSG and the communicators. It contains the answers on the aims of the cross-industry collaboration, the focus area commercial buildings and the pilot project. Answers to the interview questions concerning potential project risks, as well as differing answers regarding project risks, are presented in tables.*

---

## **Interview questions collaboration agreement actors – *Managers***

- 1. What is the aim of (use a maximum of 3 sentences for each):**
  - the pilot
  - the ioCB project
  - the joint venture
- 2. How would you define a project risk within:**
  - the pilot
  - the loCB
  - the joint venture
- 3. What is the greatest risk of:**
  - the pilot
  - the loCB project
  - the joint venture
- 4. Can you add a minimum of three additional risks with:**
  - the pilot
  - the loCB project
  - the joint venture
- 5. Has any precautions or prevention measures been taken for the risks listed above? (How and what?)**
- 6. Do you consider it possible to overlook prevention measures for any of the risks listed above? (Why?)**
- 7. If the pilot was on a bigger scale with more resources at hand, would you then have answered differently on the questions presented above? (How and why?)**

## **Interview questions collaboration agreement actors – Communicators**

*The thesis will define project risk as obstacles towards achieving the objectives with the project. Please answer the questions with your own thoughts.*

*Thank you for taking your time and helping us with our master's thesis work,*

*Annah & Andrea*

---

- 1. What are your main tasks as a communicator?**
- 2. How would you define the aim of the collaboration between ABB, E.ON and Ericsson?**
- 3. What is your role as a communicator within the collaboration?**
- 4. How would you define the aim of the loCB part of the collaboration between ABB, E.ON and Ericsson?**
- 5. What is your role as a communicator within the loCB part of the collaboration?**
- 6. From a communication perspective, what risks do you identify related to:**
  - the pilot
  - the loCB part
  - the joint venture
- 7. From a common perspective, what risks do you identify related to:**
  - the pilot
  - the loCB part
  - the joint venture
- 8. Do you consider it possible not to take prevention measures for any of the risks listed above? (Why?)**
- 9. If the pilot were on a bigger scale with more resources at hand, would you then have answered differently to the questions presented above? (How and why?)**

**Table C.1:** *The aims of the cross-industry collaboration agreement, the focus area internet of commercial buildings and the pilot project, according to the managers of the PSG and the communicators.*

	<b>Managers</b>	<b>Communicators</b>
<b>Cross-industry collaboration agreement</b>	To be stronger together as companies within an alliance and stimulate smart energy solutions. To create a platform where existing products can be used in new ways by bringing together three large companies with different portfolios and competence but with ambitions within the area of future energy solutions/system. To learn how the other companies are working and to share risk and reward as partners.	The collaboration is about finding smart energy solutions. We are collaborating to be recognised as a trustworthy and innovative team focusing on new solutions by bringing new benefits to the users. The purpose is to develop sustainable and competitive energy products for the innovative company Brunnshög Energi AB.
<b>Internet of commercial buildings</b>	We want to see how we can add value to the real estate market and to know what kind of solutions that can be created based on the perspective/with regards to “big data” and IoT. Find commercial solutions for low-voltage systems and develop solutions and offerings for different stakeholders/customers.	Find unique capabilities of the three companies. Define the areas and create the right position on the market. The only way to survive may be by joining forces. We need to find out how to maximise the positioning of the brands in the market place. Put together and attract the right audiences: potential partners, buyers and business ecosystem.
<b>Pilot project</b>	To test and verify the viability of the Internet of Commercial Buildings concept both in terms of business and technical aspects. Also, we want to test the collaboration management.	Understand uniqueness of the concept. Be able to spread strategic information about the pilot project.



**Table C.2:** *The potential, and not realised, project risks that were identified by the two focus groups managers of the PSG and the communicators, sorted under the categories defined by the thesis students.*

Category	Managers	Communicators
<b>Company goals &amp; Visions</b>	<ul style="list-style-type: none"> <li>• Different perspective on customer focus</li> <li>• Different perspective on innovation</li> <li>• Different perspective how to try new things</li> <li>• Different ambition</li> </ul>	<ul style="list-style-type: none"> <li>• Not the same idea of objectives, aim, result</li> <li>• No clear goals</li> <li>• No strong anchoring of the agreement within the companies</li> </ul>
<b>Company culture</b>	<ul style="list-style-type: none"> <li>• Different experience from scoping</li> <li>• Different time frames</li> <li>• Different cultures in general</li> </ul>	<ul style="list-style-type: none"> <li>• Different ways of how to deal with communication in each company</li> </ul>
<b>Management</b>	<ul style="list-style-type: none"> <li>• Unclear who manage which project</li> <li>• Aim or deliveries failure</li> <li>• Budget failure</li> <li>• No planning for unexpected events</li> <li>• Different expectations</li> <li>• Not taking care of learning</li> </ul>	<ul style="list-style-type: none"> <li>• Not learning from each other</li> <li>• Lack of internal commitment</li> <li>• Lack of internal communication</li> </ul>
<b>Commercialisation</b>	<ul style="list-style-type: none"> <li>• Commercialisation not successful</li> <li>• We do not have an open mind</li> <li>• We do not listen to customers</li> <li>• We have the technology but there is no demand</li> <li>• Not enough business opportunities</li> </ul>	<ul style="list-style-type: none"> <li>• Solution/technology not working</li> <li>• No found price tag</li> <li>• Trying to launch something already existing / Copycat others</li> <li>• Hard to stay trustworthy</li> </ul>
<b>Market understanding</b>	<ul style="list-style-type: none"> <li>• Interest internally, not externally</li> <li>• Loss of business reputation within the business field</li> <li>• Bad will of customer/public</li> <li>• Neglect customer needs – inside-out perspective</li> <li>• Loss in credibility</li> <li>• Darlings are not killed even if necessary</li> </ul>	<ul style="list-style-type: none"> <li>• Too proud to admit that technology innovation has no real benefits to the users</li> </ul>

**Table C.3:** *Differing answers concerning potential project risks stated by the two focus groups: managers of the PSG and the communicators. The project risks did not fit any of the categories in Table C.2.*

<b>Managers</b>	<b>Communicators</b>
<ul style="list-style-type: none"> <li>• Higher divisions are not content with the collaboration</li> <li>• No will to continue to the next phase from one company</li> <li>• None of the companies are willing to continue</li> <li>• Ending of the relationship due to slow processes or lack of resources</li> <li>• Expectations are not fulfilled</li> <li>• Expectations are not met if not to proceed with other pilot projects</li> <li>• People experience threat to personal integrity by IoCB technology</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of integration of communication within the projects</li> <li>• Complicated external communication</li> <li>• Internal rumours</li> <li>• Inaccurate information internally</li> <li>• Communication plan not used continuously</li> <li>• The potential of using communications to achieve the goals are not fulfilled</li> </ul>

# Attachments Phase II

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*This appendix contains the technical system of the pilot installation together with a brief description on how the statistics from the application usage was collected along with the script that made it possible. The appendix also contains the relevant results from the Barista test survey together with retrieved statistics regarding application usage.*

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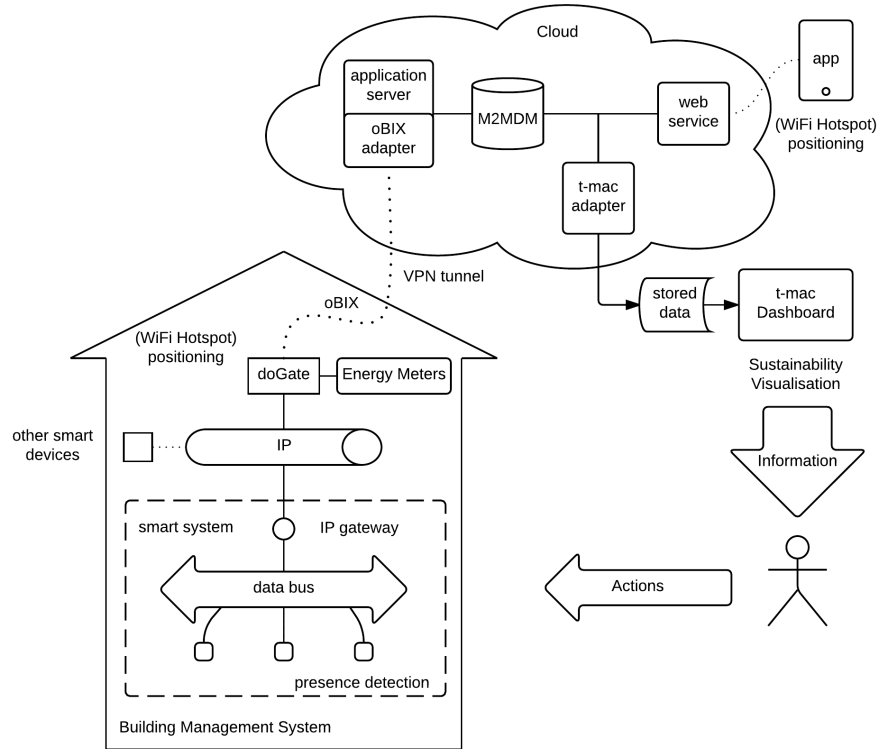
## D.1 Technical System of IOCB Pilot Installation

For the technical system, ABB has provided a hardware device called a doGate that can understand different kinds of standard protocols (see Figure D.1. That is useful within a commercial building since different communication systems within a building may use different protocols, such systems may be the printers, the elevators or the sensors. If the solution is installed in an old facility the facility may already have a BMS (Building Management System) and then the doGate is a product that helps to extract the data.

The communication, or “the Cloud” solution, is provided by Ericsson and contains an open building exchange information (oBIX) adapter, an M2MDM database, and a web service. The oBIX adapter can exchange the information via a virtual private network tunnel (VPN-tunnel) and transfer the information from the building to the Cloud. The database stores the data and can pass it on to either the web server or the t-mac adapter.

The t-mac system is provided by E.ON. The t-mac adaptor is a small Java program that is executed each 5<sup>th</sup> minute collecting data from the Ericsson server. t-mac reads the file and generates charts from it, which are used in the E.ON Energidirigent Fastighet.

The occupants can install the smartphone application, the IoCB Pilot application, on their personal smartphones. The smartphone is communicating with the web service and all the data is stored within the Ericsson database.



**Figure D.1:** Sketch of the technical system installed at the pilot facility in Ericsson, Lund.

### D.1.1 E.ON Energidirigent Pilot Dashboard

The E.ON Energidirigent Fastighet energy web-based dashboard is an advanced tool for graphical visualisation of energy data. It can provide an overview and analyse the energy flows within a building. However, the tool can not change any flows or meters within any building. It is purely a read-only dashboard, alternatively a visualisation tool, with flexible presentation enabling a wide range of analytics.

In the IoCB pilot visualisation is limited to presence, indoor temperature with set-points, outdoor temperature and heat/electricity/cooling energy usage. The basic visualisation in graphs and status diagrams is complemented by heat maps and presence maps, which is a floor plan overview enabled by the granularity of sensors.

### D.1.2 The Smartphone Application IoCB Pilot

The smartphone application is developed by E.ON Sverige AB. It is a mobile Android application named IoCB pilot and it has currently two functions: *See available rooms* and *Give feedback on indoor climate*. The source code is documented and follows the Google Java Style. The Application follows the Brunnsjö graphical profile.

### D.1.3 Collecting Statistics

When the occupant selects one of the three alternative; too hot, perfect or too cold, in the IoCB Pilot application that best corresponds to the perceived climate, it is stored in a database with the room id and the current date and time. The stored feedback data was at the end of the thesis work exported to a json-formatted file, then converted by a Python script (see Listing D.1) and analysed in Microsoft Excel.

For finding out more about the number of downloads, data was asked for from the PSG. The PSG had to ask for this from the smartphone application supplier. There was a possibility to get the download statistics during 11<sup>th</sup> of February and the 7<sup>th</sup> of March. However, if this had been thought of at the start of the pilot project, there would have been more data to analyse.

For a future study it is suggested that a web server that saves the access logs is used. The access log is a file that logs every access to the web server together with the visitors IP address and the current date and time. Thereby the access log makes it possible to make statistical analyses that at a initial state was not thought of, such as the amount of downloads of a specific file.

**Listing D.1:** *Script for converting data from JSON format to Excel format*

```
import json
from datetime import datetime

feedback_file = open('/Users/annah/Downloads/feedback.txt',
                    'r')
output = open('/Users/annah/Documents/test.csv', 'w')
data = json.loads(feedback_file.read())

for room in data:
    for report in room['opinionRSpec']:
        report_date = datetime.strptime(
            report['timestamp'],
            '%a_%b_%d_%H:%M:%S_%Z_%Y')
        output.write(room['gatewayId'][8:])
        output.write(',')
        output.write(room['type'])
        output.write(',')
        output.write(report_date.strftime(
            '%Y%m%d,%Y-%m-%d_%H:%M:%S'))
        output.write(',')
        output.write(str(report['value']))
        output.write('\n')

output.close()
```



Please answer the following 13 questions. As a thank you, you will receive a nice cup of coffee.

1. Have you **downloaded** the loCB pilot app?

Yes	No

2. If **No**, why have you not downloaded the loCB Pilot app?

Do not have an Android phone	Did not know about the loCB Pilot app	Not interested	Other reasons (please state what)

Comment: \_\_\_\_\_

If **No**, please skip the rest of the questions and go directly to question 13.

3. If **Yes**, when did you download the loCB Pilot app?

Immediately at release in November	Sometime before Christmas	In January after Barista test info	Just recently	Do not remember

Comment: \_\_\_\_\_

4. How often do you **use any of the features** in the loCB Pilot app?

Every day	A couple of times/week	Every week	A couple of times/month	Every month	Have never used it (why?)

Comment: \_\_\_\_\_

5. How often do you use the feature **See available rooms**?

Every day	A couple of times/week	Every week	A couple of times/month	Every month	Have never used it (why?)

Comment: \_\_\_\_\_

6. According to you, what is the main **advantage** with the feature **See available rooms**?

\_\_\_\_\_

\_\_\_\_\_

7. According to you, how could the feature **See available rooms** be improved?

\_\_\_\_\_

\_\_\_\_\_



8. Do you consider the feature **See available rooms** a **useful** tool?

Yes	No (please state why)

9. How often do you use the feature **Give feedback on indoor climate**?

Every day	A couple of times/week	Every week	A couple of times/month	Every month	Have never used it (why?)

Comment: \_\_\_\_\_

10. According to you, what is the main **advantage** with this feature?

\_\_\_\_\_

\_\_\_\_\_

11. According to you, how could this feature be **improved**?

\_\_\_\_\_

\_\_\_\_\_

12. Do you consider the feature **Give feedback on indoor climate** a **useful** tool?

Yes	No (please state why)

13. According to you, are there any **additional** use cases you wish were **included** in the IoCB app?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

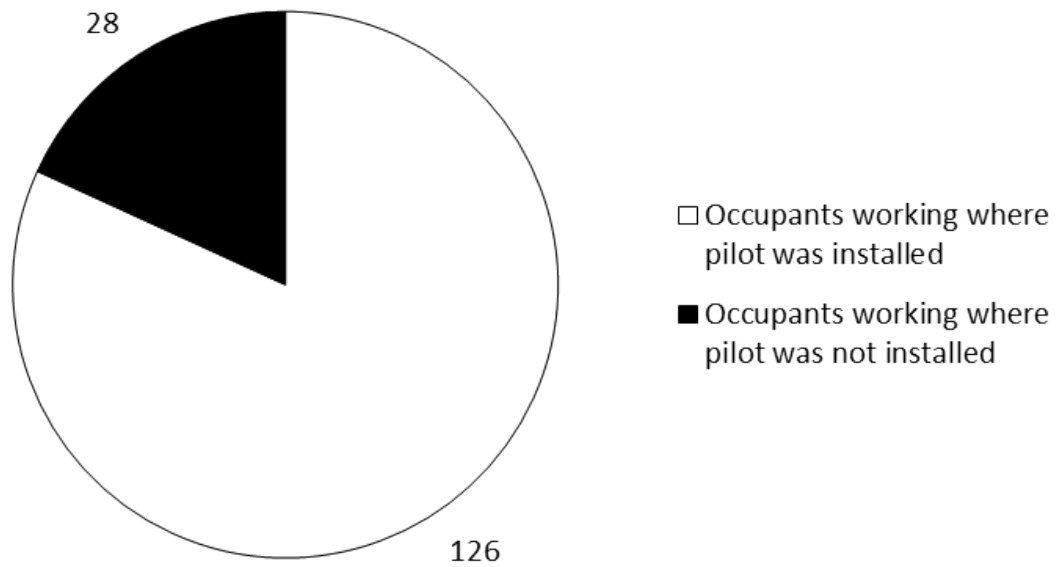
14. **Where** in the building do you **work**?

1 : 6	2 : 6	3 : 6	Other (please state where)

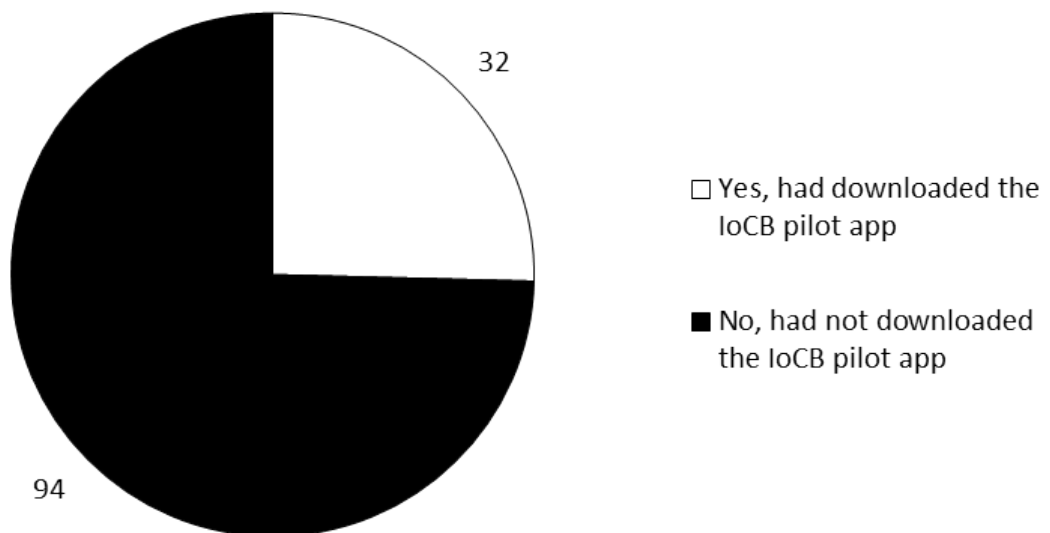
15. **Short interviews** (15 min) about your workplace and potential use of Internet of things solutions at work will be carried out in February. If you would like to participate, please **state your email**:

\_\_\_\_\_

**Thank you for your time and don't forget your coffee!**

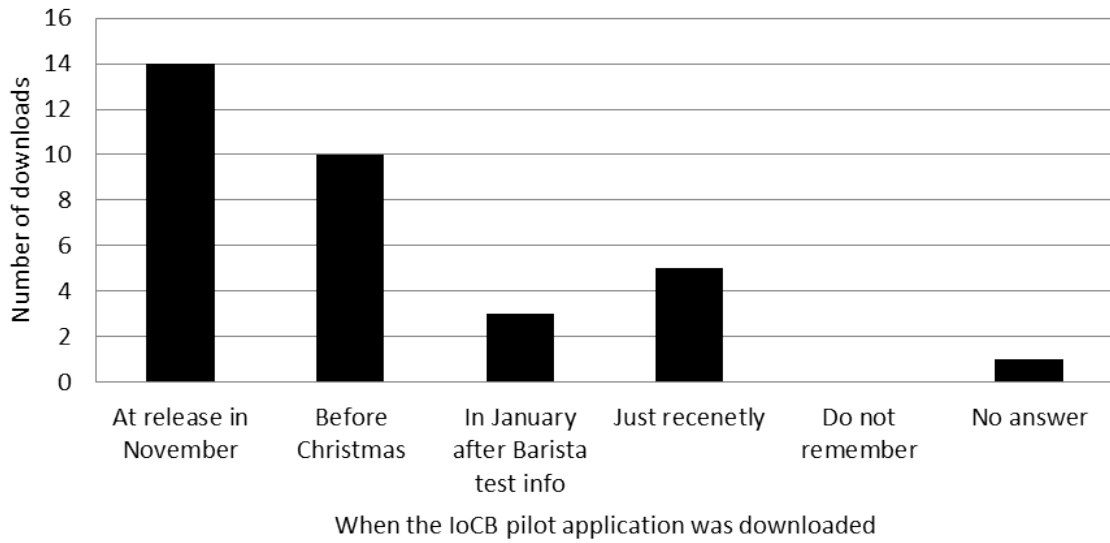


**Figure D.2:** Out of the 154 occupants that participated in the Barista test, 126 occupants worked in the area where the pilot had been installed.

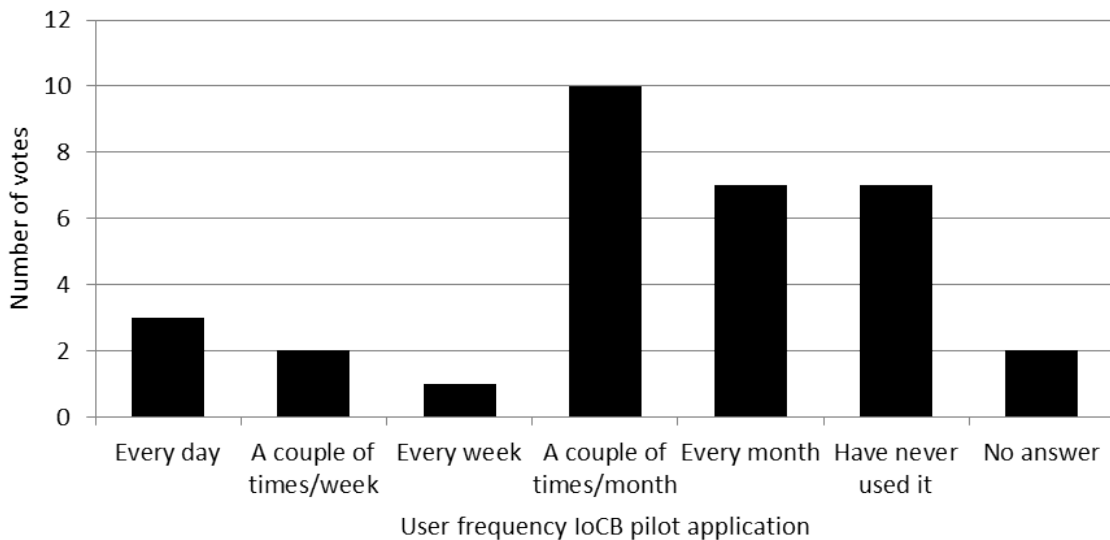


**Figure D.3:** Out of the 126 occupants that worked in the area where the pilot had been installed, 32 had downloaded the loCB Pilot Application

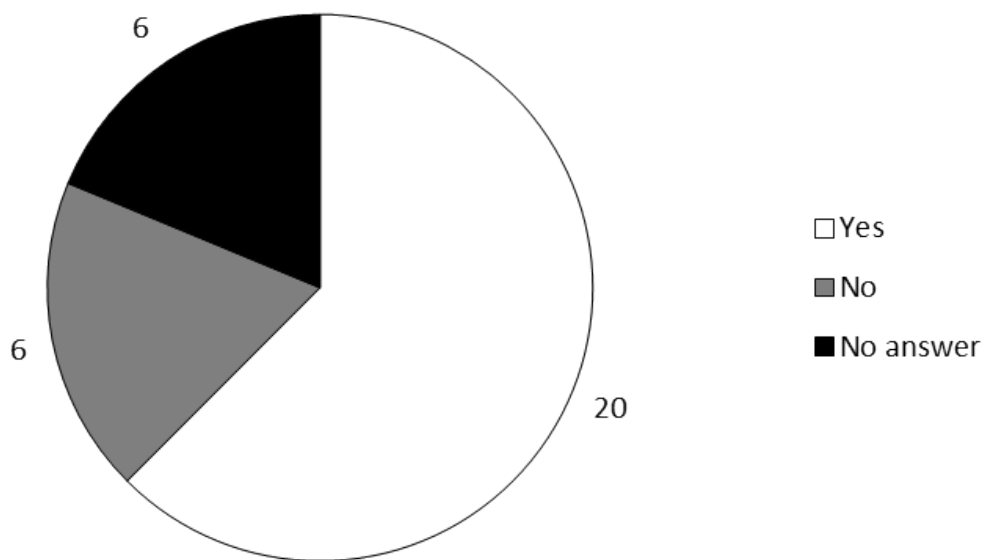




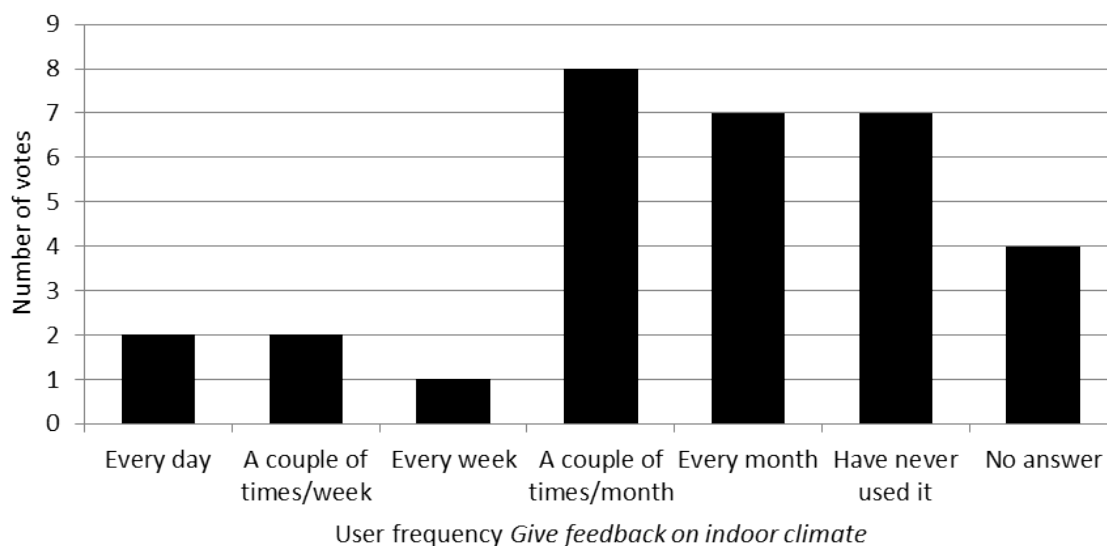
**Figure D.4:** *When the download of the loCB pilot application took place, according to the 32 occupants that had downloaded it. Most downloads took place at the release in November and just before Christmas.*



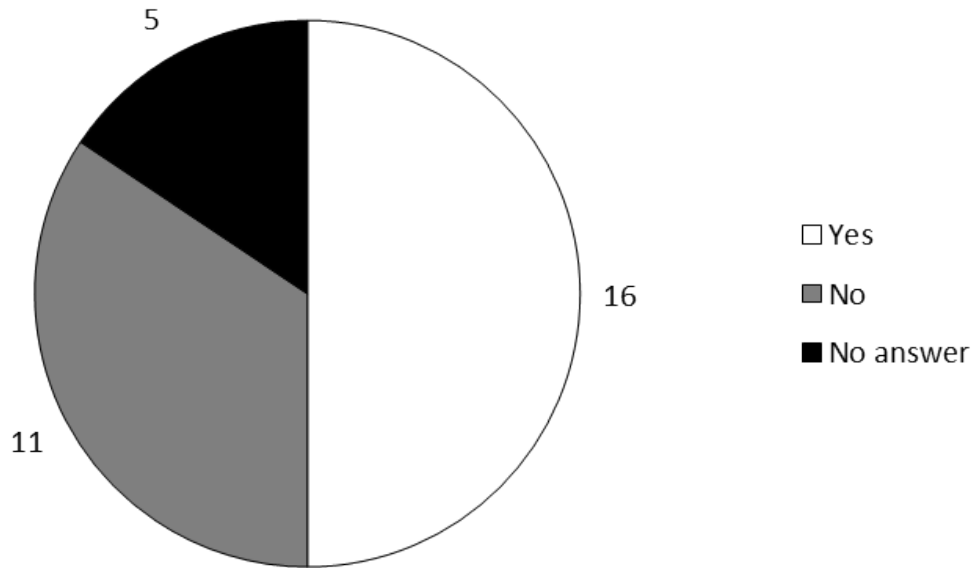
**Figure D.5:** *How often any of the features in the loCB pilot application was used, according to the 32 occupants that had downloaded the application. The answers indicates an interest in the application but it is seldom used.*



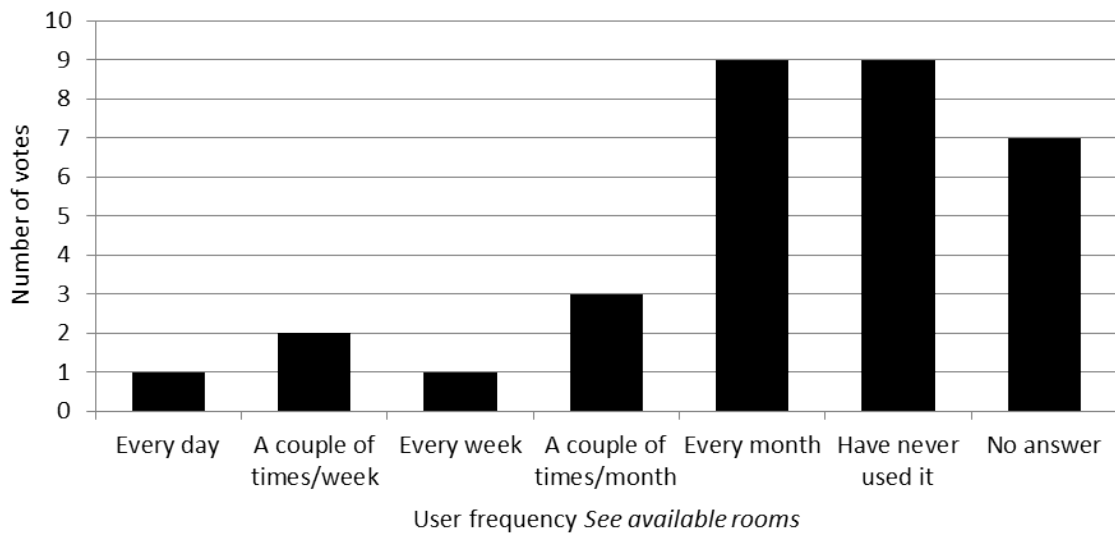
**Figure D.6:** Responses on the question if the feature Give feedback on indoor climate is a useful tool, according to the 32 occupants that had downloaded the application. According to the answers, the feature is useful.



**Figure D.7:** How often the feature Give feedback on indoor climate was used, according to the 32 occupants that had downloaded the application. The answers indicates an interest in the feature but it is seldom used.



**Figure D.8:** Responses on the question if the feature See available rooms is a useful tool, according to the 32 occupants that had downloaded the application. According to the answers, the feature is useful but perhaps not in the pilot facility set-up.



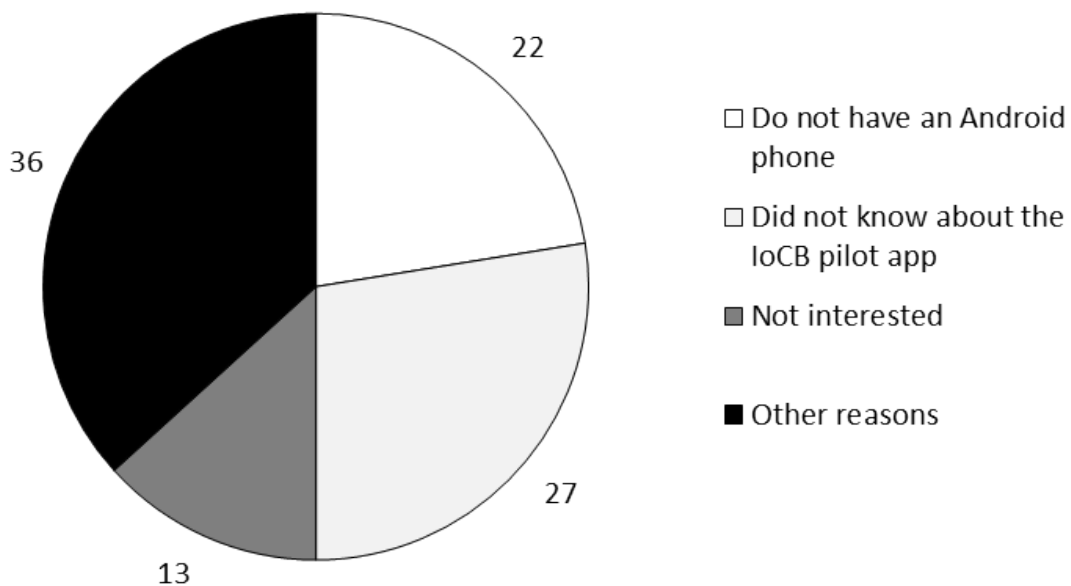
**Figure D.9:** How often the feature See available rooms was used, according to the 32 occupants that had downloaded the application. The answers indicates an interest in the feature but it is seldom used.

**Table D.1:** *Suggested new information category use cases, listed by the occupants in the Barista test, given that the information is able to extract.*

<b>Information categories</b>	
1	Find available conference rooms
2	Know for how long a room is booked
3	Be able to book a room in real time
4	Find available none-bookable mini-meeting rooms
5	Queue status to the coffee machine and the lunch restaurant
6	Information on function status of printer, projector or coffee machine
7	Gym availability
8	Toilet availability
9	Specific printer availability
10	Know if I am wasting energy on unnecessary things
11	Know if I am over-consuming the disposables (paper, coffee cups etc.)
12	Lunch menu
13	Information of noise levels over time
14	Information of indoor climate over time
15	Visualisation of the workspace temperature (heat maps)
16	Availability of pause areas close to coffee machines
17	Climate related data over time (temperature, humidity, air quality)
18	General opinion on indoor climate over time
19	Queue status to printers
20	Information on broken equipment (printers, projectors, coffee machines)
21	Availability of free spaces in general
22	Locate people in the building

**Table D.2:** Feedback categories for suggested new use cases, given that the collected feedback is used for improvement or display, listed by the occupants in the Barista test.

Feedback categories	
1	Rate the lunch menu after each day
2	Give feedback on indoor temperature
3	Give feedback on the cleaning of the workplace
4	Possibility to report outage within the workplace (projector, coffee machine etc.)
5	Give feedback on the sun flow from the window/blinding
6	Give feedback on the lighting (indoor)
7	Give feedback on the noise level
8	Give feedback on the humidity
9	Give feedback on the airflows
10	Continuously rate the overall comfort of the workplace
11	Report on broken things
12	Give feedback on draught
13	When missing something in the workplace (e.g. plug for computer)
14	Give feedback on general opinion of the workplace (comfort where sit/stand)



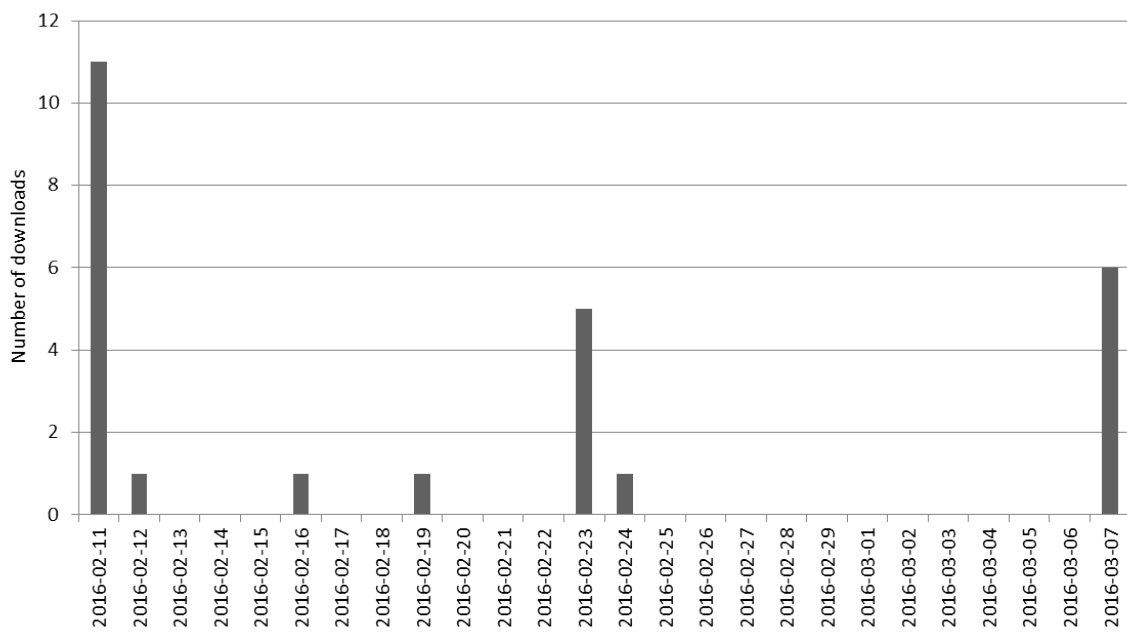
**Figure D.10:** Main reason why not downloading the loCB pilot application, according to the 94 occupants that had not downloaded the application.

**Table D.3:** *The data retrieved from using the loCB pilot application feature Give feedback on indoor climate, from October 2015 until February 2016.*

	October	November	December	January	February	Total (Oct-Feb)
<b>Mini meet</b>						
Too warm	1	9	4	3	13	30
Perfect	3	20	1	2	5	31
Too cold	7	23	9	6	4	49
<i>Total votes</i>	11	52	14	11	22	110
<b>Open area</b>						
Too warm	-	21	7	2	20	50
Perfect	2	4	1	-	-	7
Too cold	9	20	12	4	10	55
<i>Total votes</i>	11	45	20	6	30	112
<b>Conference room</b>						
Too warm	-	1	5	1	5	12
Perfect	-	1	-	-	-	1
Too cold	1	2	5	1	-	9
<i>Total votes</i>	1	4	10	2	5	22
<b>Printer area</b>						
Too warm	-	2	1	-	-	3
Perfect	-	-	-	-	-	-
Too cold	-	1	-	-	-	1
<i>Total votes</i>	-	3	1	-	-	4
<b>Unspecified</b>						
Too warm	-	3	4	4	1	12
Perfect	-	-	-	2	1	3
Too cold	-	1	3	10	1	15
<i>Total votes</i>	-	4	7	16	3	30

**Table D.4:** Average opinion on meeting rooms from October 2015 until February 2016, room id and number of votes. For the opinion, 0 equals “Too hot”, 1 equals “Just perfect” and 2 equals “Too cold”. From compiling the data, an average number between 0.95 and 1.05 is considered as “Just Perfect”, under 0.95 is considered “Too warm” and above 1.05 is considered “Too cold”.

Room type	Room ID	Average	Count	General opinion
Mini meet	1611	2	1	Too cold
Mini meet	1612	2	1	Too cold
Mini meet	1621	1	1	Just perfect
Mini meet	1630	2	1	Too cold
Mini meet	1671	1	35	Just perfect
Mini meet	2607	1.6	7	Too cold
Mini meet	2629	2	1	Too cold
Mini meet	2648	2	1	Too cold
Mini meet	3607	1.3	28	Too cold
Mini meet	3619	1.3	3	Too cold
Mini meet	3648	2	1	Too cold
Mini meet	1621A	2	1	Too cold
Mini meet	1633A	1	1	Just perfect
Mini meet	1647A	2	1	Too cold
Mini meet	2631A	0.9	7	Too warm
Mini meet	2688B	2	1	Too cold
Mini meet	3619A	-	2	Too warm
Mini meet	3632A	0.9	10	Too warm
Mini meet	3637A	2	3	Too cold
Mini meet	3647A	0.5	2	Too warm
Mini meet	3648A	1.5	2	Too cold



**Figure D.11:** Number of downloads of the loCB pilot application during the time period 11<sup>th</sup> of February 2016 to 7<sup>th</sup> of March 2016. The downloads increased when the students performed the Barista test and when information regarding the pilot project was sent out by the PSG.



## Attachments Phase III

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*This appendix contains the occupant interview questions, the occupant survey and detailed descriptions of the facility manager workshop: customer profile creation and roller coaster session. Additionally, the appendix contains the relevant results from the occupant interviews, occupant survey and the facility manager workshop.*

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## **Occupant Interview question**

1. Gender and age?
2. Where in the building do you work?
3. How many years did you work here?
4. Main task?
5. Did you know about the app IoCB and did you install it?
6. Do you think it is interesting to see what rooms are available? Why/why not?
7. Is there any other information you would like to have in the app?
8. Do you think it is interesting to give feedback on indoor climate?
9. Is there anything else you would like to give feedback on?
10. How do you think the Project steering group should do to involve the occupants here in a pilot?
11. Are people here interested in sustainability visualisation?
12. Do you think that your employer should pay for an app with any of the features that we talked about?
13. Is there anything else you have been thinking of?

**Please help Your thesis students at The Ericsson building in Lund.  
Last call for input - a 5 min survey**

Dear employee within the Ericsson building,

We are Andrea and Annah, the master's thesis students from Lund University, realizing our final survey regarding the concept: Internet of Commercial Buildings. Please help us out by filling out the form! Please answer all the questions. Thank you so much for your time!

\*Obligatorisk

**A. Gender \***

- Male
- Female
- Other

**B. Age \***

- <25
- 25-35
- 35-45
- 45-55
- 55+

**C. For how long have you worked at the Ericsson facility in Lund? \***

- <1 year
- 1-3 years
- 3-10 years
- >10 years

**D. Where in the building do you work? \***

- 1:6
- 2:6
- 3:6
- Other

**E. What is your main task? \***

- Developer
- Tester
- Simulations
- Administrations
- Other: \_\_\_\_\_

**F. Imagine an average workday, how much of your time do you spend on...**  
(try to estimate and answer in percent of your workday)

	Never using	20 %	40 %	60 %	80 %	100 %
Your own work desk						
A mini-meeting room						
A conference room						
Open spaces outside the wings						
Your smartphone						
Your computer						

**G. What is your preferred communication channel for any information regarding your workplace? \***

- Your smartphone
- Your e-mail
- An open widget
- Personal communication
- A physical note
- Other: \_\_\_\_\_

**H. What is your preferred communication channel regarding information and updates on a pilot installation where you work? \***

- Your smartphone
- Your e-mail
- An open widget
- Personal communication
- A physical note
- Other: \_\_\_\_\_

**I. Imagine that every information data about your workplace is available and used by your employer and the facility manager to improve it. How would you consider the following features?**

	Unnecessary	Nice to have	Wish to have	Essential
1. Find available spaces (and rooms) in real time				
2. Be able to book a room wherever I am				
3. Information if I am wasting energy or resources and how to improve				
4. Monitor indoor climate related data				
5. To see if any equipment is broken and current measure status (for example coffee machine, projector etc.)				
6. Are the toilets available (update in real time)				
7. Give feedback on indoor climate and see what other people think				
8. Give feedback on sun flow through windows and the current blinding				
9. Give feedback on the current noise level and see what other people think				
10. My general opinion on the comfort in my workplace including possibility to give a comment				
11. Possibility to report broken things immediately				

**J. Imagine that every information data about your workplace is available and used by your employer and the facility manager to improve it. How much would you be willing to pay per month for an app that gave you all the features stated above? (Please give your answer in SEK/MONTH) \***

\_\_\_\_\_

**K. Imagine the following scenario: An initial pilot for an emerging technology is installed at your workplace. What would be enough as a reward for you to participate in the pilot? (Check all the alternatives that apply) \***

- A cup of coffee
- A personal thank you from the team behind the pilot
- My boss' recognition
- A snack
- A ticket to the movies
- Other: \_\_\_\_\_

**L. Anything else?**

\_\_\_\_\_

## E.1 Facility Manager Workshop

In order to generate ideas and clarify what the stakeholder *Facility manager* within a commercial real estate needs, wishes and demands of an IoCB solution, the idea generation workshop was conducted. The participants of the workshop were asked to act from a facility manager's perspective. The thesis students were acting as moderators of the workshop.

### E.1.1 Customer Profile Creation

Within the workshop, the participants were asked to list their different obstacles within the current work as facility manager. After that, the different ideas were put in relation to each other by the whole group. The same procedure was carried out for potential benefits when it comes to the work as facility manager.

**Step 1.** The participants generated their ideas on the pains or the gains that the facility manager may have. A pain is something negative, such as a problem or a risk that a facility manager may experience in their work. A gain is something positive, such as an opportunity that the facility manager may see, want to achieve or experience in the work. In order to generate pains and gains a brainstorm session took place using post-it notes and trigger questions. Focus was first regarding pains and then regarding gains.

**Step 2.** During an open discussion the pains and gains were clustered and put on a scale to rank the priorities from a facility manager's perspective. The scale for pain's was set from "Moderate" to "Severe". The scale for gains were set from "Nice to have" to "Essential".

**Step 3.** The comments and discussions were documented as well as the priorities for the facility manager. A relative scale was implemented where -5 was regarded as a "severe" pain and -1 was a "moderate" pain; while 1 was a "nice to have" gain and 5 was an essential gain.

### E.1.2 Roller Coaster Session

The session took part after the customer profile creation and involved four different visualisations from the Energidirigent pilot dashboard.

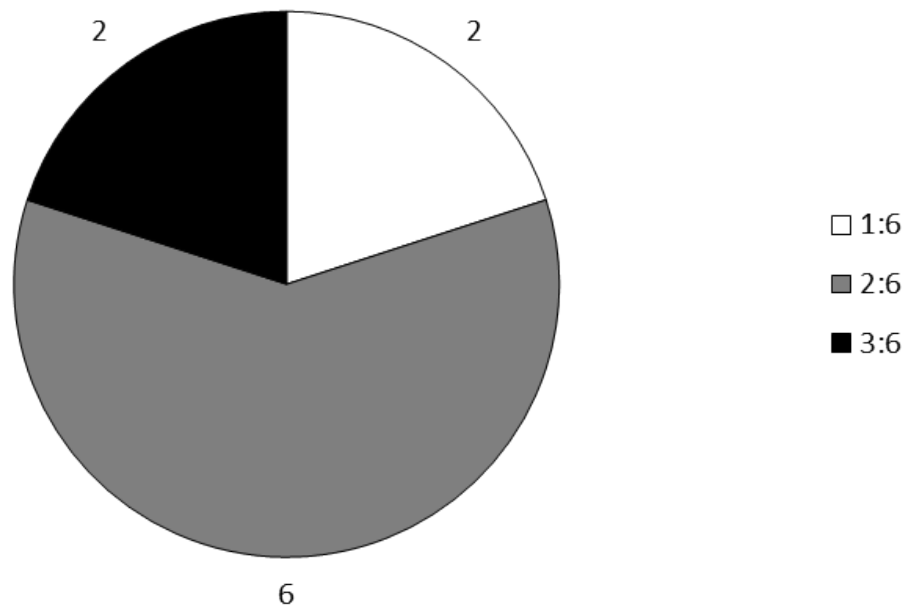
**Step 1.** Going downhill without any limitations. The participants were shown different diagrams and heat maps, one by one, and supposed to think what they could use them for.

**Step 2.** Going uphill within present limitations. The participants were shown the different diagrams and heat maps again, one by one. The moderator summarised what the participants said regarding the current picture. The participants were then supposed to assess if they are able to do what is suggested with the current setting, or if there is something missing in order to do so.

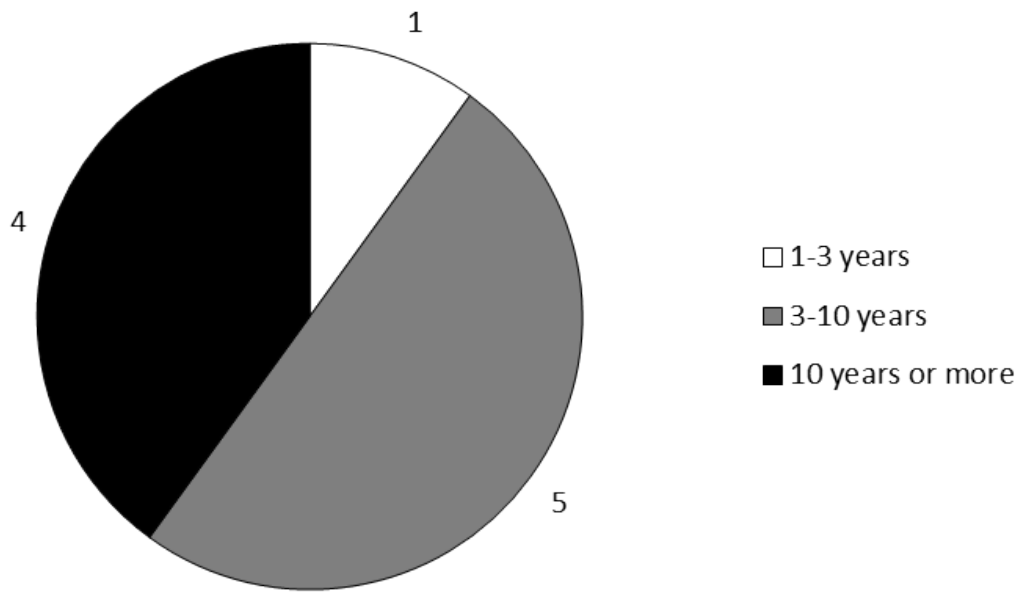
**Step 3.** Gather the opinions and compile the results. The workshop moderator collected the information and assessed it to draw conclusions to find further studies. The result was then sent out to the participants in case of them wanting to add anything.



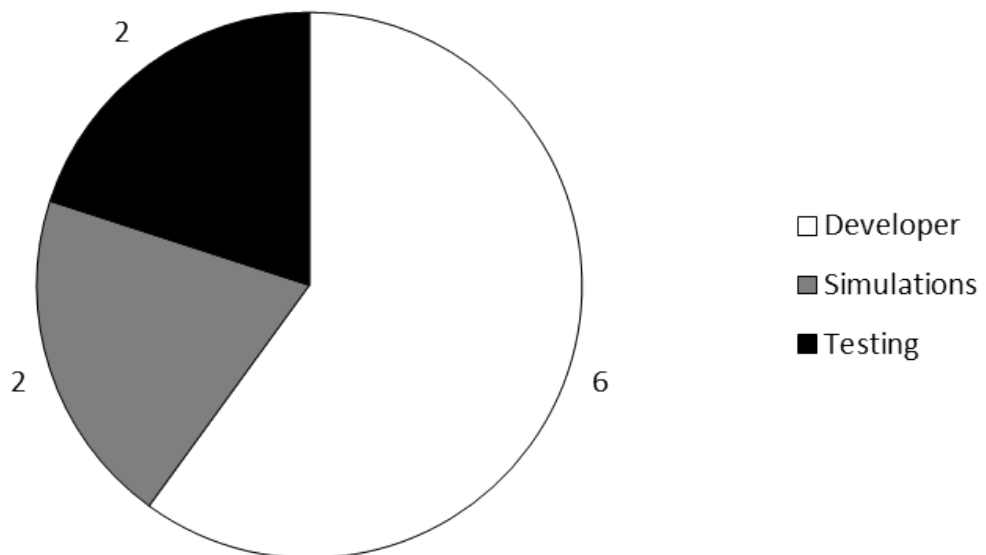
**Figure E.1:** Age of the 10 occupants that were interviewed by the thesis student. The average occupant is aged 35-45 years old. Note that all the occupants interviewed were male.



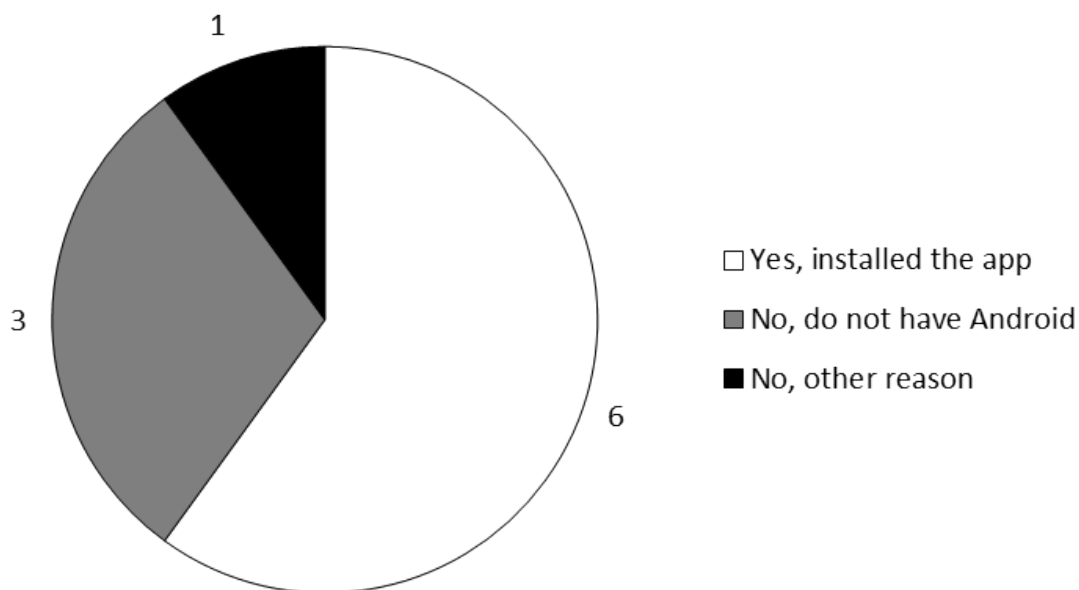
**Figure E.2:** On what floor (1:6, 2:6 or 3:6) in the facility the 10 occupants worked. 6 of 10 worked at workflow 2:6.



**Figure E.3:** For how long time the 10 occupants had worked at the Ericsson facility. The majority of the occupants had worked at the Ericsson facility between 3-10 years.



**Figure E.4:** The main task of the 10 occupants. 6 of 10 occupants worked as developers at Ericsson.



**Figure E.5:** *If the 10 occupants had downloaded the IoCB pilot application, had not downloaded the application due to not having an Android device, or had not downloaded the application due to other reasons. 6 of 10 had installed the application.*

**Table E.1:** *Crucial aspects and other suggestions on how the PSG can get the occupants to participate in a pilot project, according to the 10 occupants interviewed by the thesis student.*

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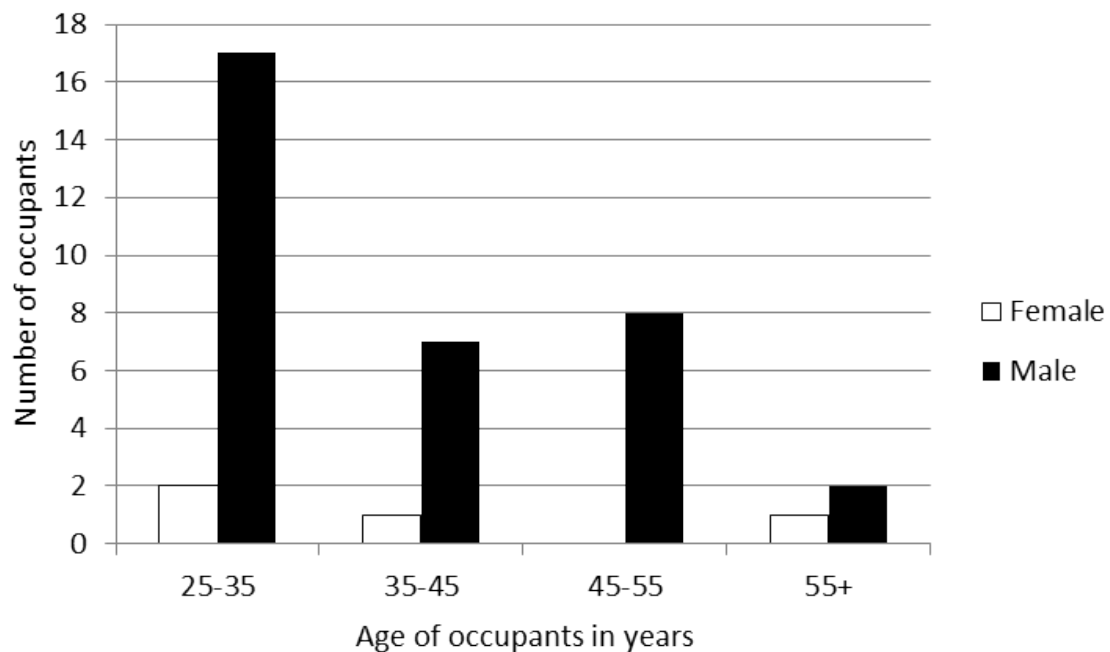
<b>Crucial aspects</b>	<ul style="list-style-type: none"> <li>• The boss/people with authority must think it is a good idea that they do it and tell them this during a workplace-meeting or similar.</li> <li>• E-mail is a good way to spread the information. But it must be clearer what the occupants are supposed to do since they already get so much info from other sources.</li> </ul>
<b>Other suggestions</b>	<ul style="list-style-type: none"> <li>• Demonstrations</li> <li>• Events with "music and fun"</li> <li>• A real usefulness, I need to feel that my opinion is important by getting feedback on that somehow</li> <li>• Rewards</li> <li>• Use the most eager people try it first and use their feedback for inspiring the rest</li> </ul>

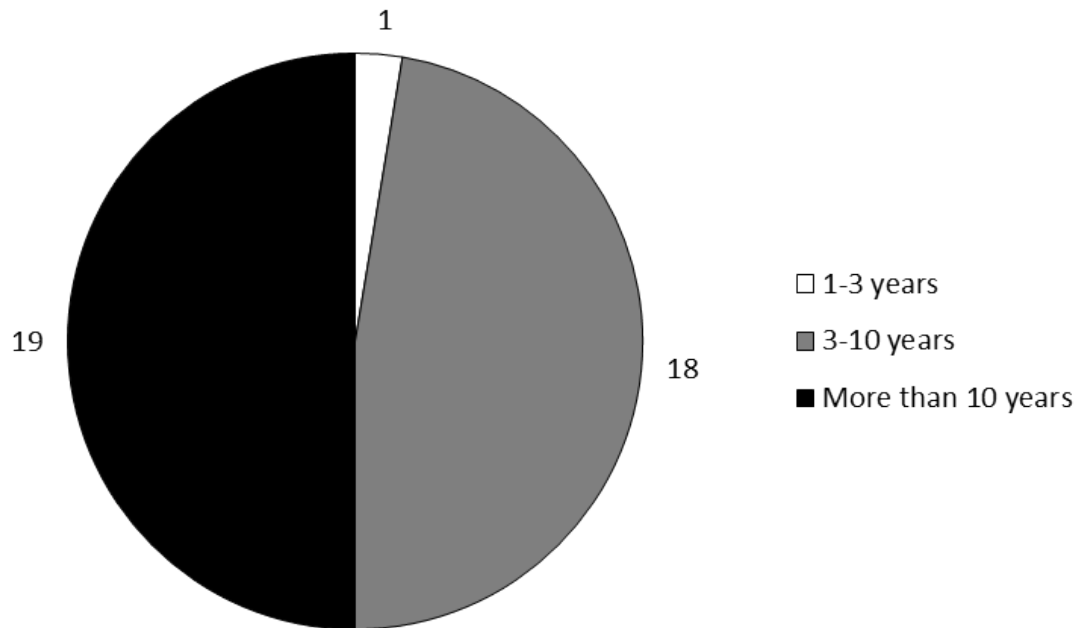
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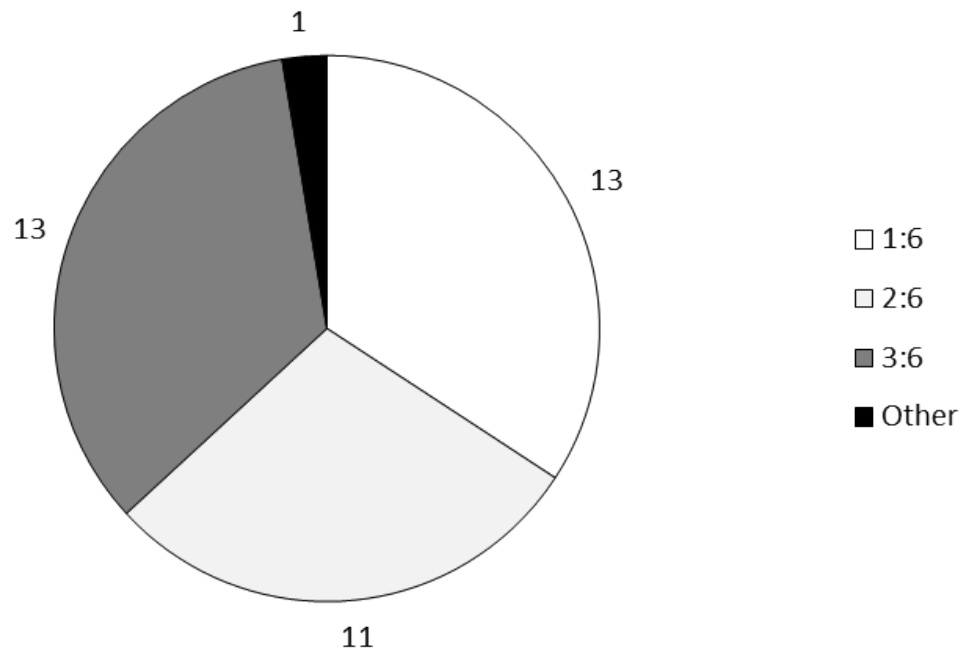
**Table E.2:** *Additional interesting findings from the occupant interviews.*

- The idea of having *everything* in one place is interesting. The idea of a connected building where everything is in the same system seems appealing. Since there are so many applications and systems today.
- Is the reason to why people complain about the fact they feel cold actually caused by too much draught? Could the system be used to find the actual problem?
- An occupant working on heat simulation commented on indoor climate being a quite complex things, so changing the temperature may not even have an effect on the actual climate if there is draught.
- Could we use the heat from the test labs to heat up some other place in the building? (New case: How do we move heat)
- Would it be beneficial if the rooms that were not used automatically turned off lights, screens and projector? (Presence)

**Figure E.6:** *Age and gender of the occupants that participated in the occupant survey. The majority of the participants were male aged 25-35 years old.*



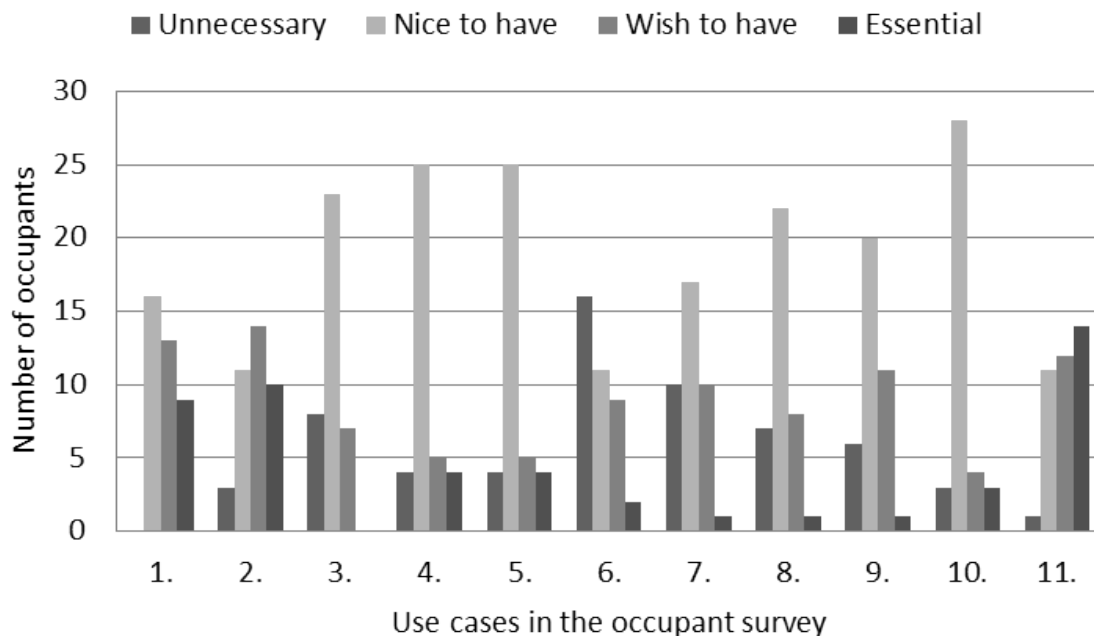
**Figure E.7:** For how long the occupants that participated in the occupant survey had worked at the Ericsson facility in Lund. The majority of the occupants had worked at the Ericsson facility for over 10 years.



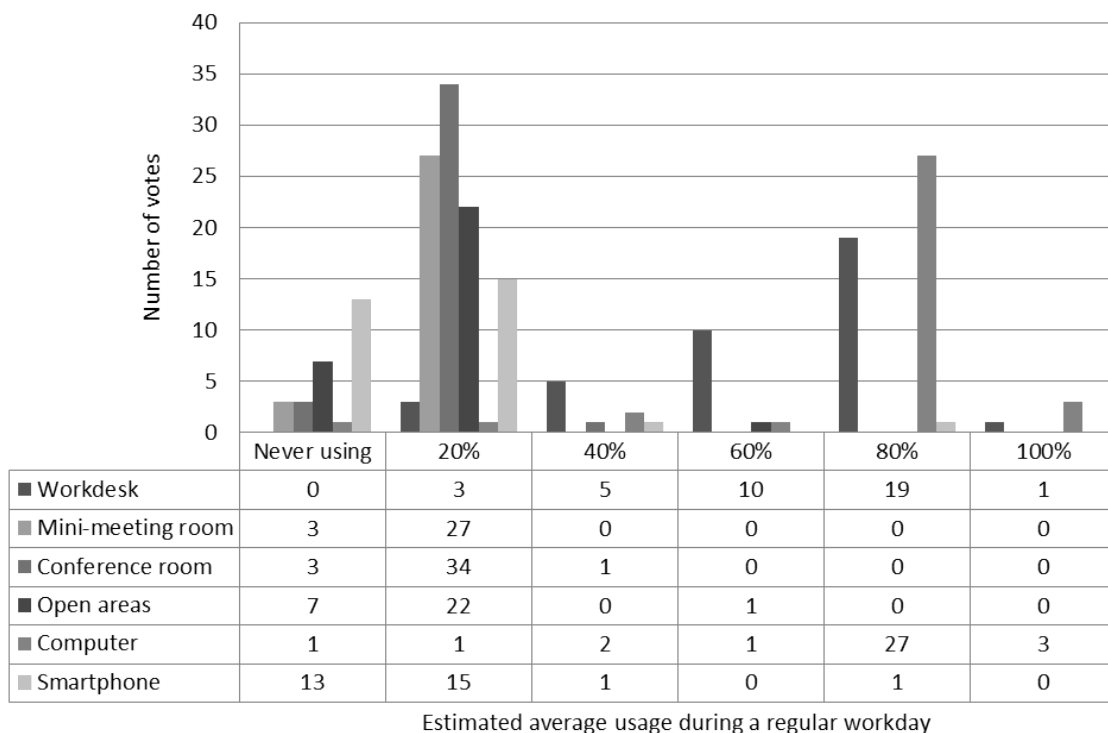
**Figure E.8:** Where in the facility the occupants that participated in the occupant survey worked, workfloor 1:6, 2:6 or 3:6. A third of the occupants worked on each workfloor.

**Table E.3:** *Eleven ideas for future use cases related to the loCB concept that the occupants could rank in order of perceived importance in the occupant survey.*

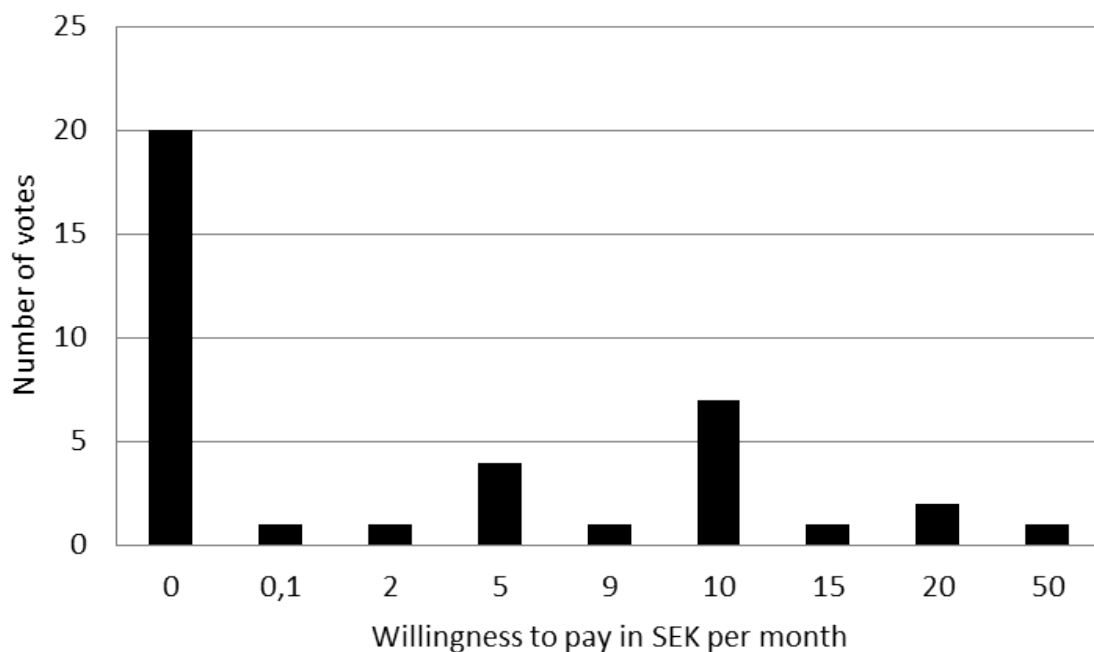
Use cases chosen for ranking	
1	Find available spaces (and rooms)
2	Be able to book a room wherever I am
3	Information if I am wasting energy or resources and how to improve
4	Monitor indoor climate related data
5	See if any equipment is broken and current measure status
6	Toilet availability (real time)
7	Give feedback on indoor climate
8	Give feedback on sun flow and blinding
9	Give feedback on noise levels and see overall opinion
10	Feedback on general comfort
11	Possibility to report on broken things



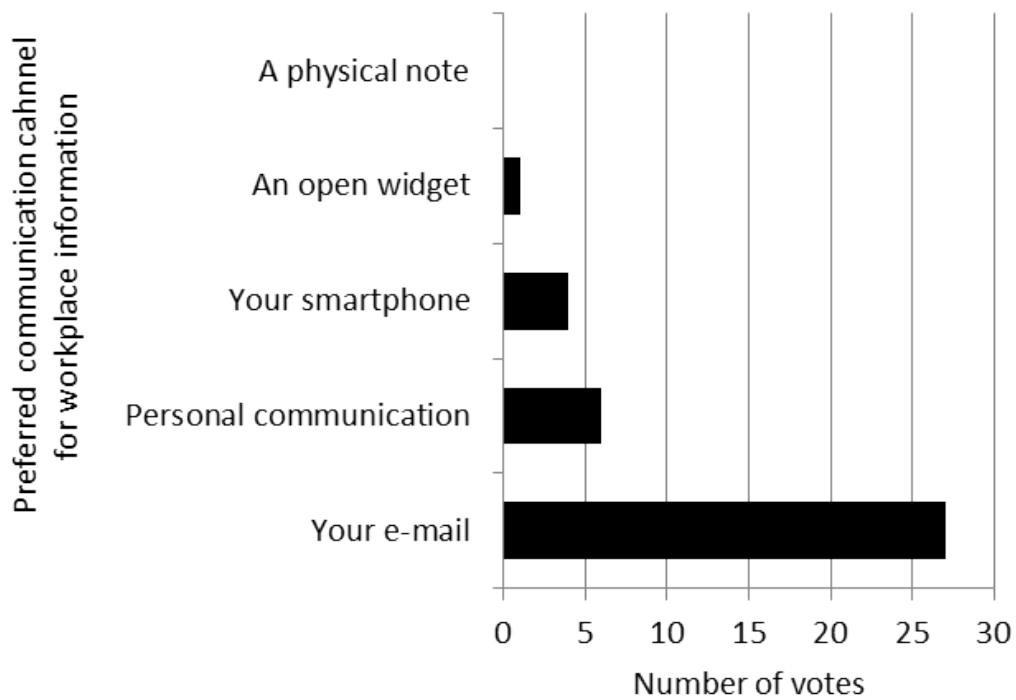
**Figure E.9:** *Stated importance of the use cases 1-11 (stated in Table E.3), resulting from number of votes on the ranking scale: unnecessary, nice to have, wish to have, essential.*



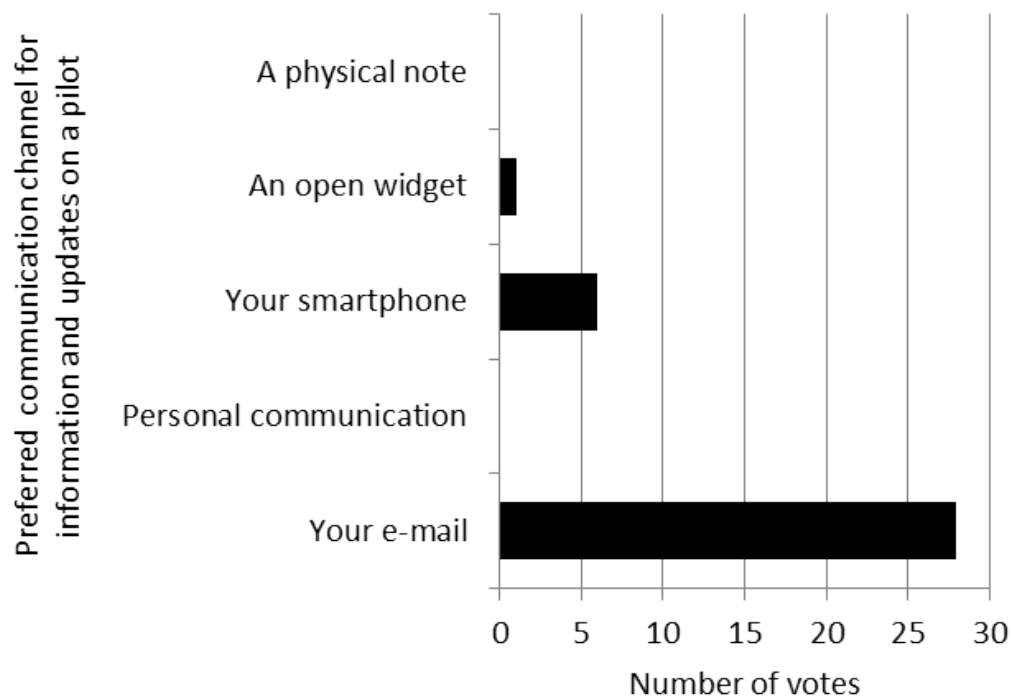
**Figure E.10:** Estimation of equipments used at the workplace during a regular workday, listed by the participants in the occupant survey. The result indicates that the workdesk and the computer is used most frequently during the workday



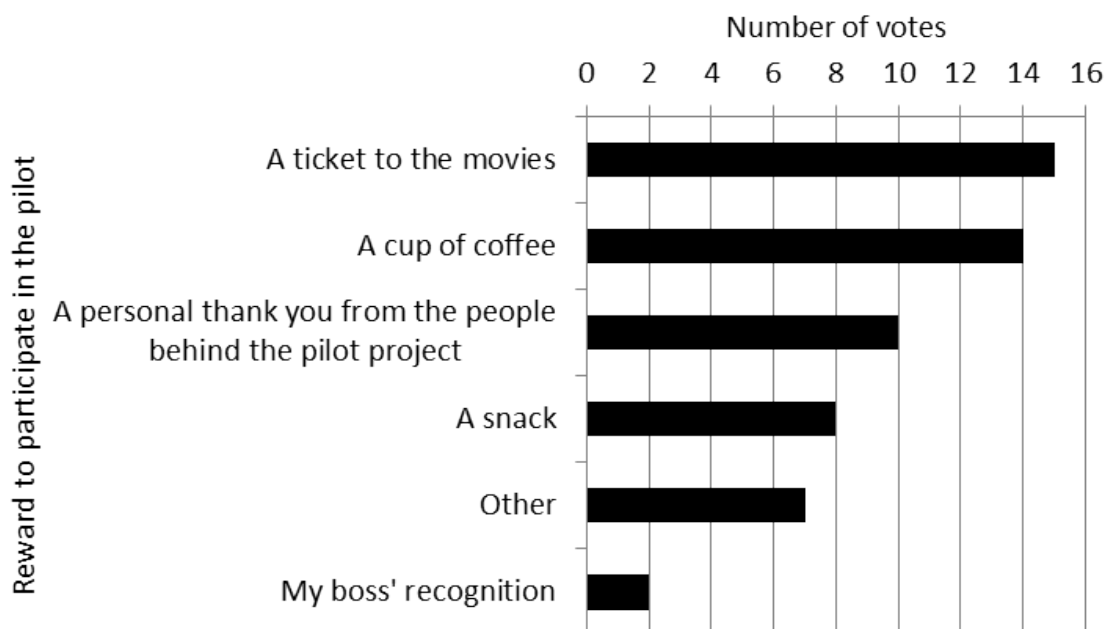
**Figure E.11:** How much the occupants that participated in the occupant survey would be willing to pay per month for an application that was based on the following: information data about the workplace is available and used by the employer and the facility manager to improve it. The result indicates that the willingness for this kind of solution is low by the occupants



**Figure E.12:** Preferred communication channel for any information regarding the workplace, according to the occupants that participated in the occupant survey. The result indicates that the occupants prefer that information is sent out via email.



**Figure E.13:** Preferred communication channel for information and updates on a pilot installation, according to the occupants that participated in the occupant survey. The result indicates that the occupants prefer that information regarding a pilot project is sent out via email.



**Figure E.14:** Sufficient reward to participate in the pilot project, according to the occupants that participated in the occupant survey. The result indicates that a movie ticket or a cup of coffee is a sufficient reward to participate in a pilot project.

**Table E.4:** *Pains of the facility manager and the relative perception of severity, where -5 is regarded as a "severe" pain and -1 as a "moderate" pain.*

Scale	Issue	Comment
-5	Climate related issues	The facility managers are siding with the fact that the occupants may want different temperatures, and that it is hard to regulate climate, blinding and light in an optimal way
-4	The facility owner	The facility managers are striding with the fact that the owner may prioritise low cost measures, rather than better service and long term investments
-4	Space usage	It is hard to know what spaces are used, what is missing and what is in excess when it comes to areas
-3	Trust in dimensions and flows	The occupants are not trusting the system and may stack things for their future need, since they do not seem to trust that the system can provide them with things when they need it
-3	Rooms	The occupants think that they do not have the rooms they need, but rather than lack of space the problem occurs because of problems with not cancelling room bookings and the logistics
-2	Proactive work	The status of different things is sometimes hard to access, and there is a frustration of not being able to work with preventing the equipment problems before they occur
-1	Guest workers	It is hard to know where, when and how guest are moving in the building. Security issue.

**Table E.5:** *Gains of the facility manager and the relative perception of severity, where 1 was regarded as a "nice to have" and 5 was regarded as an essential gain.*

Scale	Issue	Comment
5	Investments	Be able to find investments that improves the building and pays themselves over a short period of time
5	Entrepreneurs and contractors	To find skilled entrepreneurs, to know their needs and find the ideal information channels
4	Proactive work	Possibility to fix things before they occur
4	Information and automation/ "Smart building"	To know the status of the building and the usage of technical tools within the building
4	Utilisation count	The facts about actual usage of things and areas
4	Find energy savings	Save energy and reduce cost
3	Self-service	The occupants are able to fix things by themselves
3	Easy to access occupants	To know exactly who to talk to for getting information out to everyone
3	Proud of the office	That the manager and other stakeholders like the office and are proud of it. In addition, the status that may origin from environmental certifications.
2	Tenants within the building	Tenants are friendly, appreciating and cooperative
1	Environmental savings	That the building system is sustainable environmentally



# Attachments Phase IV

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*This appendix contains: the detailed description of the PSG workshop, customer profiles of the stakeholders within the pilot facility: owner, occupant and tenant, the value proposition design of the thesis students for a future IoCB solution and the four BMCs generated at the PSG workshop.*

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## F.1 PSG Workshop

The first part of the workshop started with the thesis student presenting their findings from the interviews and the survey. The workshop was formulated as a *three stage rocket* where the first phase was characterised by the managers being asked to think straight. By straight, we mean that the information presented should not be judged or evaluated, but rather independently observed. The value proposition design as described above was presented and the managers could ask questions if something was unclear.

During the second part of the workshop the managers were asked to think positive. A printed Business Model Canvas (BMC) was given to all four managers and the first step was to fill in the front stage building blocks of the BMC. Those are the blocks relating to the customer: the relationships, channels and revenue streams. After that, the managers switched BMC and they were supposed to continue on the new one in front of them. This time, filling in the backstage part of the BMC: the key partnership, activities, resources and cost structure.

During the third part of the workshop, managers were asked to think negative and address risks. The finished BMCs were switched once again and everyone got a chance to place pink post-its on the building blocks where they could imagine any obstacles from putting the Business model in use. When that was done an open discussion was held to find out what was considered the greatest risks with commercialising an IoCB Solution like the one proposed.

**Table F.1:** *The customer profile of the Owner, and the relating jobs, pains and gains*

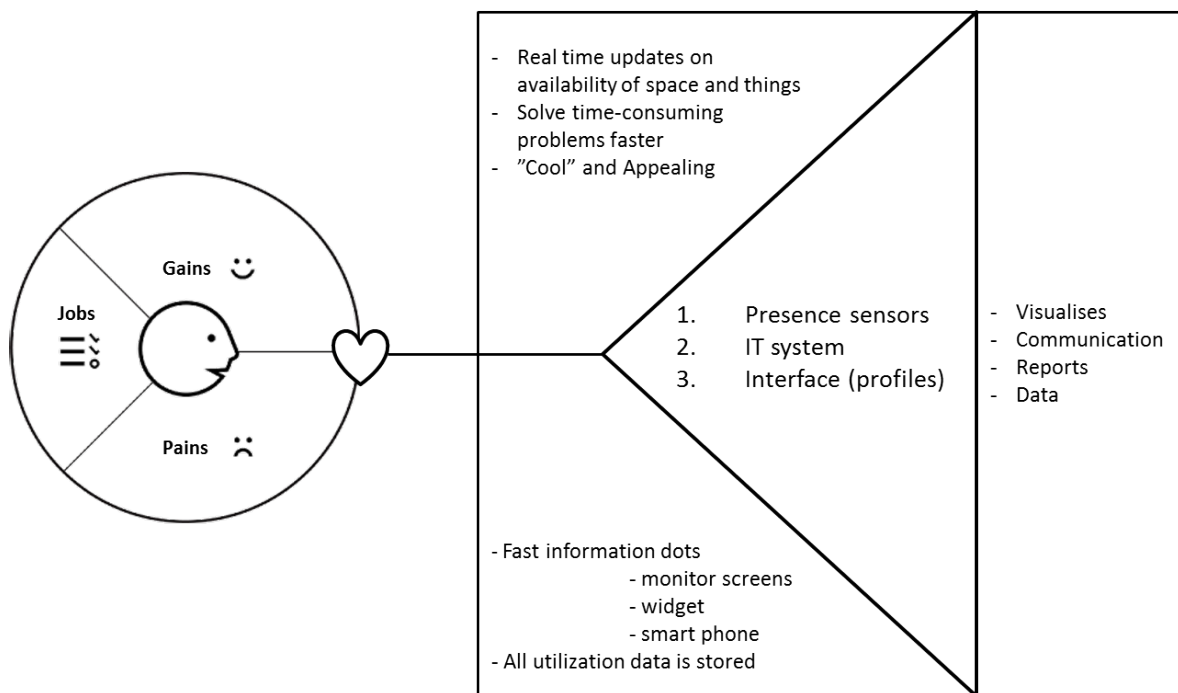
<i>Customer profile Owner</i>		
<b>Jobs</b>	<b>Pains</b>	<b>Gains</b>
<ul style="list-style-type: none"> <li>• Investment</li> <li>• Decision making</li> </ul>	<ul style="list-style-type: none"> <li>• Requirements from other stakeholders</li> <li>• Alterations</li> <li>• Lack of ROI</li> </ul>	<ul style="list-style-type: none"> <li>• Skilled facility managers</li> <li>• Get ROI</li> <li>• Cost savings</li> </ul>

**Table F.2:** *The customer profile of the Occupant, and the relating jobs, pains and gains*

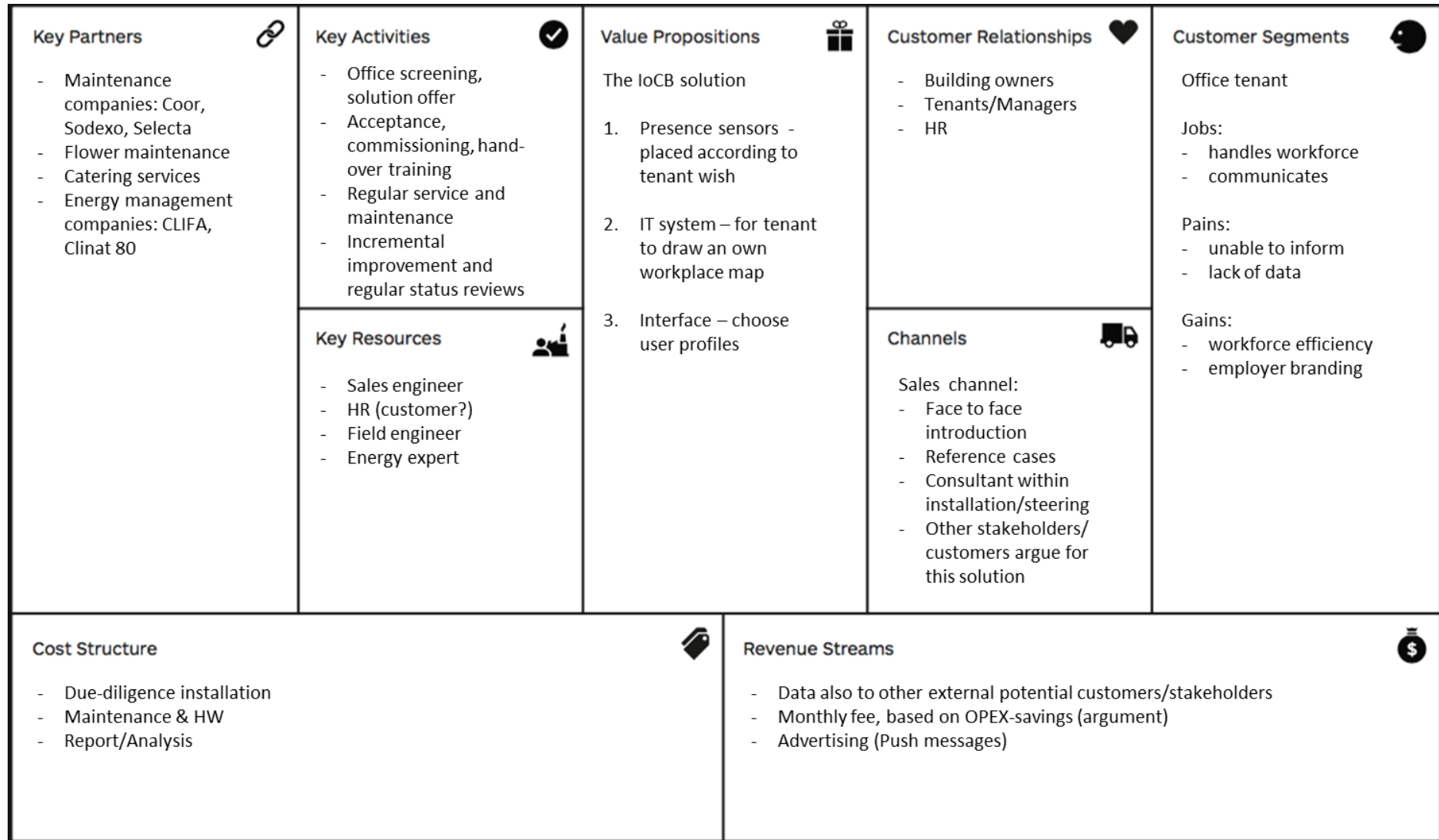
<i>Customer profile Occupant</i>		
<b>Jobs</b>	<b>Pains</b>	<b>Gains</b>
<ul style="list-style-type: none"> <li>• Job Activities</li> <li>• Interaction</li> <li>• Pauses</li> </ul>	<ul style="list-style-type: none"> <li>• No space for specific activity</li> <li>• Meeting rooms unavailable</li> <li>• Discomfort</li> <li>• Required equipment missing</li> <li>• Lack of time</li> </ul>	<ul style="list-style-type: none"> <li>• Motivation</li> <li>• Information access</li> <li>• Able to give feedback</li> <li>• Report broken things</li> <li>• Trust in work environment</li> <li>• Proud of employer brand</li> </ul>

**Table F.3:** *The customer profile of the Tenant, and the relating jobs, pains and gains*

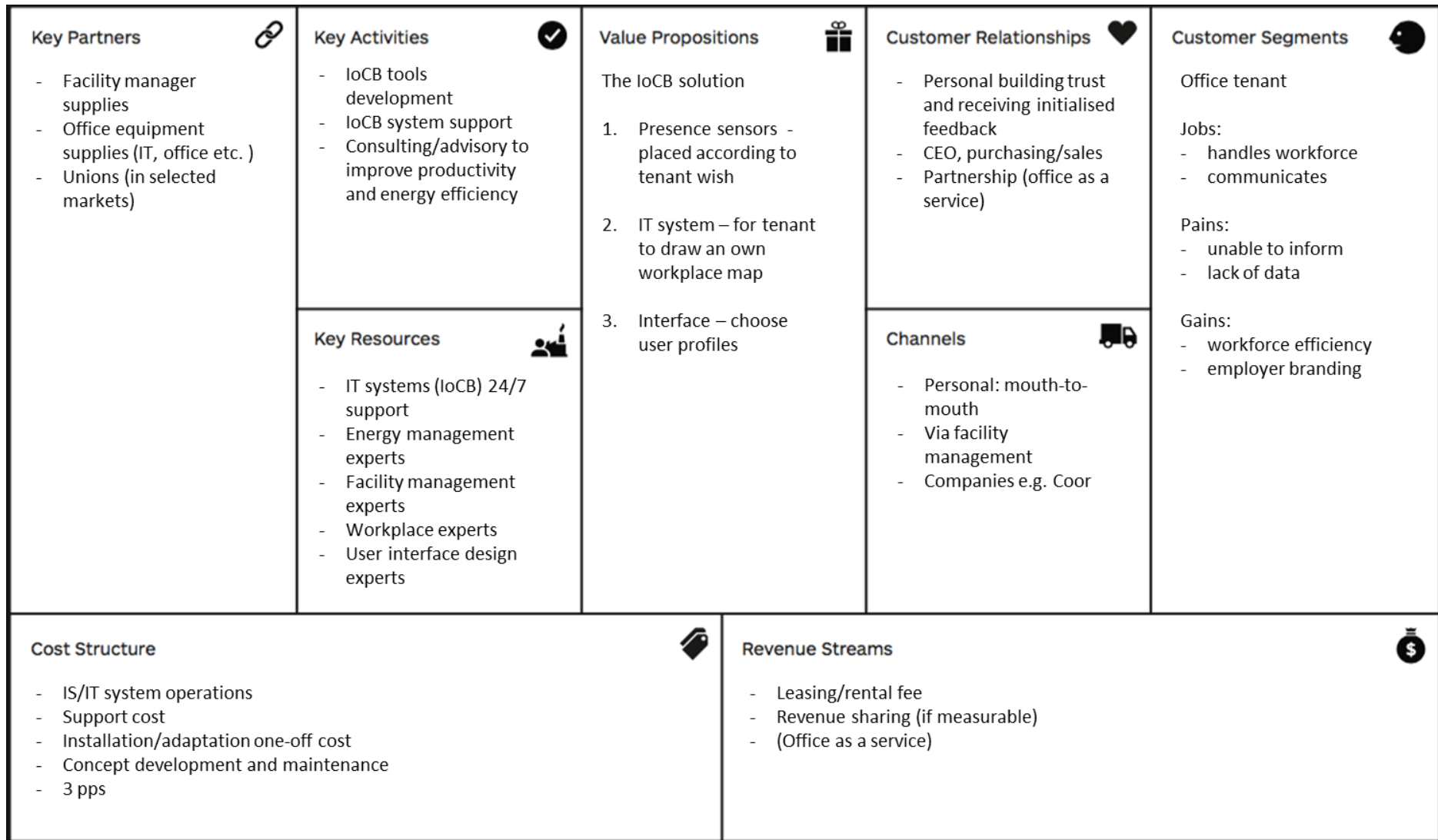
<i>Customer profile Tenant</i>		
<b>Jobs</b>	<b>Pains</b>	<b>Gains</b>
<ul style="list-style-type: none"> <li>• Handles workforce</li> <li>• Manage business</li> <li>• Communicates</li> </ul>	<ul style="list-style-type: none"> <li>• Not able to inform</li> <li>• No data</li> <li>• Lack of knowledge regarding general opinions</li> </ul>	<ul style="list-style-type: none"> <li>• Workforce efficiency</li> <li>• Employer branding</li> </ul>



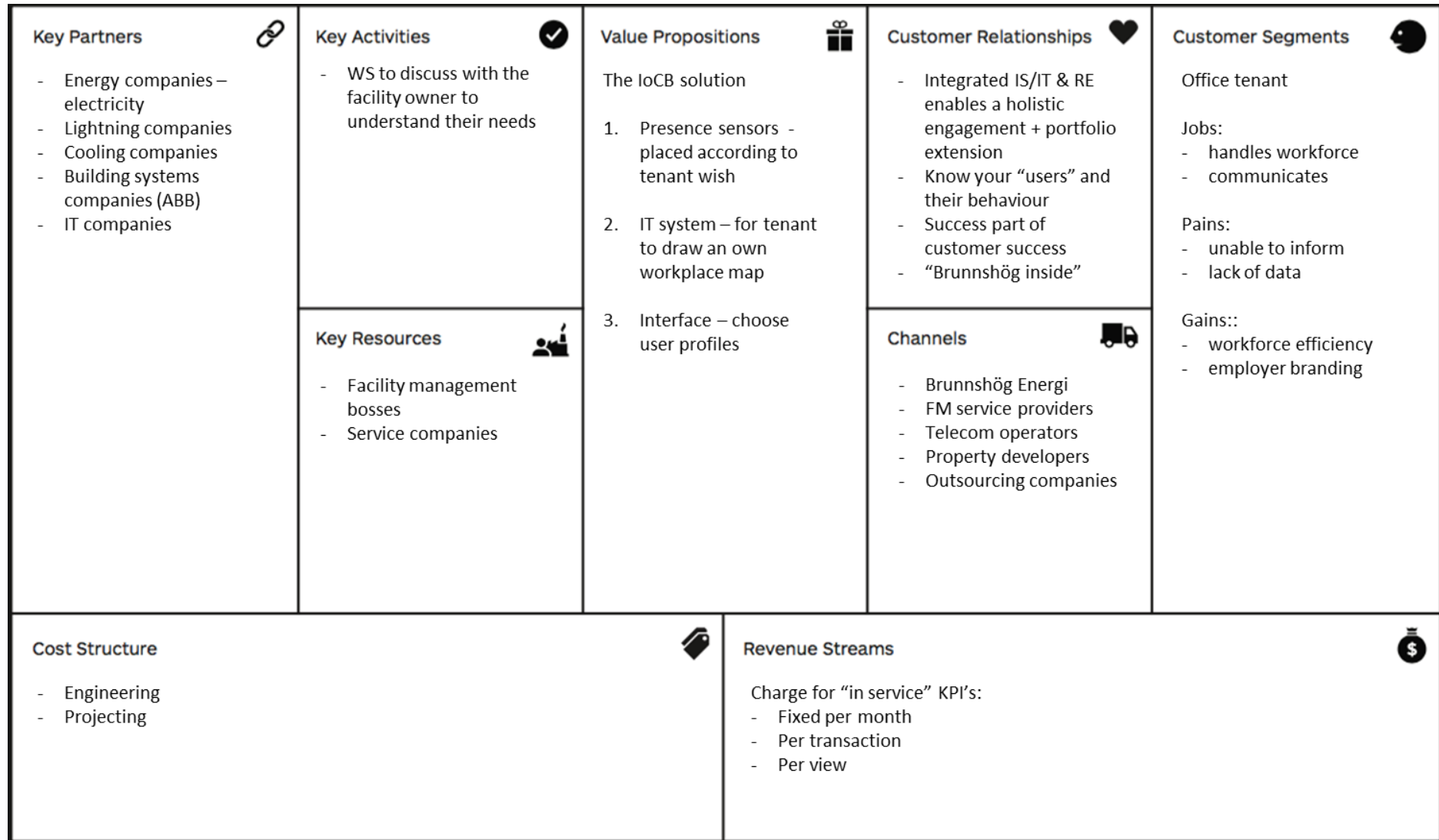
**Figure F.1:** Value proposition design created by the thesis studies fitted to an office tenant that has the jobs, pains and gains as stated in table F.1.



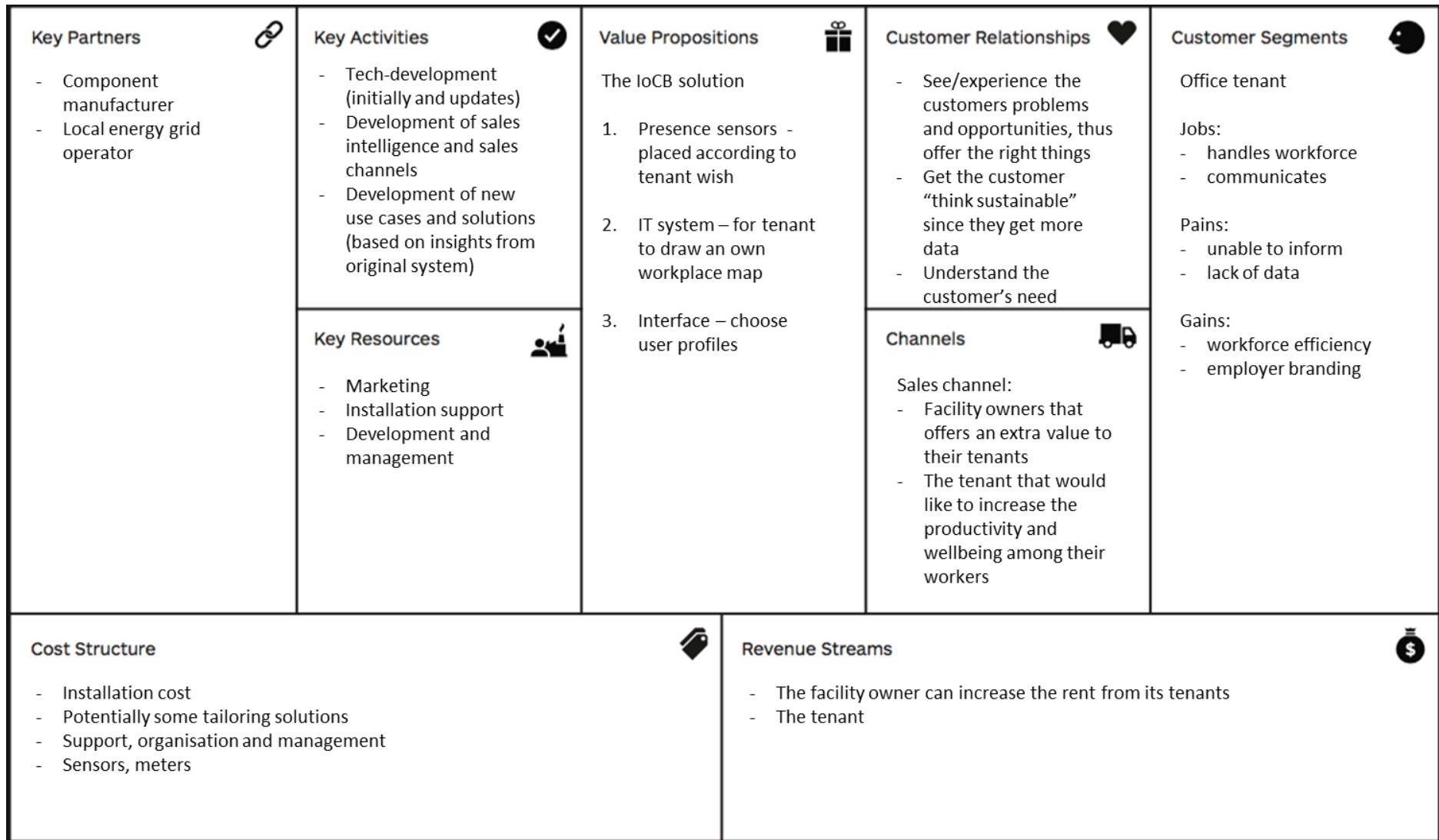
**Figure F.2:** Business model canvas created at the PSG workshop.



**Figure F.3:** Business model canvas created at the PSG workshop.



**Figure F.4:** Business model canvas created at the PSG workshop.



**Figure F.5:** Business model canvas created at the PSG workshop.

