PARK 20|20

A Circular Economy Business Model Case

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Executive Summary

R2π – Transition from Linear to Circular is a European Union Horizon 2020 project focused on enabling organisations and their value chains to transition towards a more viable, sustainable and competitive economic model in order to support the European Union's strategy on sustainability and competitiveness. A core part of this project is to work with organisations who are on the journey towards developing circular economy business models, therefore the project has conducted case studies of 18 selected organisations.

This report is about the 'Elevator as a Service' (M-Use®) business model, as implemented by Delta Development Group at Park 20|20 (Hoofddorp, the Netherlands). Park 2020 is the first full-service Cradle to Cradle® office park in the world. The R2π project choose to conduct this case study because this shows building circular is already possible.

In the autumn of 2015, the CEO of Delta Development Group (developer of Park 2020) came to the conclusion that in fact, buildings do not require elevators: the real need is vertical transport available at all times. Mitsubishi, in collaboration with Delta Development Group and the building owner, developed the 'Elevator as a Service'-model, called M-Use®. In this new circular business model, the elevator is leased (full service operational lease) instead of sold/bought, hence leaving the ownership of the product with Mitsubishi during the contract term. Consequently, suppliers are incentivized to minimize maintenance needs, to build products for long-term durability, and to reuse and recycle components.

The value proposition of the M-Use® business model is to offer high quality vertical transport with a high level of availability and complete maintenance in exchange for a monthly fee. This monthly fee is based on full service operational lease in which the ownership of the elevator lies with Mitsubishi. The M-Use® increased the quality level of the elevator, while decreasing the Total Cost of Usage. This is because the remote monitoring of the M-Use® enables Mitsubishi to plan the maintenance based on actual use. Hence, this drives the circularity of the elevator since this optimizes material usage and increases the lifespan.

This study analysed categories of contextual dimensions and factors characterising the M-Use® business model, e.g. rules and regulations, economy, and customer needs. **Rules and regulations** can be enablers as well as barriers for the CEBM. On the one hand, if take-back were to become mandatory by law, this would very likely increase the number of 'product as a service' contracts closed, since Mitsubishi supports and offers take-back already. On the other hand, the current law regarding ownership in The Netherlands poses a risk to Mitsubishi since the elevator is permanently attached to a building, which is owned by a third party. Fortunately, Mitsubishi is avoiding this risk by establishing a so-called "building right".

The most important current **financial** barrier for 'product as a service' is the financing of this new business model. With M-Use®, Mitsubishi no longer sells the products but receives a monthly fee from the users of their elevators. Hence, a new financing need arises. Most bankers currently do not want to finance that because their current calculation methods can hardly evaluate the risk of M-Use® and the residual value the elevator has. Therefore, funding opportunities are important in order to drive the scale up phase of the M-Use®.

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Currently, **customer needs** regarding elevators are not based on circularity. Explaining the M-Use® model in a way that potential customers understand and agree with implementing the elevator as a service is a challenge. Their consideration regarding elevators is still mostly cost driven and their evaluation is based on principles of the linear economy (e.g. investment costs), while the M-Use® model offers more than a reduction in the cost over time (see True Value analyses made by KPMG) and should be valued based on the principles of the circular economy (e.g. Total Cost of Usage and reuse of components).

A few **key learnings** derive from conducting this case study. Firstly, the intrinsic motivation of stakeholders helps to develop a new CEBM. Secondly, limitations of traditional business models can enable new ways of thinking and doing business. Thirdly, collaboration within the supply chain is key. Fourthly, creating a safe environment in which the stakeholders can try to develop a new CEBM without any risk supports the development of a CEBM. Finally, it takes time to explain the new CEBM to all stakeholders in such a way they understand and accept this new model.

To finalize, looking at the discussed strengths, weaknesses, drivers and barriers of M-Use®, it is interesting to replicate this 'product-as-a-service' to other industries and products. In the Netherlands, there already exist some other 'products-as-a-service' CEBM's.

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1 Introduction

1.1 Background and context

R2π – Transition from Linear to Circular is a European Union Horizon 2020 project focused on enabling organisations and their value chains to transition towards a more viable, sustainable and competitive economic model in order to support the European Union's strategy on sustainability and competitiveness.

R2π examines the shift from the broad concept of a Circular Economy (CE) to one of Circular Economy Business Models (CEBM) by tackling market opportunities and failures (businesses, consumers) as well as policy opportunities and failures (assumptions, unintended consequences). Its innovation lies in having a strong business-model focus (including designing transition guidelines) as well as in the role of policy development (including designing policy packages).

The ultimate objective of the R2π project is to accelerate widespread implementation of a circular economy based on successful business models and effective policies:

to ensure sustained economic development,

to minimize environmental impact and

to maximize social welfare.

The mission of the project is therefore to identify and develop sustainable business models and guidelines that will facilitate the circular economy, and to propose policy packages that will support the implementation of these sustainable models.

A core part of this project is to work with organisations, which are on the journey towards developing circular economy business models, as well as those who have the ambition to do so but have not yet begun. The project has conducted case studies of 18 selected organisations.

The 18 chosen cases covered all five priority areas highlighted in the EU Action Plan on the Circular Economy: plastics, food waste, biomass/bio-based, important raw materials, and construction & demolition. Additionally, the cases were selected to ensure learning in each of the seven business model patterns defined by the R2Pi project: re-make, re-condition, circular sourcing, co-product recovery, access, performance and resource recovery, and these will be discussed in more detail in this report. To gather wide-ranging lessons from differing company sizes and maturities, the following were selected: 7 large corporations, 8 small, medium enterprises, 1 public entity, 1 entire value chain with both public and private organisations and 1 on-going social project.

This particular case study is about the building industry, which currently accounts for 40% of global energy use, 30% of energy-related GHG emissions, approximately 12% of water use, and nearly 40% of waste (source: United Nations Environment Program). The buildings that we build today have an impact on our future, since buildings will last for 30, 50, to even 100 years. Knowing this, in combination with the rapidly growing world population, indicates there is an urgent need for sustainable buildings. We need to transition this traditional take – make – waste industry into a circular one, in order to create a sustainable future. Due to the challenges in this industry, such as the complex supply chains and the high level of competitiveness, changing from linear to circular is challenging.

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The R2π project choose to conduct a case study about Park 20|20, because this shows building circular is already possible. It is about the 'Elevator as a Service' (M-Use®) business model, as implemented by Delta Development Group at Park 20|20. The CEO of Delta Development Group (developer of Park 2020) came to the conclusion that in fact, buildings do not require elevators: the real need is vertical transport available at all times. Mitsubishi Elevator Europe (hereinafter: Mitsubishi) therefore changed from a traditional elevator to an 'Elevator as a Service'-model, called M-Use®. In this model products are leased (full service operational lease) instead of sold/bought, hence leaving the ownership of the product with the supplier during the contract term. Consequently, suppliers are incentivized to minimize maintenance needs and build products for long-term durability.

The next section provides a more detailed overview of the case organisation's business and the CEBM.

1.2 Business overview

This section presents a high-level overview of Delta Development Group, Park 2020 and its history, and the M-Use® CEBM of Mitsubishi.

Delta Development Group stands for sustainable development. Since 2003 they have been translating their sustainable ambitions into leading projects based on the Cradle to Cradle principle®. With projects such as Park 20|20 and the Fokker Logistics Park, they have proven that Cradle to Cradle® is a realistic business model whereby sustainability and economic efficiency reinforce each other.

Park 20|20

Park 20|20 is the first full-service Cradle to Cradle office park in the world (Hoofddorp, The Netherlands). Built through the deployment of market driven real estate business cases Park 20|20 is a living testament that Cradle to Cradle® design for the circular economy is not only possible, but highly effective.

Park 20|20 is a place where people, the environment and economic feasibility all merge together to build a better future for the companies who work there, the community where it is located and the local ecological environment.

Park 20|20 development partners include Delta Development Group, VolkerWessels, Reggeborgh Group and William McDonough + Partners.

FIGURE 1 BUILDING AT PARK 20|20 IN HOOFDDORP

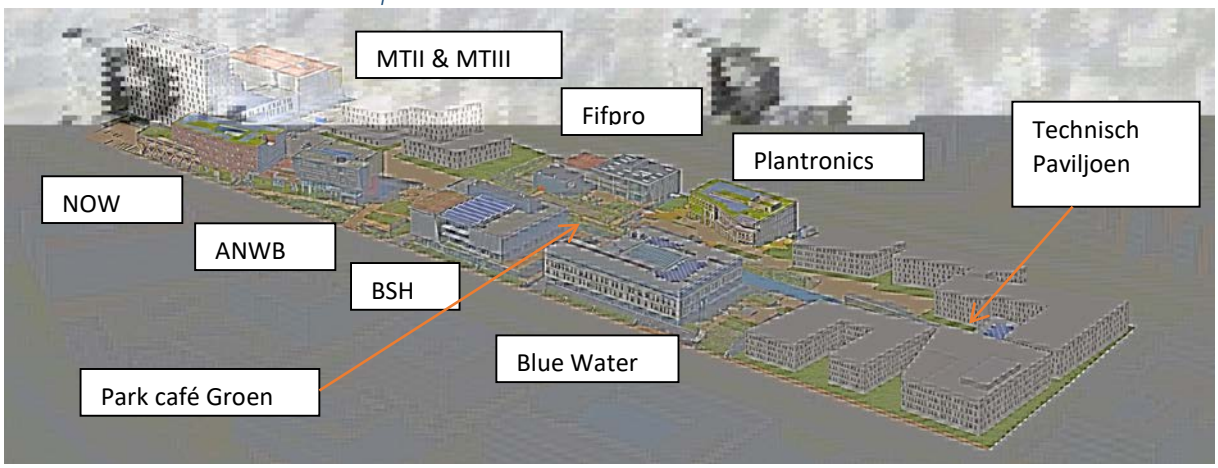

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FIGURE 2 TIMELINE OF PARK 20|20

The *Cradle to Cradle* methodology is based on 3 basic concepts directly derived from existing natural laws, namely "waste equals food", "use solar income" and "celebrate diversity". Each of these concepts has been translated into a number of practical and circular solutions, as listed below. More information on the principles and solutions can be found in Appendix A (bookmarks inserted).

Waste Equals Food:

- Centralized Grey-Water storage/reuse;
- Park 20|20 Materialization & Participants Program;
- Reverse Materials Logistics to the techno-sphere;
- Park 20|20 Greenhouses;
- Park-wide Composting Program;
- Park-wide Nutrient Management Program;
- Design For Disassembly; Flexibility and Future Area Development.

FIGURE 3 THE GREENHOUSE AT PARK 20|20

Use Solar Income:

- Centralized Heat and Cold Storage Energy System (geothermal energy);

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- Generating renewable energy;
- Park 20|20 Energy C.V.;
- Trias Energetica;
- Park-wide Solar Studies.

FIGURE 4 PARK 20|20 SOLAR PARK

This solar park is located at Fokker logistics building 7, Fokkerweg 300, Oude Meer. Provides the solar energy for the new construction projects at park 20|20.

Celebrate Diversity:

- Enhancing On-site Biodiversity;
- Diversity in Design;
- Enrichment of Local Identity;
- Spatial Diversity in Site Layout.

FIGURE 5 PARK 20|20 GREENHOUSE AND GARDEN, ENHANCING BIODIVERSITY

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Other:

- Productivity and Human Centered Design;
- Encouraging Business through Eco-Effectiveness (enables materials to maintain their status as resources and accumulate intelligence over time);
- Cradle to Cradle® as an initial intention and objective;
- Continuous Improvement;
- Education;
- Mobility;
- Social Initiatives;
- Sharing Knowledge.

FIGURE 6 AFTER WORK SPORT PROGRAM AT PARK 20|20

Brief history of Park 20|20

In 1999 the consortium of Delta Development Group, VolkerWessels and Reggeborgh Groep purchased the Fokker production facility in the Schiphol Rijk area of Haarlemmermeer for a large 44 hectare, mixed-use area for re-development. The project had immense opportunity but also had two challenges. The first was how to effectively construct a masterplan that would maximize the site's potential for offices and logistics space while making the most optimal use of existing infrastructure. The second was positioning a product in a market with a large amount of office stock, but not great connectivity to transportation.

One of the challenges at Fokker was external to the organization and not presenting itself till a later stage of the project. Up until this point, due to the proximity to Schiphol, the logistics halls were renting and selling very well but the consortium was not generating the success in office space that it had initially anticipated.

In 2007 - at exactly the same time while the problem facing the office component of the project was starting to present itself - a 60-minute documentary called "Afval is Voedsel" (Waste is Food) was shown on the Dutch television program Tegenlicht. Afval is Voedsel introduced the concept of Cradle to Cradle® to a large audience and was very well received by the public. The program was also incredibly impactful to Delta Development Group owner and CEO Coert Zachariasse and within the week Coert began contacting architect and Cradle to Cradle® co-creator William McDonough to

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discuss a potential new office for Microsoft. Eventually Microsoft choose for a location directly at Schiphol Airport instead of Schiphol Rijk, which solidified the growing perception that the Schiphol Rijk market was oversaturated and instigated a re-conceptualization of the project.

From this market dilemma Park 20|20 was born by repositioning the entire Fokker site into a 100% logistics park and shifting the office component to Beukenhorst West. From the very start of concept, the desire to build the world's very first full-service Cradle to Cradle® office park occupied a central position. Coert Zachariasse brought in William McDonough for the project master plan and from there Park 20|20 was started.

FIGURE 7 PARK 20|20 IN HOOFDDORP

The scope of this case study is the circular economy business model (CEBM) of Mitsubishi's elevator concept M-Use®, which is implemented by Delta Development Group at Park 20|20. The R2π project choose to conduct this case study, because this shows building circular is already possible. The next section provides in-depth information about this CEBM.

M-Use® information

In the autumn of 2015, Delta Development Group was working on the development of the NOW-building, a multi-tenant office, with 6441 m^2 over four floors. The management of Park 20|20 reached out to Mitsubishi for the elevators for this newly to be built office and requested a quotation. Note that this is already at the stage in the development process of reaching out to suppliers. The initial offer was based on the traditional model: Mitsubishi sells its elevators and the ownership is transferred to the buyer. However, the offer was clearly above budget. Therefore, a meeting was scheduled between Mitsubishi and Delta Development to discuss options. During this meeting it became clear that Mitsubishi was finding difficulties in coping with the difference between the short-term revenue model of the contractor and building owner versus the long-term quality of the Mitsubishi elevators.

To overcome this, Mitsubishi could decide to develop lower quality elevators with a shorter lifetime. This though would require more service and maintenance over time, resulting in an increase in the

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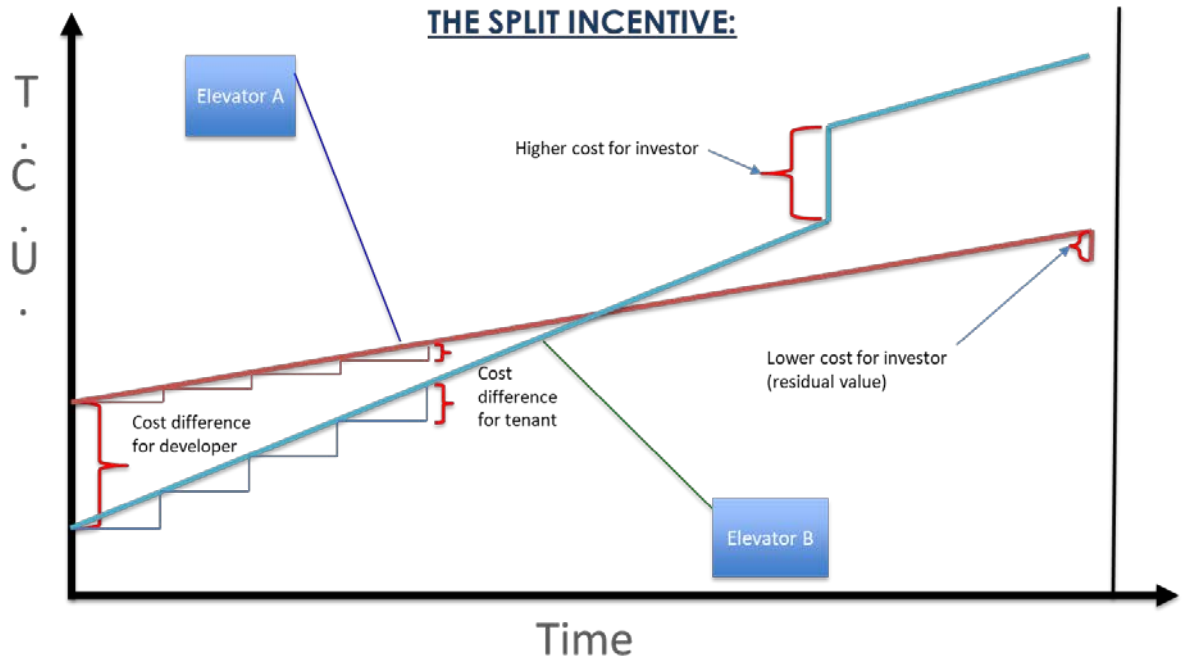
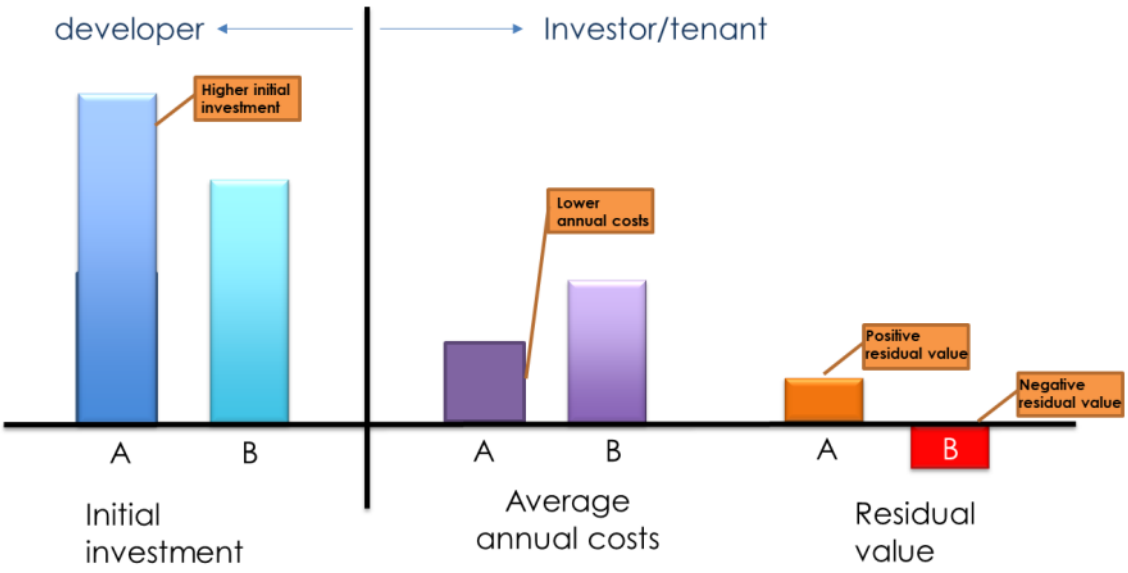
Total Cost of Usage of the elevator. Conversely, a higher quality elevator would need higher investment upfront and result in lower cost for service, maintenance and replacement for the owner and user of the building. Hence, there was a split incentive between the developer and the owner/user of the building regarding the investment cost of the elevator (see Figure 8 and 9).

FIGURE 8 THE SPLIT INCENTIVE



Elevator A = high quality elevator (e.g. Mitsubishi elevator)
Elevator B = lower quality elevator (e.g. competitors of Mitsubishi)

FIGURE 9 COST ALLOCATION IN TRADITIONAL BUYING SITUATION



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Looking at both the financial aspects as well as circularity, it would be undesirable and irresponsible to ask Mitsubishi to develop a lower quality elevator. Delta Development then came to the conclusion that in fact, the NOW building did not require elevators: the real need was *vertical transport available at all times*. And so the ask of Mitsubishi changed from a traditional one to a 'product as a service'-model.

In this model products are leased (full service operational lease) instead of sold/bought, hence leaving the ownership of the product with the supplier during the contract term. Consequently, suppliers are incentivized to minimize maintenance needs and build products for long-term durability. The management of Delta Development requested Mitsubishi, Standard Life (the buyer of the NOW-building) and Delta Development to collaborate in order to make this 'Elevator as a Service'-model work. The only reluctance of Mitsubishi was the challenge it had to face regarding the ownership of the elevator since the elevator would still be attached to the building (this will be explained in more detail later on in this case study). As an incentive Delta Development guaranteed Mitsubishi that whatever the outcome of this collaboration and investigation, they would buy the Mitsubishi elevators. This approach then motivated Mitsubishi to investigate the possibilities for the new model. Note however, that there was a set time and budget, since the development process was already in the phase of reaching out to suppliers.

Ultimately, the main driver for the development of the new business model was the intrinsic motivation of Coert Zachariasse, the CEO of Delta Development. Coert wanted to show that this innovative model, that promotes circularity, could really work on many levels and for a variety of stakeholders.

For Delta Development, the most important aspects of the new business model were circularity and the NMTU-principle (Not More Than Usual). As the concept of Mitsubishi's 'Elevator as a Service', extends the lifetime of the elevator, is dismountable and comes with a material passport, circularity of the elevator could be proved. Firstly, by adding sensors and intelligent software to the elevator, Mitsubishi can measure usage data (remote monitoring). Therefore, they know how many rides, for how many minutes, an elevator made, and what the effect is on important elevator components. By live monitoring and comparing with historic data, Mitsubishi can align their maintenance program with actual usage of the elevator. This ensures every elevator gets the right maintenance just in time, resulting in efficient use of materials and an optimal lifespan. The maintenance program of M-Use® leads to an extended lifespan compared to a traditional elevator. Secondly, Mitsubishi has a take back program, in which they disassemble the elevators and reuse components where possible. Other components are recycled and used again. They are continuously working on the design of the elevator to further improve the circularity. Note however that take back has not occurred yet, since the M-use CEBM is only implemented since 2015 for a contract periods of 20 years. Lastly, the elevator comes with a material passport in collaboration with the Dutch organisation Madaster. This material passport facilitates the reuse of components after the contract period.

The NMTU-principle states that the user of the elevator should pay the same, or even less, than when *buying* the elevator. KPMG was hired to calculate and compare the Total Cost of Leasing of the Mitsubishi elevator versus the Total Cost of Purchasing of a typical office elevator in the Netherlands. KPMG also used their True Value analyses methodology to provide valuable insights on the impact of long-term leasing concepts. They analysed the Total Cost of Usage (TCU) and two external costs of the Mitsubishi elevator: environmental and socio-economic costs (see Figure 10).

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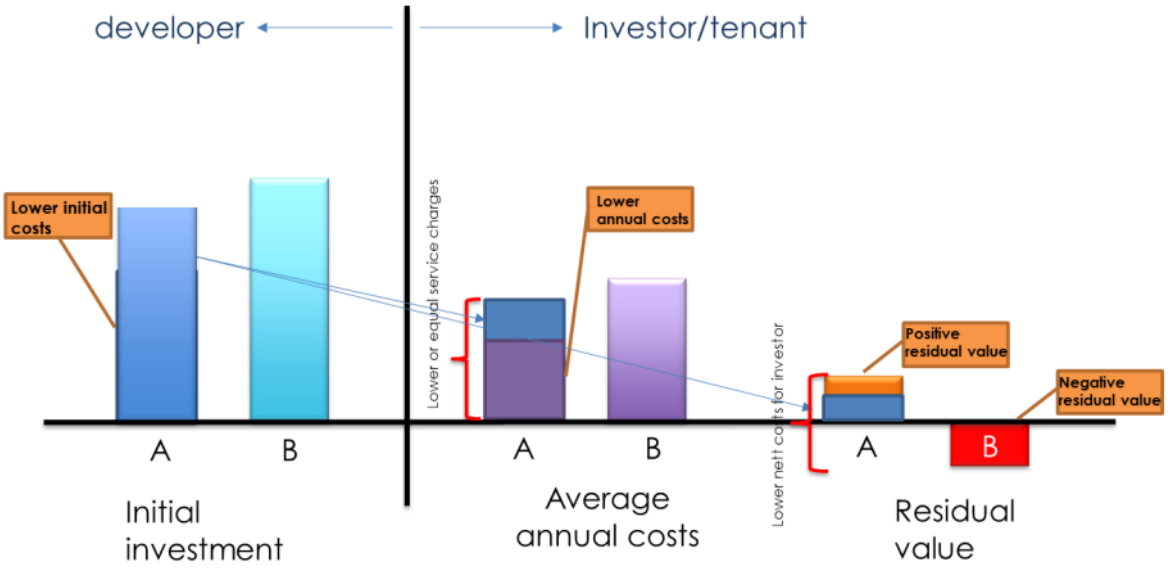
FIGURE 10 ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS THAT THE TRUEVALUE ANALYSIS QUANTIFIES IN FINANCIAL TERMS

The results (see appendix B) showed that leasing rather than owning elevators makes sense from both a financial and societal value perspective. This helped Delta, Mitsubishi and Standard Life to show and explain their stakeholders the benefits of leasing. For instance, Mitsubishis M-Use® model is EUR 13,127 more cost-effective compared to buying an industry average elevator for a 30 year period. Furthermore, the Mitsubishi elevator shows an overall higher energy-efficiency during operation and has a reduced number of disturbances. Based on this study as well as Delta's and Mitsubishi's own research, it was decided by Delta, Mitsubishi and Standard Life to implement the Mitsubishi 'Elevator as a Service', now named M-Use®, in the NOW building.

Due to the full-service contract with Mitsubishi, the implementation of M-Use® would result in a higher quality level of the elevator (hence higher quality of the building), while lowering the Total Cost of Usage. Besides, the M-Use® model offers a viable solution for the split incentive between the developer and the user of the building regarding the investment cost of the elevator (see Figure 11).

FIGURE 11 COST ALLOCATION IN CASE OF M-USE®



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Details of M-Use®

Project: Park 20|20 NOW building, multi-tenant
Developer: Delta Development Group
Buyer: Standard Life
Lease: Full service operational lease / pay-per-use based on 3000 rides a week.

FIGURE 12 MITSUBISHI ELEVATOR

Construction

- The contractor placed the shafts;
- Mitsubishi placed the elevator.

Contract

- Contract was initially between Delta and Mitsubishi. Upon completion of the building, the contract was transferred from Delta to Standard Life. The reason was that Delta sold the building to Standard life, hence the ownership of the building itself was transferred and needed the contract to be transferable as well;
- Mitsubishi is and remains the owner of the elevators as contractually defined in a building right. Hence, the building owner owns a building 'without' elevators;
- Duration of the contract is 20 years;
- The contract is performance based and includes KPI's (for an overview, see table 1). Periodic compensation is recalculated each year based on the KPI's;
- Incentives for Mitsubishi to meet the KPI's are assured by discounts. Meaning that the periodic reimbursement will be decreased with the amounts as mentioned in the discount-table which lists a specific fine for every unachieved KPI;
- Costs are based on the level of usage, calculated for the first year at 3000 rides a week.
- The owner of the building has two options by the end of the contract:
    1. Purchasing the elevator from Mitsubishi by paying the residual value, as computed by Mitsubishi;
    2. Extending the contract (monthly fee will be less than during the first 20 years); while seemingly paradoxal, this is in fact due to the annual charge during the first 20 years has been high to compensate the low initial price;
- Included in the contract are maintenance, repairs, replacements and tests.

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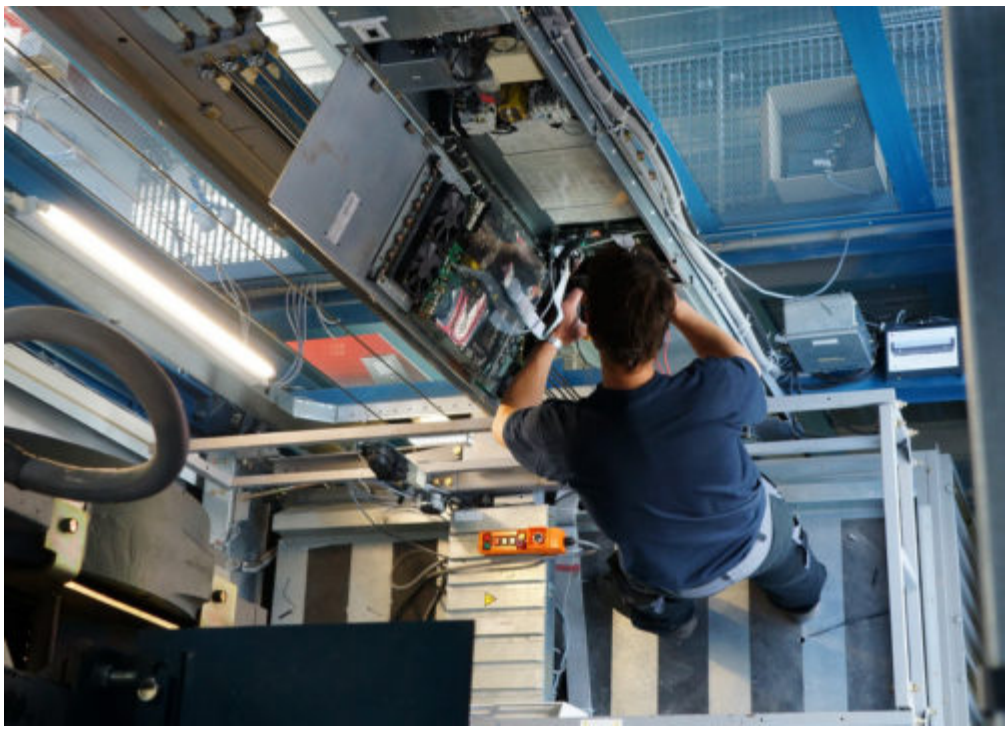
TABLE 1 OVERVIEW OF THE KPI'S

Subject
Availability
Malfunction coefficient
Noise level inside the cabin
Noise level in shafts
Driving comfort
Condition level
Functioning of speak-listening connection

FIGURE 13 MAINTENANCE OF MITSUBISHI ELEVATOR



1.3 The case study analysis process

The aim of this sub-section is to explain the case study analysis process employed with Delta Development Group. Note that de case study is conducted in cooperation with Delta Development Group, while the case study is about the M-Use® model of Mitsubishi. This makes sense since Delta Development Group asked Mitsubishi to develop this new circular business model.

This case study is conducted together with the Product as a Service (PS) Advisor of Delta Development Group. She studied several PS cases within the company, including the M-Use® case. For her PS study

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different stakeholders were interviewed, including the Sales Manager New Installations of Mitsubishi. Most information regarding the M-Use® case that was needed for the R2Pi case study, was therefore already known by this employee. When information was missing, the contact person at Mitsubishi was asked for more in-depth information. Besides, although the case study is conducted with Park 20|20, Mitsubishi's Sales Manager was asked several times to verify the findings of the study.

The analysis process started with gathering information about Park 2020 and about its history. Second, a story is written about the steps that were taken leading to the implementation of the M-Use® model in NOW-Building, the latest building completed at Park 2020. Thirdly, a more in-depth analysis is conducted resulting in a Business Model Canvas, material flow and value exchange mapping, and a stakeholder mapping. After that, a business context list was employed which outlines dimensions and factors on which the M-use® model had to be analysed. After receiving this list completed, the contextual dimensions were further explained by describing them regarding drivers and barriers for the M-Use model®. All this was done within one and a half months.

1.4 Report outline

The information conducted from the above mentioned steps in the case study are described in this report. In chapter two, the business context analysis of the M-Use® model is explained. Followed by an explanation of the business model in chapter three. Finally, a conclusion and recommendations for business and policy are given in chapter four.

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2 M-Use®'s business context analysis

2.1 Scope of the business context analysis

The scope of this case study is the Circular Economy Business Model (CEBM) of Mitsubishi's elevator concept M-Use®, which is implemented by Delta Development Group at Park 20|20. The objective of the context analysis is to identify the main external factors that are to be considered in order to explain the success (or failure) of Circular Economy Business Models (CEBM), as well as their potential role in accelerating the transition towards a Circular Economy.

The PS Advisor of Delta Development carried out the business context research in three stages. In the first stage, a business context checklist was filled out to outline contextual dimensions and factors that may potentially affect the business model. The results of this analysis can be found in Appendix C. In the second stage, the results were linked to drivers and barriers, adding more detail. Finally, they were shared with Mitsubishi to verify the results.

2.2 Contextual factor analysis

In this section the result of the three stages of the business context analysis, as explained above, is presented.

2.2.1 Demographic trends

Several contextual factors have been analysed as part of the demographic dimension, such as the CE roadmap at the national, regional, and local level. The findings are explained in this section.

CE roadmaps created by national, regional and local initiatives help creating a circular mindset. For example, the Roadmap Circular Land Issue (Roadmap Circulaire Gronduitgifte) written by the Municipality of Amsterdam, which stimulates and measures circular building and innovation. Other examples are 'The Netherlands Circular in 2050' and the 'National Raw Material Agreement' which both stimulate a circular economy. A circular mindset is needed to understand the need and added value of new circular business models in general and M-Use® of Mitsubishi in particular. One of the tasks of these initiatives is to set circularity objectives and monitor progress towards pre-defined milestones. The circular M-Use® model can contribute to reaching the circularity objectives, which will therefore activate potential customers to implement the M-Use® model. Besides, these objectives were a strong motivation for innovation for the product designers of Mitsubishi to further improve the circularity as well as quality and lifespan expectation of their elevator.

2.2.2 Rules and regulations

Several contextual factors have been analysed as part of the dimension regarding rules and regulations, such as competition regulation and mandatory take-backs. There exist, and can be developed, rules and regulations that drive het M-Use® business model. These are explained in this section.

Mitsubishi, in contrary to their competitors, can take back the elevators at the end of the contract duration. If **take-back were to become mandatory** by law, this would very likely increase the number

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of M-Use® contracts closed, since Mitsubishi supports and offers take-back already. Note that not only the take-back is important, but also the reuse and recycle program of the company. In other words: taking back the product without reusing, remanufacturing or recycling it, does not make sense. Besides, the used products should be designed to regenerative meaningfully. Mitsubishi and its waste collection and recycling service providers organized the logistical processes in a way that the elevators can be disassembled effectively after their initial technical lifespan and their valuable materials can be reused or recycled. Furthermore, together with their parent company (MELINA) in Japan, Mitsubishi is continuously working on the design of the elevator to further improve the circularity.

Regulations regarding take-back will increase innovation regarding such reuse and recycle programs. Such regulations make producers think about the residual value of their products. Same holds for **extending producer responsibility**, which is as well a driver for the M-Use® model and 'products as a service' in general. In case of 'products as a service', producers and/or suppliers are responsible for the products during its lifetime. Extending the current linear responsibility of producers (e.g. a guarantee for only one year) will lead to more 'product as a service'-models, supporting circularity.

However, rules and regulation can be a barrier as well, such as the current **law regarding ownership** in The Netherlands. This is a barrier since the elevator is permanently attached to a building, which is owned by a third party. For example, once that third party goes bankrupt, the law regarding ownership states that everything that is permanently attached to a building belongs to that building. However, regarding M-Use®, the elevator is owned by Mitsubishi. Hence, this law poses a risk to Mitsubishi. Mitsubishi is currently avoiding this risk by establishing a so-called "building right". This building right is a standard Dutch law, which is already used for years for all different kinds of products. For example, this right states that the ownership of a product, owned by person A, that is attached to a product/building/etc. of person B, will still be owned by person A, in the case of bankruptcy of person B. Mitsubishi is and remains the owner of the elevators as contractually defined in a building right. In case Mitsubishi gets bankrupt, the building owner can buy the elevator.

2.2.3 Economy and environment

Several contextual factors have been analysed as part of the dimension regarding economy and environment, such as the financing of the business model and (Green) lending programmes. These are explained in this section.

An important barrier is the **financing of this new business model**. In the 'product as a service'-model, Mitsubishi no longer sells the products but receives a monthly fee from the users of their elevators. Hence, a new financing need arises. Most bankers currently do not want to finance that because their current calculation methods can hardly evaluate the risk of M-Use® and the residual value the elevator has. Important drivers therefore are **funding opportunities and venture capital for CE-related investment**, as well as **(Green) lending programmes from banks**. Such funding opportunities will drive the scale up phase of the M-Use®.

Regarding the environment, Delta Development Group has been wanting to leave a lasting, inspirational, and positive footprint with their Cradle to Cradle® optimized projects. This **strong ambition** helped Mitsubishi to rethink the traditional business model of the elevator.

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2.2.4 Competition

For the dimension regarding competition, the contextual factor that has been analysed is competition regulation.

The current **competition regulation** in the Netherlands is a barrier for the M-Use® model, for example regarding tenders. Some tenders are currently still judged based on lowest initial investment without looking at the cost during exploitation. Hence, the Total Cost of Usage is not taken into account. In case other awarding criteria are in force, then these are hardly focused on circularity.

For the M-Use® model, costs and quality are not the only indicators that matter. The Life Cycle Assessment (LCA) and True Value make this product more interesting than their linear editions. Selecting elevators based on these criteria as well will probably result in closing more M-Use® contracts.

2.2.5 Technology trends

The technology dimension has been analysed as well and shows that technology is an important driver for the circular M-Use® model.

New technological developments in the sector can result in more possibilities to increase the circularity of the elevator. The remote monitoring of the M-Use® that helps to plan the maintenance based on actual use, is such a technological development that drives the circularity of the elevator. **R&D capacities are a way to stimulate these technological innovations**.

As mentioned before, Mitsubishi and its waste collection and recycling service providers have procedures and logistics in place for the effective dismantling of the elevators after their initial technical lifespan and the reuse and recycling of their valuable materials. This will facilitate keeping the components and materials at higher value after use. Moreover, especially **IT-infrastructure** can increase the residual value by supporting transparency and information sharing. Based on remote monitoring and in collaboration with strategic partners and companies such as IBM, Mitsubishi is investigating how individual elevator components can be allocated as optimally as possible in different application areas. They do this by looking at the technical lifespan by different types of users and different types of use intensity. Such systems and mechanisms will increase the collaboration between companies and help finding high value second life options for these components and materials.

2.2.6 Customer needs

The dimension regarding customer needs had been analysed by looking at contextual factors like social attitudes, the mind-set, and the preference for green products of the customers.

Social attitudes are an important driver as well. When people start to realize the linear economy is finite, their social attitudes towards waste, recycling, eco-friendly production, consumption and energy use might change. Changes in the social attitudes of the potential customers of Mitsubishi will make them realize that the M-Use® model is the best option available since it is the most circular elevator worldwide. Currently, explaining the M-Use® model in a way that potential customers understand and agree with implementing the elevator as a service is a challenge. Their consideration regarding elevators is still mostly cost driven and their evaluation is based on principles of the linear economy (e.g. investment costs), while the M-Use® model offers more than a reduction in the cost over time (see True Value analyses made by KPMG) and should be valued based on the principles of

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the circular economy (e.g. Total Cost of Usage). For example, the M-Use® is more energy efficient, which results in lower emissions in the value chain. Furthermore, the better quality of the elevator lead to less disruptions, less replacements and a longer lifespan, which results in a positive social-economic impact. The **preference for green products** can become an important driver as well once the M-Use® model has a green certificate (for example Cradle to Cradle).

However, the **mindset and social attitude of people** is currently a barrier since people need to understand the circular economy in order to be open to this new business model. For example, a building investor needs to be open towards this new model, which leads to different cash flows and includes other maintenance programs than the traditional linear elevator model. The circular mindset of the CEO of Delta Development was key in realizing the CEBM for the M-Use®.

2.3 Conclusion

To conclude, the **demographic trends** have been a driver for M-use® because the Dutch initiatives set circularity objectives which indirectly promoted the implementation of the M-Use® model. Besides, these circularity objectives were a strong motivation for innovation for the product designers of Mitsubishi to further improve the M-Use®. **Rules and regulations** can be enablers as well as barriers for the CEBM. Hence, some of the discussed rules and regulations already exist, others would be interesting to implement in order to enable the implementation of CEBM opportunities. The most important current **financial** barrier for 'product as a service' is the financing of this new business model. Currently, (Green) lending opportunities would therefore enable the implementation of this CEBM. Furthermore, in the Netherlands, current **competition** regulation regarding tenders is a barrier for the M-Use®. Fortunately, there are also important drivers for the circular M-Use® model such as **technology** and the changing **customer needs**.

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3 Business model assessment

3.1 The M-Use® business model

3.1.1 Business model overview

The aim of this sub-section is to explain how the business model assessment was undertaken as part of the case study analysis process to gain an in-depth understanding of the Case Organisation's business model; M-Use®. In this model elevators are leased (full service operational lease) instead of sold/bought, to create a CEBM. The ownership of the elevator is thereby left with Mitsubishi during the contract term. Consequently, Mitsubishi is incentivized to minimize maintenance needs, build products for long-term durability and ensuring residual value. This positively affects the circularity of the elevator.

Remember that de case study is conducted in cooperation with Park 2020, while the case study is about the M-Use® model of Mitsubishi. This makes sense since Delta Development Group asked Mitsubishi to develop this new circular business model. Although the case study is conducted with Park 2020, Mitsubishi is asked several times to verify the findings of the study.

Firstly, the information for the business model assessment was gathered together with an employee of Delta Development Group, the developer of Park 2020. Thereafter, this information was structured using several tools, such as a Business Model Canvas, Material Flow and Value Exchange Mapping, and a Stakeholder Mapping. To ensure the information is correct, these completed tools have been checked by Mitsubishi.

3.1.1.1 Depicting the Business Model Canvas

This section shows a visual representation of the M-Use® business model, based on the Business Model Canvas. A narrative description on each of the nine building blocks can be found in the BMC in Figure 14.

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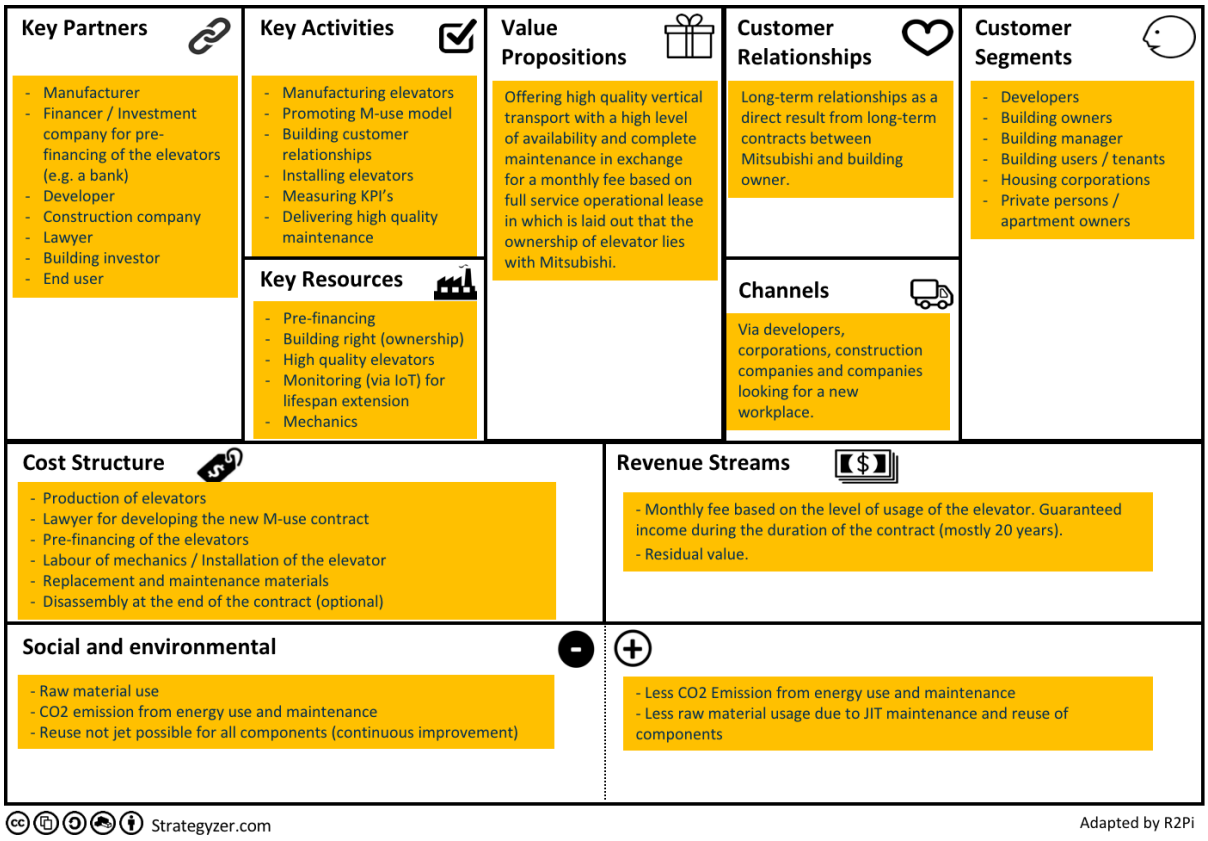
FIGURE 14 BUSINESS MODEL CANVAS



Key partners

- Manufacturers of the elevator components are important partners. Note that the final manufacturing stage is within the Mitsubishi Group itself.
- Financer / Investment company is an important partner for the pre-financing of the elevators (e.g. a bank). In the 'product as a service'-model, Mitsubishi no longer sells the products but receives a monthly fee from the users of their elevators. Hence, a new financing need arises. Most bankers currently do not want to finance that because their current calculation methods can hardly evaluate the risk of M-Use® and the residual value an elevator has.
- Developer of the building is an important partner, since this party can request the construction company to implement the M-Use® model.
- Construction company since they purchase and plan the installation of the elevator.
- Lawyers due to the new contract terms.
- Building investor, because he/she will buy a building in which the elevator is owned by a third party.
- End-user is the one who uses the elevator and benefits from the high-quality elevator with a very low risk of delay.

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Key activities

- Manufacturing elevators is a key activity, since Mitsubishi itself is responsible for the final stage of manufacturing. Mitsubishi improved the design of the M-Use® elevator in order to be able to disassemble, reuse and recycle at end of life.
- Promoting M-Use® model, since this is a new circular business model that needs explanation in order for (future) clients to understand it.
- Building customer relationships. Due to the long contract term between Mitsubishi and building owner, they will have a long-term relationship.
- Installing elevators within the building will be the responsibility of Mitsubishi. They will handle this in collaboration with the construction company.
- Measuring KPI's which are included in the M-Use® contract, to measure the performance of the elevator.
- Delivering high quality maintenance to guarantee a high-quality elevator with a very low risk of malfunctions.
- Elevator take-back and reuse once the contract expires.

Key resources

- Pre-financing. In the 'product as a service'-model, Mitsubishi no longer sells the products but receives a monthly fee from the users of their elevators. Hence, a new financing need arises; Mitsubishi needs to pre-finance the elevator.
- Building right (ownership): the law of ownership is a barrier to the M-Use® business model, since the elevator is permanently attached to a building which is owned by a third party. For example, once that third party goes bankrupt, the law regarding ownership states that everything that is permanently attached to a building belongs to that building. However, regarding M-Use®, the elevator is owned by Mitsubishi. Hence, this law poses a risk to Mitsubishi. Mitsubishi is currently avoiding this risk by establishing a so-called "building right". This building right is a standard Dutch law, which is already used for years for all different kinds of products. For example, this right states that the ownership of a product, owned by person A, attached to a product/building/etc. of person B, will still be owned by person A, in the case of bankruptcy of person B. Mitsubishi is and remains the owner of the elevators as contractually defined in a building right. Should Mitsubishi go bankrupt, the building owner can buy the elevator.
- High quality elevators are needed to be able to sell the M-Use model®. The elevators will deliver the performance on which the contract is based.
- Monitoring (via IoT). By adding sensors and intelligent software to their elevator, Mitsubishi can measure components and usage data. Therefore, they know the number and duration pf the rides and what the effect is on important elevator components. By live monitoring and comparing with historic data, Mitsubishi can align their maintenance program with actual usage of the elevator. This ensures every elevator gets the right maintenance just in time, resulting in an optimal lifespan and efficient use of materials. Compared to a traditional elevator, the aligned maintenance program of M-Use® leads to an extended lifespan.

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- Mechanics, who are responsible for the installation and maintenance of the elevator.

Value proposition

The value proposition of Mitsubishi is to offer high quality vertical transport with a high level of availability and complete maintenance in exchange for a monthly fee based on full service operational lease in which is laid out that the ownership of elevator lies with Mitsubishi.

Customer relationships

Long-term relationships resulting from long-term contracts between Mitsubishi and building owners. During this relationship they will have several contact moments regarding maintenance, performance and contract extension.

Channels

There are different channels via which Mitsubishi will be in contact with their customer.

- Developers since they are the connection between the (future) building owner, construction company and Mitsubishi. The developer can suggest implementing the M-Use® model.
- Corporations represent a group of apartment owners or renters that need an elevator in their building. The board of the corporation will communicate with Mitsubishi regarding the elevator.
- Construction companies are (traditionally) responsible for purchasing needed building materials and products. They will communicate with Mitsubishi about purchasing and installing the elevator.
- Companies looking for a new workplace, since they can demand the M-Use® CEBM since that ensures high-quality vertical transportation available at all times.

Customer segments

- Developers, since they develop buildings (offices, apartments, schools, etc.) in which elevators are needed.
- Building owners, since they own buildings in which elevators are needed.
- Building manager, since he/she is responsible for the elevator and needs to make sure the elevator has no malfunctions and thereby delays. Vertical transportation needs to be available at all times.
- Building users / tenants, since they need vertical transportation within their building.
- Housing corporations, since they are responsible for the elevator and needs to make sure the elevator has no malfunctions and thereby delays. Vertical transportation needs to be available at all times.
- Private persons / apartment owners who need vertical transportation being available in their building.

Cost structure

The costs that Mitsubishi will incur:

- Production of elevators, e.g. materials, transportation and labour.

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- Lawyer for developing the new M-use contract.
- Pre-financing of the elevators will come at an expense as well.
- Replacement and maintenance materials to ensure no malfunctions and delays.
- Labour of mechanics who install and/or perform maintenance (wages). Installation of the elevator: Mitsubishi can let their own mechanics install the elevators or outsource it to another company.
- Disassembly at the end of the contract (optional) will incur in labour, material, and transportation costs.

Revenue streams

The revenue streams are the monthly fees the customers pay based on the level of usage of the elevator. Mitsubishi has a guaranteed income during the duration of the contract (mostly 20 years). Besides, the elevator has a residual value which can lead to a revenue at the end of the contract.

Social and Environmental

The Social and Environmental costs and benefits of this CEBM are related to (raw) materials and CO2 emissions. At this moment, there are still raw materials needed to build the elevators. However, due to JIT maintenance and reuse of components, the use of raw materials is less compared to linear elevator business models. Mitsubishi is continuously improving the design of the elevator in order to increase the reusability of components. Although M-Use leads to less CO2 emissions from energy use and maintenance, this CEBM still emits CO2. Fortunately, Mitsubishi recently developed M-Zero; an intelligent energy-neutral elevator that contributes to an even lower environmental impact.

FIGURE 15 MITSUBISHI ELEVATOR

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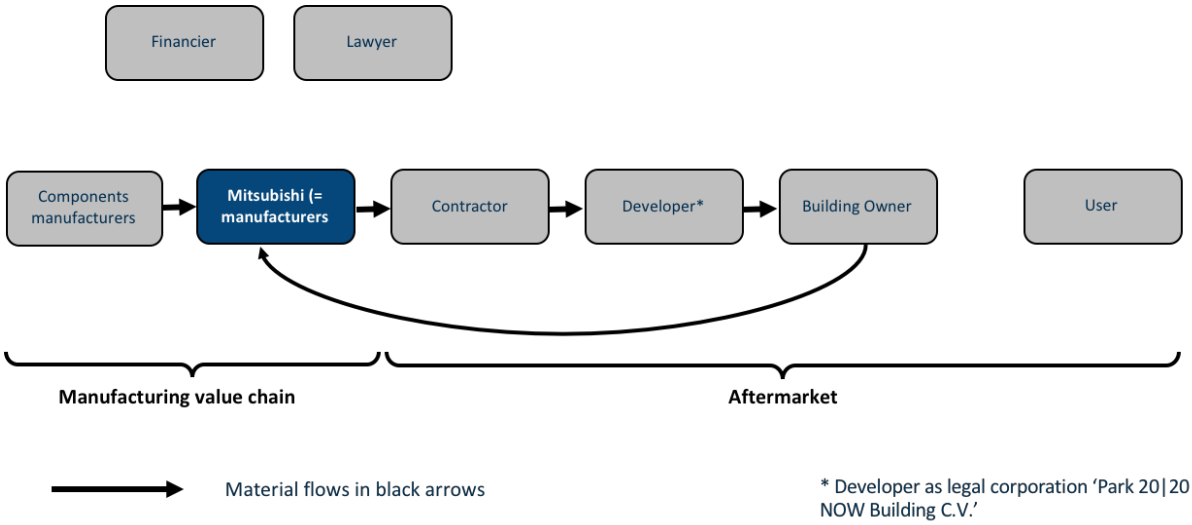
3.1.2 The Material Flow and Value Exchange

In this section a mapping of the material flow and the value exchange are presented.

3.1.2.1 Material Flow

The material flow shows the way the materials of the M-Use® elevator flow during their lifecycle. In Figure 16, the material flow arrow shows the materials start being used at the components manufacturers in Japan. After completion, the materials go to the next step within the supply chain; Mitsubishi itself. There the different components are assembled, resulting in a Mitsubishi elevator. Thereafter, the elevator will be delivered and assembled at the construction site together with the contractor. Hence the developer (in this case Park 20|20 NOW Building C.V.) owns the building before it is sold to a new building owner. Once the building owner decides to demolish the building, the materials of the elevator will flow back to Mitsubishi, such that these materials can be re-used.

FIGURE 16 MATERIAL FLOW



3.1.2.2 Value Flow

The value flow shows the route of the value exchange between different stakeholders. Mitsubishi exchanges value (materials vs money) with the components manufacturers in Japan and exchanges value (advice vs money) with its financiers and lawyers in order to receive advice regarding the implementation of the new M-Use® business model. Thereafter, a contract is signed between Mitsubishi and the developer for the 'elevator-as-a-service'. The value that is exchanged at this point is 'vertical transport at all times' (hence: includes maintenance, checks, measurements, etc.) versus a monthly fee. Once the building is bought by a new building owner, the contract is transferred from the developer towards the new building owner. Hence, there is a value exchange between the building owner and Mitsubishi. Once the building owner contracted a tenant, the tenant pays the building owner a fee for which he can use the building in exchange. Hence, this includes the use of the elevator.

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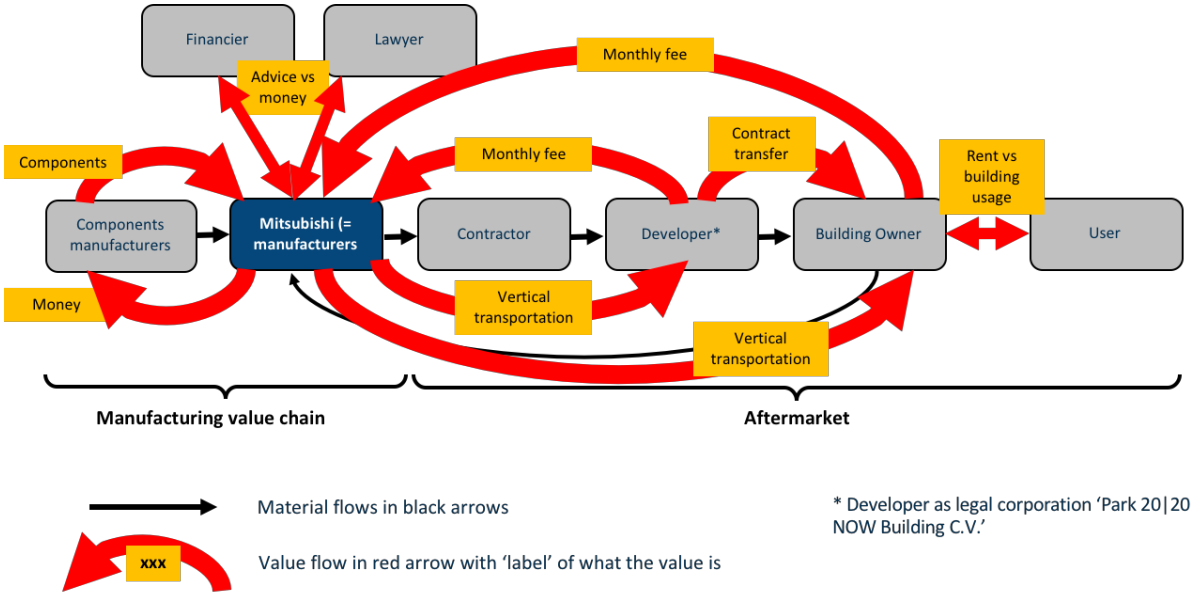
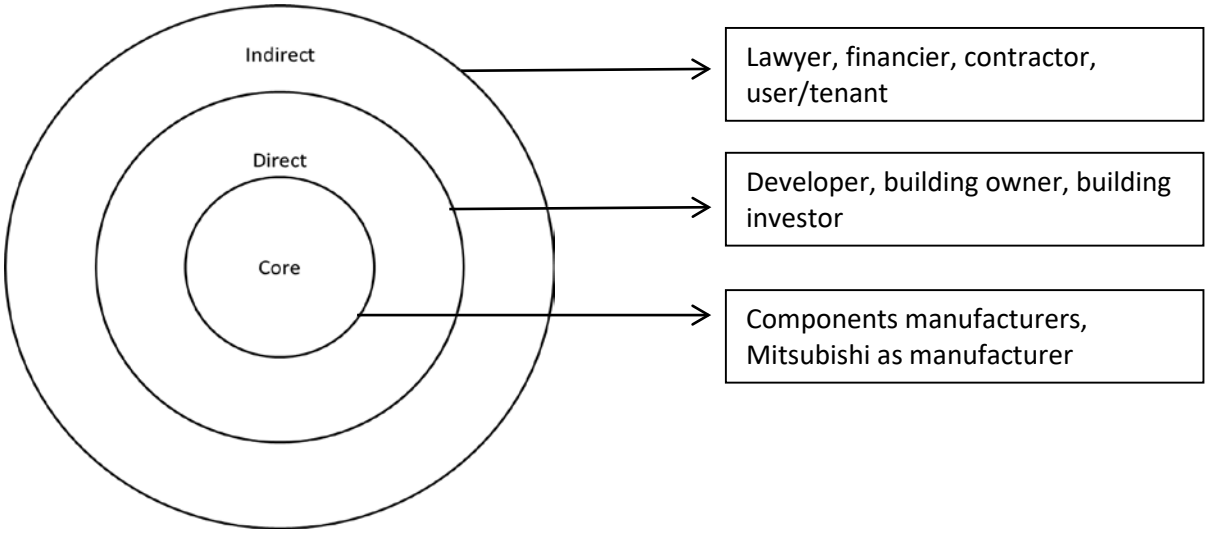
FIGURE 17 MATERIAL FLOW WITH VALUE FLOW OVERLAY



3.1.3 The Stakeholder Mapping

This section shows a graphical presentation of the stakeholders involved in the M-Use® model. As discussed in the section above, Mitsubishi uses lawyers and financiers to set up the new business model. Hence, these are indirect stakeholders when looking at the M-Use® model. Other indirect stakeholders include the contractor and the building user/tenant. The direct stakeholders are the developer (Delta Development Group) and the building owner/investor. The core in this stakeholder map is of course Mitsubishi itself and the components manufacturers.

FIGURE 18 STAKEHOLDER MAPPING



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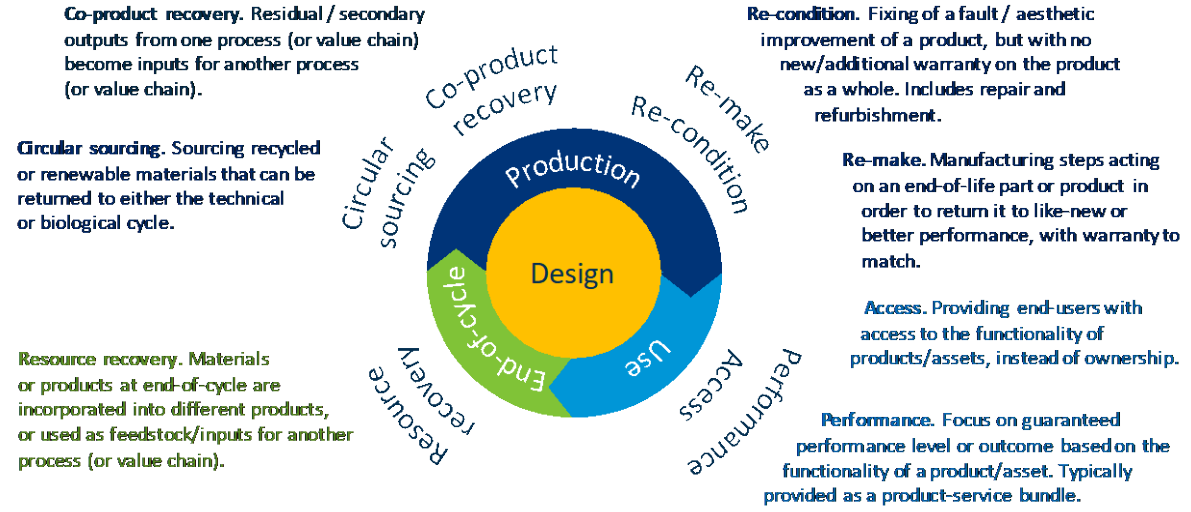
3.2 Business model circularity assessment

This section provides an assessment of the M-Use circular business model. It begins with a depiction of the 7 Circular Economy Business Model Patterns identified by the R2Pi project, and describes which of these patterns are utilised by Mitsubishi. This is followed by a SWOT analysis, based on the information provided by Delta Development Group, including the strengths, weaknesses, opportunities and threats of the CEBM.

3.2.1 Circular Economy Business Model Patterns

Mitsubishi utilises primarily the patterns of access and performance, which will be discussed in more detail in the following sections.

FIGURE 19 CIRCULAR ECONOMY BUSINESS MODEL PATTERNS



Source: R2Pi

Firstly, the access pattern is applicable because Mitsubishi provides their end-users access to the functionality of an elevator: vertical transportation. With the M-Use® model, elevators are leased (full service operational lease) instead of sold/bought. Monthly costs are based on the level of usage, calculated for the first year at 3000 rides a week. The ownership of the elevator remains with Mitsubishi during the contract term. This is an important aspect of this CEBM, since leaving the ownership with Mitsubishi contributes to the circularity of the elevator. Mitsubishi is incentivized to minimize maintenance needs, build products for long-term durability and ensuring residual value. Therefore, fewer materials are needed for maintenance, replacement of the elevators is only required in the longer term, and Mitsubishi will reuse materials due to their residual value. This positively affects the circularity of the elevator.

Secondly, the performance pattern is applicable because M-Use® is an 'Elevator as a Service' model that comes with a performance-based contract (see Section 1.2). This contract focuses on a guaranteed performance level based on the functionality of the elevator, by including Key Performance Indicators (for an overview, see table 1). Periodic compensation is recalculated each year based on these KPI's. Besides, incentives for Mitsubishi to meet the KPI's are assured by discounts. Meaning that the periodic reimbursement will be decreased with the amounts as mentioned in the discount-table, which lists a specific "fine" for every unachieved KPI.

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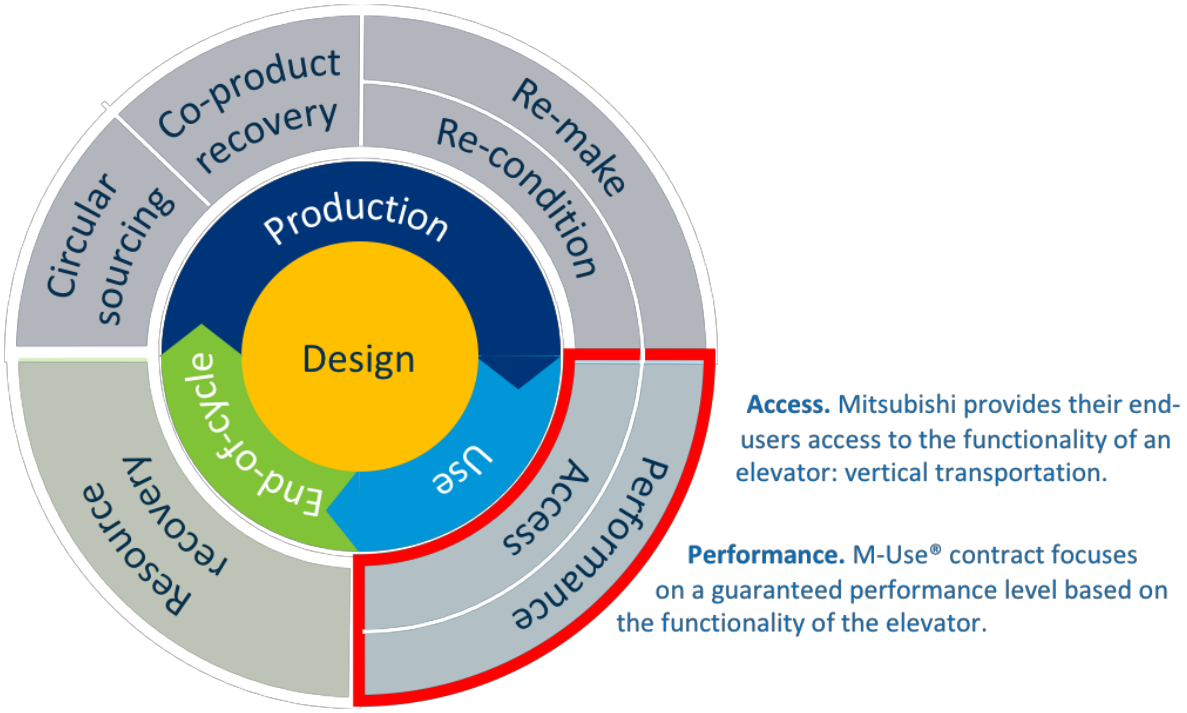
FIGURE 20 CIRCULAR ECONOMY BUSINESS MODEL PATTERNS OF MITSUBISHI



3.2.2 SWOT analysis

This SWOT analysis is conducted looking at the strengths, weaknesses, opportunities and threats of the 'elevator as a service' business model, based on the information provided by Delta Development Group.

FIGURE 21 SWOT ANALYSIS

Strengths	Weaknesses
• Grip on future raw materials since Mitsubishi stays the owner of the elevator; • Secured income during contract period; • Optimally use of the elevator; • Mitsubishi and user have shared interests; • Expertise of Mitsubishi is used.	• Should determine ownership (establishing 'building right'), which is time consuming; • Risk of higher maintenance costs for Mitsubishi than calculated in advance; • Pre-financing required for Mitsubishi due to periodic payments; • In this case there was a set time schedule and budget, which putted pressure on the development of this new CEBM;
Opportunities	**Threats**
• Residual value at end of contract duration; • PaaS use for marketing purposes; • Giving direction in construction chain; • Apply more innovation (at your own risk); • Delivering end-result instead of a physical product; • Receive customer experiences & usage data, optimize the service; • Closer related to customer, knows changes in demand as first; • More influence on process and design;	• Changing requirements / techniques; • Will you receive your materials in the event of demolition / bankruptcy of the building (owner)?; • Inattentive use due to less sense of ownership by the user;

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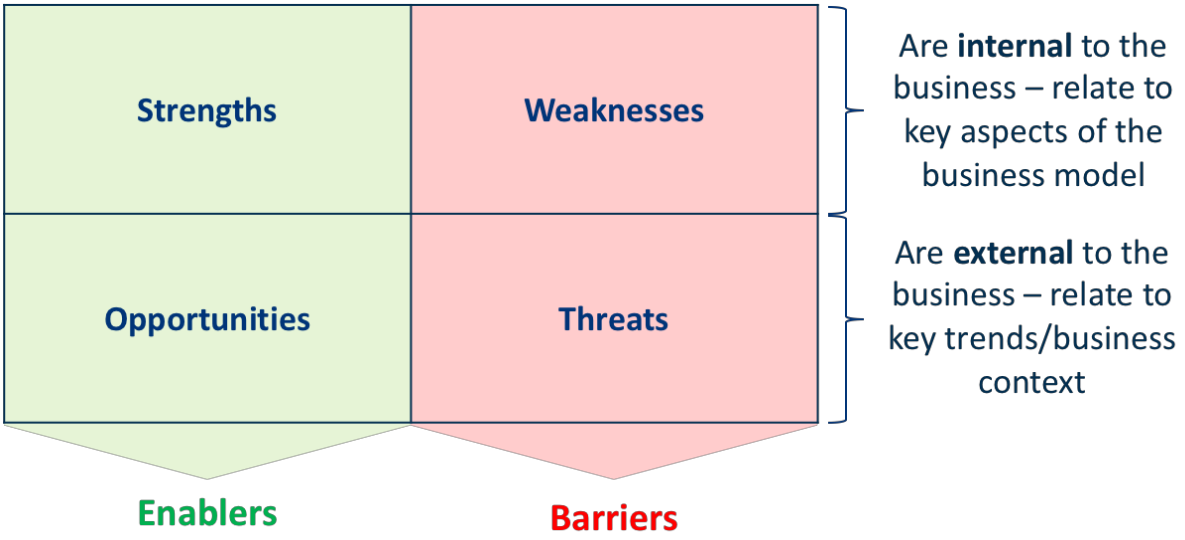
FIGURE 22 SWOT ANALYSIS FEEDS INTO ASSESSMENT OF ENABLERS AND BARRIERS



3.2.3 Final Assessment

The M-Use® model of Mitsubishi has proven to be both ecologically and economically viable. These efforts have shown significant improvements over the traditional linear buying of elevators as exemplified by the positive financial and non-financial outcomes listed previously. There are always both enablers and barriers to any business model, and having discussed these above, the company can consider several ways to move forward and continue their journey towards circularity. Some of these are listed below:

- Seek to move to a higher level of residual value by further improving the design of the elevator.
- Use the received customer experiences and usage data to further optimize the service.
- Listening to your customers. Due to the stronger relationship Mitsubishi can be aware of changes in demand, which gives a competitive advantage.
- Explore other solutions, such that the time-consuming 'building rights' are no longer necessary.
- Improve the M-Use® model to further decrease energy usage.
- Explore additional ways to re-use (components of) the elevator and give the product multiple use phases.
- Start operating on the global market, while seeking for solutions to re-use elevator components locally and when not possible, to recycle material locally.
- Increase marketing and education across multiple channels to increase awareness of and demand for M-Use®.
- Pursue cross-industry cooperation to overcome system issues and build the necessary infrastructure for increasing recovery, reuse and recycling of the components and materials.

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4 Discussion & Conclusions

This section contains a discussion and conclusion derived from the conducted case study.

The M-Use® business model from Mitsubishi is a great example of a circular business model that is already available on the market. Mitsubishi and Delta Development Group show that innovative CEBM's work, as long as they cooperate with each other and put effort into creating this new business model to drive circularity.

Although the M-Use® model is a mature circular business model, Mitsubishi keeps working on improvements. For example, there is a lack of existing infrastructure for recycling and recovery. Therefore, Mitsubishi is further developing this infrastructure together with its partners. Furthermore, the original elevator was not designed for disassembly for re-use purposes. The design of the M-Use® elevator is being improved continuously to enable easier detachment from the building.

Looking at the value chain perspective, Mitsubishi had some major breakthroughs which include the material passport for M-Use® and the IT-infrastructure to increase the residual value by supporting transparency and information sharing. Regarding policies Mitsubishi also had some breakthroughs. Since the current law of ownership is a barrier to the M-Use® business model, Mitsubishi applied a so-called "building right". This building right is a standard Dutch law, which is already used for years for all different kinds of products. For example, this right states that the ownership of a product, owned by person A, that is attached to a product/building/etc. of person B, will still be owned by person A, in the case of bankruptcy of person B.

The three most important contextual factors that drive the M-Use® are customer needs, technology and economy. First, the CEO of Delta Development Group (= customer) asked for vertical transportation instead of an elevator. Second, the remote monitoring technology of the M-Use® elevator drives the circularity of the elevator. Finally, the high-quality elevator of Mitsubishi has a residual value.

Looking at the strengths, weaknesses, drivers and barriers and the CEBM patterns of M-Use®, this 'product-as-a-service' definitely offers opportunities for replication to other industries and products. This case study shows that a 'product-as-a-service' model offers substantial potential for positive environmental and economic benefits. Companies and industries must, of course, reflect carefully on their specific context and product design when choosing the circular model they intend to pursue. In the Netherlands, already a number of 'products-as-a-service' CEBM's exist.

The key learnings derived from this conducted case study can be of value for others. Firstly, the intrinsic motivation of stakeholders helps to develop a new CEBM. Ultimately, the intrinsic motivation of the CEO of Delta Development, Coert Zachariasse, was the main driver for the development of the new business model. Coert wanted to show that this innovative model, which promotes circularity, could really work on many levels and for a variety of stakeholders.

Secondly, limitations of traditional business models can enable new ways of thinking and doing business. Mitsubishi was, in the traditional business model, finding difficulties in coping with the difference between the short-term revenue model of the contractor and building owner versus the long-term quality of the Mitsubishi elevators. Looking at both the financial aspects as well as circularity, it would be undesirable and irresponsible to develop a lower quality elevator. Delta Development then

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came to the conclusion that in fact, the NOW building did not require elevators: the real need was *vertical transport available at all times*.

Thirdly, collaboration within the supply chain is key. Delta Development Group, Mitsubishi and a building investor together decided to market M-Use®, world's first Elevator as a Service model. This resulted in three steps in the supply chain together putting effort in making this new CEBM work. Furthermore, Mitsubishi is collaborating with strategic partners and companies such as IBM, to help find other high value second life options for the components and materials of the elevator.

Fourthly, creating a safe environment in which the stakeholders can try to develop a new CEBM without any risk helps in developing a new CEBM. As an incentive Delta Development guaranteed Mitsubishi that whatever the outcome of this collaboration and investigation, they would buy the Mitsubishi elevators. This approach helped Mitsubishi to investigate the possibilities for the new model.

Finally, it takes time to explain the new CEBM to all stakeholders in such a way they understand and accept this new model. The consideration of customers regarding elevators is still mostly cost driven and their evaluation is based on principles of the linear economy (e.g. investment costs), while the M-Use® model offers more than a reduction in the cost over time (see True Value analyses made by KPMG) and should be valued based on the principles of the circular economy (e.g. Total Cost of Usage). People need to understand the circular economy in order to be open to this new business model.

Finally, an overview of recommendations for business leaders and policy makers.

Recommendations for business leaders:

- Develop a material passport for your product to support the reuse and recycling of the product and its components, increasing the residual value of the product.
- Implement an IT-infrastructure to increase the lifespan and residual value by supporting transparency and information sharing.
- Provide marketing and education across multiple channels to increase awareness of and demand for your CEBM.
- Pursue cross-industry cooperation to overcome system issues and build the necessary infrastructure for increasing recovery, reuse and recycling of the components and materials.
- The intrinsic motivation of stakeholders can support the development of a new CEBM, so ensure their motivation.
- Think about the limitations of your traditional business models. These limitations can enable new ways of thinking and doing business.
- Collaborate with your supply chain when you want to implement a CEBM.
- Creating a safe environment in which the stakeholders can try to develop a new CEBM without any risk.

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Recommendations for policy makers:

- Rethink the current law regarding ownership, since this law poses a risk for the supplier of a 'Product-as-a-Service' CEBM.
- Make take-back (by the supplier/manufacturer) of the product mandatory by law. This will force the manufacturer to rethink the design of the product.
- Search for other ways to extend producer responsibility. Extending the current linear responsibility of producers (e.g. a guarantee for only one year) will lead to more "product as a service"-models, thus supporting circularity.
- Subsidise reuse and recycling programs.
- Develop circular economy roadmaps on national, regional and local level, because they help creating a circular mind-set.
- Create funding opportunities and venture capital for CE-related investment. CEBM's require new financing needs that most banks currently do not want to finance.
- Change the current competition regulation regarding tenders. For example, Life Cycle Assessment (LCA) and True Value analysis are important topics to consider.
- Support new technological developments that can support circularity of a product or business model. For example, create R&D capacities.
- Educate people about circularity. Social attitudes are an important driver in developing new CEBM's.

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Appendix A: about Park 2020

A.1 Waste equals food

- **Centralized Grey-Water storage/reuse (image: water diagram)**
  - An underlying infrastructure designed for park-wide grey-water separation, storage and reuse connects the individual structures and public spaces in a closed-loop system for water reclamation and filtration.
    - Design both within the park and at the buildings considers rainwater and surface run-off water as possible resources that can be leveraged within the infrastructure and building systems. Because of this, impermeable ground cover is minimalized.
      - Rainfall on hardscaped areas in the park and on green roofs at buildings as well as grey-water from the buildings are captured and centralized into the on-site water retention canal where natural filtration occurs by means of an extensive helophyte construction. The water from the canal is then reused within the offices grey and black water needs and in the park for landscaping irrigation.
      - Materials are scrutinized for their possible negative effects on water systems at the park. Toxic chemicals and heavy metals are banned where possible.
  - Steps are taken to ensure that groundwater contamination does not from construction activities and Park 20|20 Services works with tenants to optimize their water consumption and reuse/filtration activities in order proactively work against potential groundwater contamination that could result from the operations of Park 20|20 tenants.
    - Careful consideration of water efficiency techniques are taken throughout the design and realization of the site master plan and its individual structures.
- **Park 20|20 Materialization & Participants Program**
  - Park 20|20 encourages the use of Cradle to Cradle Certified™ products and actively supports those companies that are engaged in certifying and improving their products according to the Cradle to Cradle® principles. Park 20|20's general contractor VolkerWessels, architectural firm William McDonough + Partners, Material Intelligence Expert Eco Intelligent Growth (EIG) and Delta Development Group, all continuously contributes to the development of an extensive working databases of Cradle to Cradle Certified™ materials available in the Netherlands and Europe which is made readily available to the design and construction teams active in Park 20|20's creation.
    - As part of Park 20|20's continuous improvement strategy, each phase of development strives to expand upon the use of Cradle to Cradle Certified™ materials and decrease the amount of "undefined" materials.
  - The Delta Development Group also actively works with local building material providers in order to establish distribution channels for Cradle to Cradle Certified™ materials from other European markets in order to expand the availability of Cradle to Cradle Certified™ building products within the Dutch market.
  - Where Cradle to Cradle Certified™ building materials are not currently available for specific needs, Park 20|20 has engaged the services of EIG in order to assess a variety of products for Cradle to Cradle® *potential*. For those products that show potential for Cradle to Cradle® Certification, Park 20|20 then offers incentives in order to encourages certification with and officially recognized Cradle to Cradle® certification organizations.

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        - Where alternative materials are necessary, materials have been chosen that minimize hazardous chemicals.
    - In order to stimulate innovation and establish close contact with material and service providers, Park 20|20 has built up an exclusive networking program. This program continuously evolves to meet the demands of a market but always promotes the use of Cradle to Cradle Certified™ products.
        - "Speed dating" sessions are often held in the early design phases of a project to enable direct contact between providers of Cradle to Cradle Certified™ products and the design/build team (plus client where possible). This process helps the design/build team to identify potential solutions and materials earlier in the process of construction.
        - The Park 20|20 network encourages an atmosphere of mutual benefits and encourages the development of professional relationships between participants in order to strengthen eco-effective business activities.
- **Reverse Materials Logistics to the Technosphere**
    - Park 20|20 actively encourages and looks for *reverse logistics* opportunities for technical nutrients in order to upcycle them back to industrial manufacturing process at an equal or higher level of quality. Take-back and leasing programs that look to redefine the concept of ownership and make material manufacturers responsible for eco-effective design are incorporated wherever possible in both the master plan and individual projects.
        - Park 20|20 works with BB-Lightconcepts for lighting solutions in parking areas. BB-Lightconcpets incorporates a *take-back program* into its sales and leasing services, effectively working to bring technical nutrients back into its production process of new products.
        - Park 20|20 has also worked in *product as a service* constructions for office furniture and elevators. More specifically on elevators, Park 20|20 and the Delta Development Group were, together with Mitsubishi designers of the "leasing of vertical mobility program" known as M-Use. Park 20|20 has also worked with a professional sustainability analyst and strategist to further develop its product as a service program.
- **Park 20|20 Greenhouses:**
    - Greenhouses have been incorporated into the site designated for future development. These greenhouses supply organic food to Park Café Groen and other restaurants in the surrounding area. As phasing commences to the areas currently accommodating the greenhouses these are then moved to other areas at Park 20|20. Park 20|20 is also investigating opportunities and solutions to scale-up the m^2 of these greenhouses and incorporate them into the final area development and buildings in order to continue its urban farming activities and supply healthy food to the local community.
        - The Greenhouses are operated by a local farm in close proximity to Park 20|20 in order to support local agriculture business.
        - Once a week, products from the local farm are available for sale to the Hoofddorp community at Park 20|20 through the greenhouse.
        - Food either not delivered to Park Café Groen and other local restaurants is sent to a foodback in Hoofddorp.
- **Park-wide Composting Program**
    - Park-wide composting contributes to the development of topsoil that can be used for landscaping needs at Park 20|20.
    - The Park 20|20 compost pile is located in a public area to encourage park visitors to contribute biological nutrients.

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- **Park-wide Nutrient Management Program with De Meerlanden & Royal Dutch Bammens**
    - Park 20|20 has partnered with De Meerlanden and Royal Dutch Bammens through its innovation network in order to research and develop eco-effective solutions to the management of waste and nutrient streams in public areas. Together Park 20|20, De Meerlanden and Royal Dutch Bammes are pursuing designs to eliminate the concept of waste and instead develop eco-effective nutrient streams that can bring biological nutrients back to nature and technical nutrients back to industrial production processes at an equal or higher level of quality. Given the variety of settings incorporated into the area design of Park 20|20, as well as the variety of clients at the office park there is a positive opportunity to provide more insight on how people interact with waste within diverse settings. Park 20|20 is a pilot location for Royal Dutch Bammens where they can test new product developments in waste and nutrient disposal systems. De Meerlanden is responsible for the collection and optimization of biological and technological nutrient streams.
- **Design For Disassembly; Flexibility and Future Area Development**
    - William McDonough + Partners, N3O, VolkerWessels and our structural steel engineers has incorporated flexibility into the design and development of the master plan and individual buildings through the use of designs that are able to be disassembled in order to accommodate the future built environment needs of the region.
        - While *human centered design* incorporates the specific needs of current occupants, individual commercial structures are also designed to accommodate the needs of future occupants as well.
        - While the current use of Park 20|20's structures is for commercial real estate, individual developments have also been designed with the potential to function as residential and retail buildings.
        - In the most extreme situation, Park 20|20 is able to be returned to its infrastructural elements which are able to accommodate the water and energy needs of any required future situations such as residential, logistics, retail and leisure.

A.2 Use Solar Income

- **Centralized Heat and Cold Storage Energy System**
    - Project specific energy requirements are optimized by connection to a central energy infrastructure that is able to identify excesses and insufficiencies within individual buildings and then transfer heating and cooling where it is needed to stabilize fluctuations. 100% of the cooling and 75% of the heating requirements for all of the buildings is provided by the centralized hot and cold storage installation. The centralized hot and cold storage system is combined with the water storage canal to realize a multiplier eco-effective strategy. In the winder, cold water from the canal is stored in the ground and serves as cooling for the summer. Visa-versa in the summer warmer water is stored in the ground and is then pumped into the building and heated with a heat-pump to provide heating in the winter.
- **Park 20|20 Energy C.V.**
    - Park 20|20 Energy C.V. is committed to the Search for *clean* renewable energy investment opportunities both on-site and off-site in order to achieve Park 20|20's ambition of an area development that produces more energy than it consumes.
- **Trias Energetica**
    - The relationship between design and the energy grid has been carefully considered. In order to facilitate the progressive development towards Park 20|20 as a net-positive energy exporter, development incorporates a three-part *trias energetica*

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strategy continuously 1.) Reduces energy requirements on the park as a whole, 2.) Stimulates the use of *clean* energy produced by renewable methods, and 3.) Where supplementation is necessary, purchases energy from the local grid. In Park 20|20's trias energetica strategy, components one and two are continuously enhanced while component three is continuously reduced and eventually completely off-set by the production and delivery of clean renewable energy to the grid.

- Park 20|20 is 100% electric. Gas connections are not available at Park 20|20 eliminating the possibility for the future reintroduction of fossil fuels.
- Until such time occurs that investments in *clean* renewable energy sources are scalable to a level that is able to exceed Park 20|20's energy requirements, Park 20|20 Energy C.V. is committed to the purchase of energy from the grid that is only produced from renewable sources.
- Structural investments have been made in a large solar PV installation at the Fokker Logistics Park to further off-set electricity consumption at Park 20|20. Where electricity must be purchased "sustainable electricity" is what is used.

- **Park-wide Solar Studies**
  - As identified in the Hannover Principles, solar energy has been evaluated not only for its ability to generate renewable energy, but also for the ways that Park 20|20 occupants and visitors are able to enjoy sunlight throughout the annual cycle.
    - Numerous solar studies have been undertaken by William McDonough + Partners on the site master plan to best understand and strengthen the presence of sunlight in communal areas throughout the various park spaces.

A.3 Celebrate Diversity

- **Enhancing On-site Biodiversity**
  - An assortment of habitats have been created throughout Park 20|20 in order to support and stimulate the inhabitation of a variety of animals and insects. Together with the landscape architect specific attention has been paid as to how to best create environments where local and migrating animals and insects can live and flourish.
    - *Bird's eye view* considerations have been taken into account. From above green roofs of individual buildings are attractive to local and migrating birds and provide safe nesting areas that are out of reach from potential land-based predators.
    - Early on, Park 20|20 engaged national biodiversity experts and an organization called the Vlinderstichting for inspiration on how to best design and develop its landscaping and various pocket parks located throughout the master plan. Three critically endangered species of butterflies were found to be native to the local Haarlemmermeer and as a result, the choice of flora at the park is largely done to provide food-sources and breeding grounds for these three critically endangered butterflies.
- **Diversity in Design**
  - As identified in the Hannover Principles, architecture at Park 20|20 is designed to incorporate the presence of *spirit* by creating relationships between people and their surroundings, and to invoke a firsthand feeling of belonging to the nature in a particular place. In this way, design solutions are intended to present an aesthetic statement that engages occupants and visitors in honoring and more deeply understanding the human place in the natural world (Hannover Principles; pgs; 27-28)

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- No structures at Park 20|20 are based upon the same design as a previous structure. At Park 20|20 architectural design is considered to be an opportunity to celebrate creativity.
  - Uniqueness and creativity is enabled through the use of *human centered design*, whereby occupants and visitors are considered in all design elements. A result incorporating a human centered approach is that the needs and unique characteristics of an organization and its employees are carefully considered and reflected in its design and creation.

- **Enrichment of Local Identity**
  - Park 20|20 is seen as an extension of the current built fabric of the Beukenhorst area in Haarlemmermeer, not as an independent, self-contained development.
    - During the development of Park 20|20's site plan careful consideration of the needs of the surround office parks was made in order to provide ample connectivity to the Park and its facilities. The intention of this decision is to enrich the surrounding areas by providing their occupants with access to facilities and services that were not yet otherwise available in the Beukenhorst.
  - Local produce is organically grown on-site in several greenhouses and Park 20|20 works with local farmers to operate these greenhouses in order to provide food for Park 20|20's restaurants and cafés as well as for other local restaurants and cafes in the immediate vicinity.
  - For those needs that are not harvested in our onsite greenhouses, such as cheese and potatoes, Park 20|20's restaurant, *Park Café Groen* also exclusively purchases these products from local farmers from the Haarlemmermeer.
  - The incorporation of a canal for water retention needs celebrates the local Dutch culture and techniques for water management that have been in practice in the Netherlands for centuries.
- **Spatial Diversity in Site Layout**
  - In line with the Hannover Principles, a well-rounded culture offers a full range of landscape experience, from the urban to the wild, allowing the human ecology of a place to emerge as humans interact with a diversity of landscapes over time. Throughout the site-plan a variety of garden areas have been built into the site plan, each intended to provide a different atmosphere and experience to visitors as they interact with the natural and built environment.
  - From an area development perspective, building footprints on each plot have taken into consideration the need to promote landscaping elements and to provide views into the central park from the outside.

A.4 Other

- **Productivity and Human Centered Design**
  - Park 20|20 has an extensive research and innovation program that continuously studies the effects of building systems on the performance, productivity and wellbeing of people and works directly with its clients to positively influence health, wellbeing and productivity. Specific areas of focus for influencing health, wellbeing and productivity are: acoustics, natural light, air quality, biophilic design, thermal comfort and interior layout. To date Park 20|20 has invested over € 250.000,00 in its R&D program and as a result is delivering cutting edge solutions personalized for tenants to help have a positive effect on employees and the business.
  - Park 20|20 engages as a base to design and layout the Leesman Group and conducts pre-occupancy Leesman survey's about the effectiveness of the office being occupied prior to relocating to Park 20|20. This information and data serves as a key

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data input into the identification of firm-specific needs and solutions when designing a healthy, productive office. Following the relocation move to Park 20|20 a Leesman post-occupancy survey is conducted to assess the effects of design. Key lessons learned from each project is leveraged across the construction team to enhance the teams understanding, effectiveness and professionalism in delivering healthy, productive buildings.

- Park 20|20 actively engages in *Activity Based Working* (ABW) and what is know in interior design and layout circles as "smarter working" in order to design and layout interiors based on how a specific company works and its anticipated growth strategy instead of a more traditional "sale of square meters" approach.

- **Encouraging Business through Eco-Effectiveness**
  - All activities at Park 20|20 must meet predefined return targets within the confines of *normal* commercially viable business cases (without the need for subsidies). The reason for this requirement is that Park 20|20 aims to serve as a positive example that confirms to the professional community that added value for stakeholders is possible through the implementation of eco-effective business practices.
- **Cradle to Cradle® as an initial intention and objective**
  - From the very beginning of the initial concept phase, Park 20|20 has clearly stipulated its intention and determination to implement Cradle to Cradle® as the underlying strategy for the entire project. As a result, Cradle to Cradle® is seen as the key value driver for projects for all economic and development strategies at Park 20|20.
- **Continuous Improvement**
  - Implementation of Cradle to Cradle® at Park 20|20 is through the development of a *descriptive framework* that is able to guide our economic and creative activities. The selection for a descriptive framework as opposed to a *prescriptive* set of requirements allows for Park 20|20 to continuously review, evaluate and improve upon its design and build techniques as well as its identification for areas of increased stakeholder value.
    - The Design and realization of Park 20|20 is seen in terms of a long-term strategy whereby buildings and the area development as a whole is able to adapt to evolving regional needs. As a result Park 20|20 leaves room for the changing understanding of humanity's and the built environments' place in the natural world.
  - Examples of specific development aspects that have been given incessant attention of continuous improvement include (but are not limited to):
    - Water
    - Clean Renewable Energy
    - The Use of Safe and Healthy *Cradle to Cradle Certified™* Materials
    - Enhancement of Biodiversity
- **Education**
  - In order to improve our team cohesiveness, internal decision-making process and design/build activities, Park 20|20 has engaged the services of EPEA and MBDC to provide Cradle to Cradle® Training Sessions to the firms involved in the realization of Park 20|20. These training sessions include representatives from development, construction, engineering, infrastructure, architecture and technical advise.
  - The Park 20|20 Experience Center located within the *Technical Nutrients Pavilion at Park 20|20* has been constructed as a public gathering facility where industry professionals either directly or indirectly related to the built environment are welcome to see, experience and learn more about how Cradle to Cradle® can be successfully implemented within the built environment.

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- Park 20|20 regularly works with educational institutions at all levels to provide lectures, workshops, develop case studies and offer inspiration as it relates to the implementation of Cradle to Cradle® Working in the built environment.
    - Among other education initiatives, Park 20|20 has partnered with the Municipality of Haarlemmermeer to host the first annual KidZ SHARE Awards. At the KidZ SHARE Awards, local high-school students were first given workshops on Cradle to Cradle® and real property development by a diverse range of professionals from Park 20|20. Following these workshops students were then, within teams, asked to develop a concept for "*The Office of the Future*". These teams then presented their concept before a panel of judges and the winning group was presented with an award during a special event at the FOX Vakanties Travel Theater by Cradle to Cradle® co-creator and Park 20|20 architect William McDonough.

- **Mobility**
    - Bicycles and pedestrians are given priority.
        - Connectivity to the surrounding area through footpaths has been incorporated into the site masterplan.
        - Showers and bicycle parking areas at buildings encourage the use of bicycles at Park 20|20.
    - Park 20|20's location makes accessibility possible through a variety of public transportation options.
        - Buss stations are located immediately on either side of Park 20|20 within 300 meters.
        - The Hoofddorp Central train station is located within 300 meters of the western point of Park 20|20, providing direct access to a national train hub at Schiphol International Airport.
    - For automobiles, careful attention has been taken to incorporate future energy needs through the incorporation of electrical charging stations for hybrid and 100% electric automobiles. These charging points are provided at the best parking spaces within parking garages.
        - Charging stations are also made available at taxi areas.
        - Park 20|20 offers a car-sharing plan for tenants of not only Park 20|20 but the entire Beukenhorst area.
- **Social Initiatives**
    - At the Park 20|20 greenhouses and urban farm park-time work is available for people with distance to the labor market that are having difficulty finding work elsewhere. This service is initiated and managed by the local farmer that operates the greenhouses.
    - Park 20|20 is an active supporting member of the sustainable incubator *Haarlemmermeer Enginn* which provides support for sustainable entrepreneurs.
- **Sharing Knowledge**
    - The Delta Development Group has provided a number of internships to young enthusiastic students interested in Cradle to Cradle® in real estate development; has participated in a number of research and study programs; and are very active in the larger international Cradle to Cradle® community through actively giving talks, workshops and presentations on various topics of Cradle to Cradle® applications for the built environment. Delta team members also happily and proudly serve on a number of committees and service positions at the Cradle to Cradle Products Innovation Institute (C2CPII) which is the international non-profit organization responsible for the administration of the *Cradle to Cradle Certified™* Product Standard. These committees and service positions within the C2CPII include:

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- Member of the C2CPII board of directors
- Member of the C2CPII European Advisory Council
- Advisor to the C2CPII Built Positive Initiative
- Member of the C2CPII Built Positive Owners and Developers Roundtable

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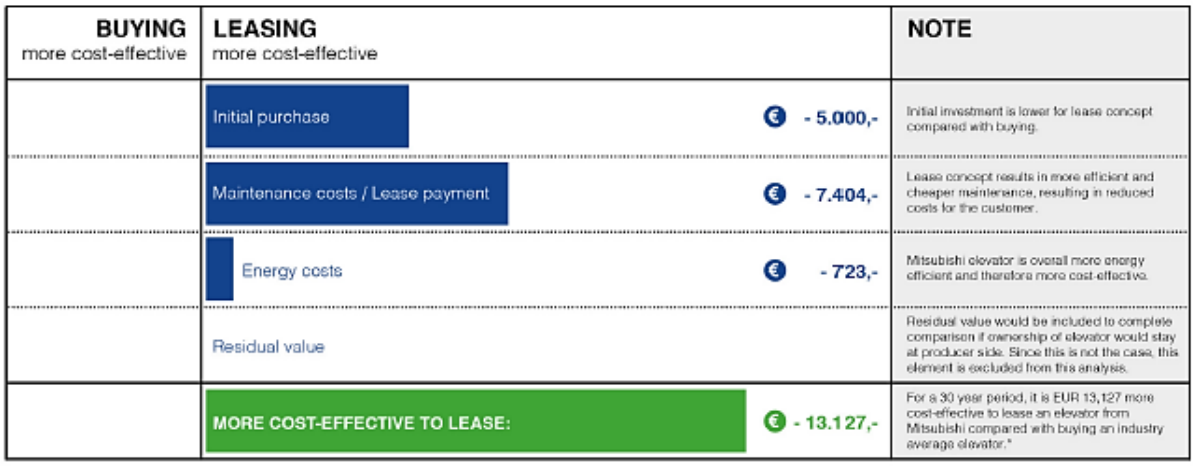
Appendix B: The results of the KPMG TrueValue analyses

Leasing versus Ownership

Leasing a Mitsubishi elevator is more cost-effective than purchasing an average industry elevator.

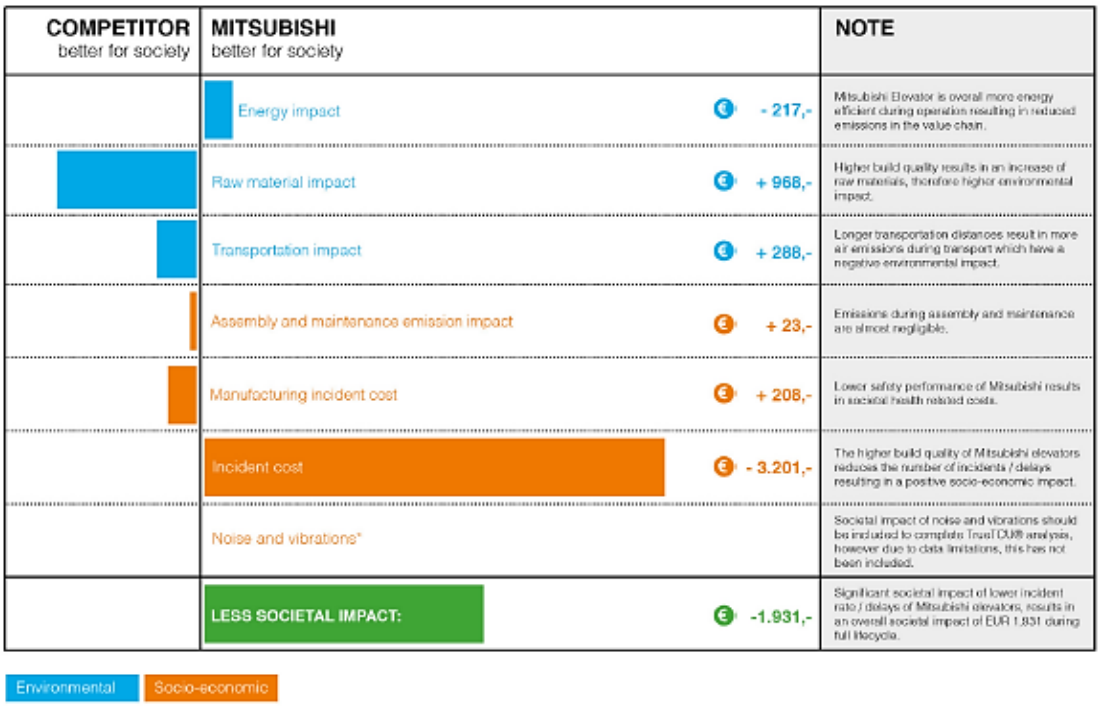


* for a 6 floor elevator in an office building, usage category 4 (NEN 2767 part 1).

Analysis 1: Comparison of buying an industry average elevator and leasing a Mitsubishi elevator, for a 30 year period, in the Netherlands (customer perspective). Numbers expressed in present value.

Social and Environmental impacts

A Mitsubishi elevator has a lower socio-environmental impact than an average industry elevator.



Analysis 2: Comparison of the socio-economic and environmental impacts of the industry average elevator in the Netherlands and a Mitsubishi elevator (30 year period). Numbers expressed in present value.

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Appendix C: Contextual analysis

R2PI project

Contextual analysis

Company: _Delta Development Group

Name and position of respondent: Eline de Leeuw

Duration (total time devoted to fill out the Excel): _____

Data: _____ 15/02/2018

DRIVER						Please, rank the following according to how much of a driver / barrier you think they represented for implementing your CEBM (put an X where appropriate)	BARRIER					
Not at all important	Slightly important	Moderately important	Very important	Extremely important	N/A		Not at all important	Slightly important	Moderately important	Very important	Extremely important	N/A
				x		CE roadmap / initiative at the national / regional / local level						
			x			Setting of end-goals and monitoring (CO_2, noise, movements) at the national / regional level						
					x	Activity permit (license)						
						Warranties law (e.g. second-hand products)			x			
						Intellectual property rights (e.g. components susceptibles of being reused)		x				
						International trade agreements (e.g. requirements in certain markets)						
					x	Dramatic change in a target market regulation (e.g. banning the use of plastic bags in China)						
						Competition regulation (e.g. positive discrimination for CE products is not permitted in public procurement)			x			
						Public subsidies that support linear economy (e.g. subsidies to fossil fuels, car purchase incentives)		x				
		x				Resource efficiency targets, requirements of reusing percentage of components and raw materials in new products						
						Waste regulation, recycling regulation, water regulation, energy regulation and choice restriction		x				
		x				End of life regulations						
			x			Mandatory take-backs						
			x			Extended Producer Responsibility						
x						Material and design standards (national and across industries)						
	x					Controls and penalties (e.g. controls and sanctions on the use of specific products)						
				x		Fiscal measures (green taxes): land-value taxes, value-extracted tax, product levy and recovery rewards						
			x			Differentiated VAT rates (e.g. products with high recycled content included among VAT reduced goods)						
				x		Green public procurement (e.g. performance procurement by public sector)						
	x					Public subsidies for eco-innovation, eco-design						
				x		Public support for demonstration and commercialisation of innovation in Circular Economy (technology platforms, pre-commercial procurement, lead markets)						

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DRIVER						Please, rank the following according to how much of a driver / barrier you think they represented for implementing your CEBM (put an X where appropriate)	BARRIER					
Not at all important	Slightly important	Moderately important	Very important	Extremely important	N/A		Not at all important	Slightly important	Moderately important	Very important	Extremely important	N/A
						Availability or prices of raw materials that support linear economy (water and energy included)				x		
						Availability or prices of raw materials and products that support CE				x		
	x					General economic "health"of incumbent companies in a sector (crisis, decline, stability, growth)						
						Competition trends in the market		x				
					x	CE-supportive business environment (technology providers, advanced services, eco-design businesses…)						
					x	Relevant and expanding CE / environmentally oriented market segment in the country / region						
						Market purchase capacity		x				
					x	Suitable infrastructure for recycling and recovery / other (e.g. supporting shared use)						
				x		IT-infrastructure (supporting transparency and information sharing; joint collection systems; match-maker mechanisms)						
	x					Extensive raw materials information service						
					x	Funding opportunities / venture capital for CE-related investment						
					x	(Green) lending programmes from banks						
				x			Apropriated technologies for CE						
				x			Major technological trends in the sector; new sectoral developments						
				x			R&D capacities and strengths (innovation agency, university research groups supportive to CE)						
						x	R&D capacities and strenghts in green energy						
	x						Public support for CE-related R&D (new materials, new products/services, supply chain resource tracking)						
	x						Training in CE-oriented activities						
						x	Rural vs urban distribution of population						
						x	Ratio of young vs old population						
				x			Social attitudes towards waste and recycling in the country						
					x		Social attitudes towards eco-friendly production and consumption in the country						
						x	Social attitudes towards water use in the country						
				x			Social attitudes towards energy use in the country						
x							Social movements pressure regarding environmental problems (NGOs, civil society)						
					x		Preference for green brands / products, services by consumers in the country						
		x					Perception of environmental problems by businesses in the sector / country						

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