

# THE POTENTION OF LEASING MODULAR BUILDING SYSTEMS BY RESEARCHING OTHER DISCIPLINES

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**Keywords:** *Lease, modular building systems, building environment, flexibility, aspects*

## ABSTRACT

In the building environment, leasing is not used very often in building systems. This paper investigates what the building environment can learn from other sectors by means of an explorative research. The aim is to investigate the potential of leasing for based modular building systems. The first chapter contains a theoretical framework in which the different lease models are discussed, the specific aspects of the building environment are mapped, and how flexibility in modular systems can be obtained. In the second chapter the identified aspects were examined in other sectors on the basis of a case study. In the third chapter, all case studies in a matrix are compared, followed by an analysis and a translation in the building environment.

## INTRODUCTION

Nowadays, leasing is becoming more popular. There are two various reasons; The user pays a fixed monthly fee for the service and the product, and is therefore not faced with unexpectedly large costs. In addition, lease companies can purchase their products in large quantities, so that the costs remain low for the user.

In the building environment there are already experiments with lease contracts. An example of this is the TU facade. However, leasing is not yet very common in the building environment, while this principle of 'the new purchase' does have the potential in the current market (Communication-BK, 2016).

This paper examines which aspects and factors are important in developing a realistic business model for a modular building system. The following question will be answered:

*What can the building environment learn from other disciplines, to develop a lease based modular building system?*

This research focuses in particular on modular systems for existing buildings. The aim of this research is to clarify how modular building systems have potential to be (partially) leased and what requirements must be set. Results of this study can therefore assess the modularity of the system, and can be the starting point for the technical development. The relevance to conduct research into other disciplines is to gain insight into the aspects that determine how leasing can be successful.

## Method

To answer the central question, a theoretical framework is first formed. This specifies how the building environment, and specifically flexible modular building systems, distinguishes itself from the other disciplines. By determining the characteristic properties, it is possible to determine which aspects can be examined in a case study. In addition, the theoretical framework explores the different lease models.

To investigate different case studies, the explorative research method is used. Various case studies are being explored, whereby the direction of the results prior to the research is not yet known. The aim of the research method is to gain insight into how other disciplines deal with the identified aspects. During this research process different ideas will be gained, which can be used to answer the research question. With this method there are no strict restrictions; all possible interesting data are collected and selected for quality. (Krishnaswamy, Sivakumar, & Mathirajan, 2009) The case studies are compared in a matrix, and analyzed below. This can be used to determine how modular building systems have the potential to be leased, and how this can be translated into a technical elaboration. The conclusion, the ultimate goal of this research, is a collection of factors that contribute to making a business model that influences the technical elaboration of a modular building system.

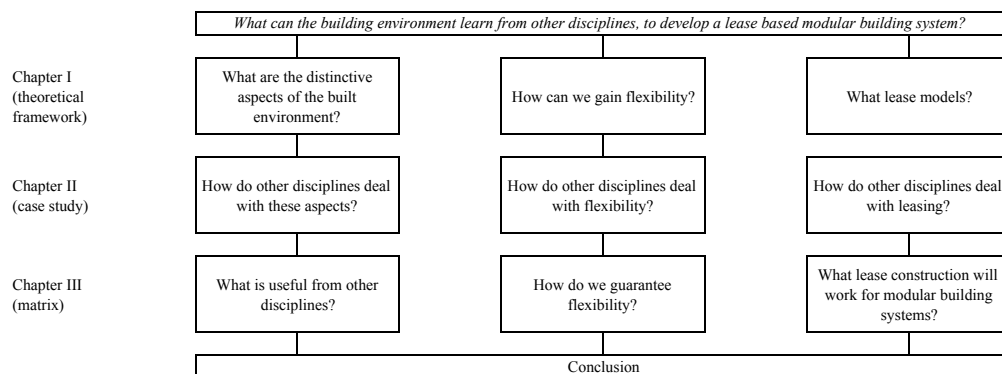


Figure 1: Process of the explorative research

## Chapter I: Theoretical framework

### Distinctive aspects of the building environment

To conduct exploratory research in a goal-oriented manner, it is important to determine what distinguishes the building environment from other disciplines. By systematically charting this during an interpretative elaboration, various aspects emerged. The first aspect is *circularity*. Buildings have a longer lifespan, compared to for example cars and computers. On the other hand, all the parts of buildings have different lifespans than the building itself, which means that there are different circulations. It can be argued that the building environment is complex. Therefore, with all these different components, the second aspect in the building environment is *complexity*. A building consists of several parts, each component having different dimensions, requirements and materials. In spite of this, all these components must be combined integrally and cooperate together as a whole. We can speak of different standards, that are complex to combine. This brings the following aspect *standardization* to the order. There are various standardized systems and building materials in the construction industry, each with their own dimensions. Combining and tuning these systems and materials is therefore often problematic. This challenge also applies to existing buildings in combination

with modular systems, where it is nearly impossible to integrate everything. That is why parts have to be customized, to make it suitable in specific contexts. The result, and the following aspect, is that *reusability* in the building environment is a complex task when we speak about customization. Today, the reuse of materials or elements must be taken into account. This is an important aspect for the flexibility of building systems, because it determines how suitable a system is in different circumstances. Anyone who assembles and adjusts these parts brings us to the next aspect *self-adaptability*. In the building environment, not everything is done by professionals. A modular building system, for example, can also be partially adapted by the user itself. This aspect is therefore important for the quality assurance and the complexity of a building systems.

All these related aspects have a great influence on each other and need to cooperate to develop a modular lease-based building system. In order to translate these aspects into a technical elaboration for a flexible modular system, it is also important to examine how flexibility is achieved.

### **Flexibility**

A modular system is a construction in which the components can be assembled into a whole in different ways (Ensie, 2016). When we speak about modular designs, there is a difference between someone who designs it and someone who assemble it. With this reasoning it can be stated that design is different than assembling.

Various modular systems are already on the market in the building environment. The purpose of a modular building system is to be able to play in a flexible way on the diverse and changeable needs of the user. Flexibility is therefore an important factor of modular building systems. How do we get flexibility in the building environment? This question was asked earlier in the 1960s. Post-war housing in the Netherlands was problematic because it was the only objective to build quickly and many houses, resulting that these houses were monotonous and unadaptable. John Habraken states in his publication 'De dragers en de mensen' that flexibility can be achieved by making a subdivision between the framework and the infill. The framework is the structural and enveloping part of a building object. The fill is the (temporarily) layout of the object. According to Habraken, architect should be responsible for the infill and the occupant must be involved with the design of the individual dwellings. (Bergen, 2013)

Flexibility is therefore an important aspect to development of a building system. A division has been made between a construction, the static, and a fill, the dynamic part. The latter is the flexible aspect of modular building systems. The next chapter also examines how this aspect has been applied in other case studies.

### **Lease models**

Leasing is originally an American principle, and origin of the term 'rental contract'. Lease financing is based on the observation of Donald B. Grant, who made it possible to divide lease from rent: "Why own a cow when the milk is so cheap? All you really need is milk and not the cow." With his approach, the characteristic of leasing and the distinction of renting is made; The separation between a user and the owner. In this way three parties arise: the user, the owner and the landlord. The company that leased a product with service is called a 'lessor'. The person who leases the product is called a 'lessee'. (Gopal, 2014)

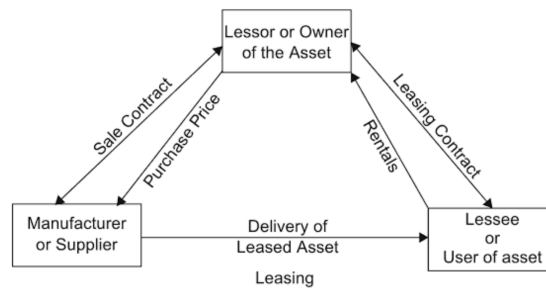


Figure 2: Process of leasing Source: Management of Financial Services, p.279

There are two basic models of leasing. The first is the financial lease. In this model, the lessee lends the money, which means that he is the owner of the product. The lessee therefore does not pay an amount per month for the product, but for the money and the interest of the loan. This means that the product is the property of the lessee at the end of the contract and the residual value of the product is deductible. In the second model, the operational lease, the lessee leased the product for a fixed monthly amount. This includes the costs for maintenance and repair. The product remains the owner of the lessor in this model. Of these two basic types of leasing are different variants, where the financing or takeover of the product is arranged with other parties. (Chakraborty, 2012, pp. 9-12)

## Chapter II: Case study

The case study examines how other sectors deal with the distinctive aspects. Only the relevant aspects are discussed. An overview of all aspects can be found in the matrix in the next chapter. In the case study not only lease products are examined, but also non-lease products. The purpose of this is to understand when a product has or has no potential to be leased, or when a combination would be possible. In addition, these case studies also provide technical insight into the possibility for a lease based modular system.

The identified aspects representative the following opposites:

Circularity:	One circularity versus different circularities
Complexity:	Complexity versus simplicity
Standardization:	Standard versus custom
Reusability:	Reuse versus negligible
Self-adaptability:	Professional versus DIY

### Hardware

Leasing hardware is now popular for companies and individuals. Both laptops, computers, mobile phones and drones are offered with 3 to 5-year lease contracts. The objective in leasing these products is that the user does not pay a large initial amount and does not incur unexpected maintenance costs. After the end of the contract, the user can choose to take a new model free of charge, or to buy the current model for an attractive residual value. In some lease contracts, the product is the property of the user after the contract. (Computer.nl, 2017) Leasing works well in the world of hardware, because the developments of these products go very fast. By means of this construction the lessor loses his outdated products, so that he can offer new lessees new products.

### LED Lease

The Amsterdam company LED Lease provides light as a service. For a fixed amount per year you can lease the lighting with maintenance, including the required electricity, with a 'PayPerLux agreement'. Together with the user LED Lease creates a lighting plan with the necessary costs. After the lease contract has expired, the lighting is the property of the customer. The lease contract is mainly used in large public buildings and offices. LED Lease claims that the costs are 15 to 40% lower. These figures are based on the use and maintenance of the existing lighting, which uses more energy. In addition, the company can take care of the installation in cooperation with the installer of the company. (Leadlease, sd)

### **Swapfiets**

In the Netherlands, the bicycle is the most important means of transport in densely populated cities. While bicycles are relatively cheap, regular repairs and maintenance are pricey. Swapfiets responded to this by putting a lease bike on the market. At a low monthly rate, one rents a bicycle including the service for maintenance and repairs. Repairs are done at the door within 12 hours by an employee. If your bike can no longer be repaired, it will be replaced free of charge. (Het Parool, 2017)

The concept is successful because the company has grown into a large company with a lot of party purchase. A bicycle is basically a standard element without complexity, of which parts can be easily and quickly replaced. In addition, all components have a different lifespan, making it interesting to lease service.

### **Ikea kitchen**

The Swedish furniture company Ikea has a wide range of different kitchen styles, all of which have been built using the same standard module system 'METHOD'. Using a simple software program, the consumer can compile a kitchen with additional advice from a specialist. (IKEA, 2017) In addition, there are also companies that supply higher-quality finishes, in addition to the universal IKEA system (Houtmerk, sd) Despite the fact that Ikea kitchens are built from standard modules, customized end modules have to be made. The same applies to kitchen countertops, which are different in every home. A large part must therefore be tailored to make the kitchens lease-based. There could have been chosen to buy a combination of customized elements and lease standard elements, but this would be contradictory to the Ikea principle. The modules are only made to build a fast and low budget kitchen. The reuse of kitchen cabinets is therefore not the starting point.

### **USM Haller**

The Swiss company USM Haller is specialized in producing modular furniture for businesses and individuals. The system is made up of an aluminum frame work, filled in with panels of different materials, and a variety of colors. Cabinets and desks can be assembled by different suppliers, after which USM Haller produces and delivers the parts themselves. Only specialized technicians can assemble the furniture. It is also possible to adjust the furniture at a later stage, which also requires specialized technicians. (USM, 2017)

USM Haller has ensured the quality of the furniture by designing the system in such a way that only professionals can make and adjust the furniture with specific tools. The disadvantage is that the costs are high for adjusting a furniture, because a technician has to be hired. That is why this furniture system is rarely adjusted. This furniture system is interesting for the study of modular building systems, because a literal translation has been made between a frame and a padding.

## Chapter III: Findings

This chapter includes case studies of the previous head pieces are compared in a matrix. The chosen aspects are the aspects that distinguish the building environment from other disciplines. Subsequently, an analysis is made of which patterns can be found, and how this can be translated interpretively into modular building systems.

	Lease or buy	Circularity	Complexity vs. Simplicity	Standard vs. Costum	Reuse vs. negligible	Professional vs. DIY
<b>Hardware</b>	Operational and Financial lease	Different life cycles of hardware	Simplicit	Standard	Hardware obsolete, so reusability expires	Professional
<b>LED Lease</b>	Operational lease	Different life cycles	Simplicit, uniform Philips light	Standard	Lighting fixture is not reusable	Professional
<b>Swapfiets</b>	Operational lease	Parts of the bikes have differen lifecycle	Simplicit, bike has no brakes or gears	Standard	Reuse of bikes possible, parts not	Professional
<b>USM Haller</b>	Buy	Whole system is sustainable for one longterm lifecycle	Simplicit, framework and panels	Standard, with costum possibilities	Furnitures are durable and all parts can be reused infinitely	Professional
<b>IKEA Kitchen</b>	Buy	Whole system is based on one lifecycle	Simplicit	Standard, with costum possibilities	Not reusable for minimizing costs	Professional and DIY

Figure 3: Matrix comparison of disciplines

### Analysis matrix

The matrix shows that lease products are only adapted and repaired by professionals. From a contractual point of view this is logical, because this is part of the lease contracts. Looking at the circularity, it is striking that all components of non-lease-based products together have one life cycle. Unlike products that are based on lease, there are different life cycles per component. The service for maintenance therefore depends on different life cycles of the parts. Leasing is therefore more interesting when a product does not have a comprehensive life cycle.

Hardware products have the goal of staying with the user, while Swap bikes can be taken over by different users afterwards. The main reason is the technology development of the product itself, where the lessor has no need to take back an outdated product. A timeless product is possible in circularity to be leased to different users.

In the complexity it can be noted that in all case studies there are no combinations of complex parts. Everywhere there has been thought about integration, in a logical and simple way. In the field of standardization, it is noticeable that all non-lease products consist partly of customized parts. Lease products, on the other hand, are standardized, so that the service and maintenance can take place quickly and easily. Customized parts often can not be reused in other situations, and therefore have no potential to be leased. The only possibility is a financial lease model, where the product is paid off within the user term

### Translation of analysis for modular building systems

In order to develop a modular construction system that is (partly) lease based, the following findings were made on the basis of the comparison of explorative research:

- A building system in which the different parts all have different life cycles has potential to be leased. Service can be provided for repairing or adjusting parts. Think of building physics or installations, because the technology and the regulations change regularly.

- The complexity must remain minimized. The more complex the building system is, the more expensive the integration of all components is for the lessor. This means that both standardized and custom-made products can be made, but the essence lies with the technical simplicity of a construction system.
- What is standardized best lends itself to being leased in the form of an operational lease model. Custom made parts could be leased separately in the lease contract in the form of a financial lease model, based on a repayment term of the minimum rental period of a house. The user is then the owner of the customized products at the end of the contract.
- Parts that are reused for a lease building system are easiest to lease in a standard operational lease model.
- The part that a user can adjust himself is complicated to make lease based, because this influences the guarantees for maintenance. A lease model variant could be created on this, whereby the user can adjust something without the warranty for maintenance being canceled.

## **Conclusion**

The research has shown that research into other disciplines can provide insight into the possibility of developing a lease based modular building system. The research has shown that modular building systems have the potential to be leased both entirely or partly, if we compare the aspects with the case studies. However, compared to other sectors, a lease model is more complex, due to the different aspects that make the building environment distinctive. It is possible to speak of a 'hybrid lease model'. A modular building system splits on the leasing of standard elements that can be reused and negligible custom made elements. The reusable elements can be leased in a traditional operational lease model, where the user leases the system at a fixed monthly charge. The negligible elements could also be leased, but then in the form of a payment model whose term would be equal to the minimum rental period of a house.

## **Further research**

Now it has been researched how leasing has potentials in the building environment, it would be very interesting to test leasing in an experimental study. This follow-up study comparable with the Lease facade of TU Delft, where it is not yet clear how the results will be in the coming years. Another interesting topic is to investigate what budget is available and should be available for lease-based building systems in specific circumstances.

## **Acknowledgement**

This research paper is done with the support of Research-tutor Marcel Bilow and Architecture-tutor Pieter Stoutjesdijk. Both have made a valuable contribution to the research to provide insight into the subject, the method of research and the knowledge of the case studies.

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