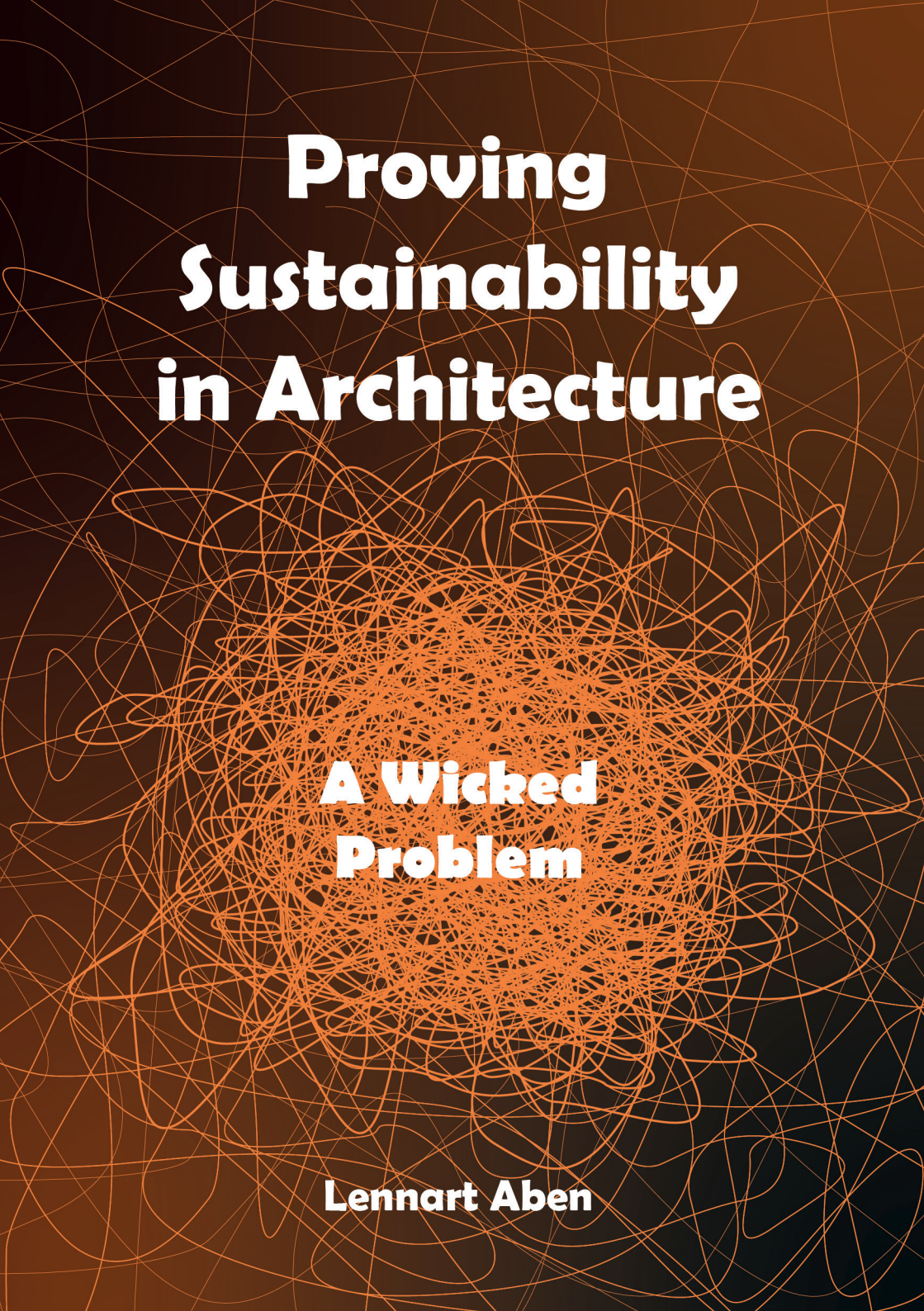
Proving Sustainability in Architecture



A Wicked Problem

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Abstract

Sustainability is trending. With large numbers, architects are part of the movement that is in search of a more sustainable world. An important part of this search is the urge to prove sustainability. Currently available methods to prove sustainability in architecture play into this demand. However, practice shows that these methods are not always well received as professionals experience issues and inconsistencies with them. How is it, that proving sustainability is so difficult, that even these great corporations cannot deliver a method to unequivocally prove sustainability? This questions is researched in this study. Professionals in the world of (Dutch) sustainable architecture are interviewed. Analysis of these interviews showed that the problem of proving sustainability is such an immensely complex and extensive one, that it can – and should – be approached as a Wicked Problem. Theory on Wicked Problems and results from the interviews are combined to explain the difficulties one faces when attempting to prove sustainability in architecture. Literature on strategies to approach Wicked Problems is discussed, to give an understanding on how problems of this size can be tackled. This gives a better understanding of why proving sustainability cannot be done with one general method, but rather needs a multitude of methods or approaches as every project is unique and therefore actually needs a tailor-made method of proof. Several approaches on how to think about proving sustainability are mentioned that might pique the interest of the architect.

This paper is a summary of the Dutch research: *Bewijsvoering van Duurzaamheid in Architectuur – Een Wicked Problem* by Lennart Aben

Keywords

proving sustainability, measuring methods, wicked problem, architecture

Chapter 1

In search of the Holy Grail of Sustainable Architecture?

Sustainability is hip. Sustainability is trending. People everywhere are working hard to make the world a more sustainable place. From Tony's Chocolonely's noble ambition to "make chocolate 100% slave-free" (Tony's Chocolonely, 2020), to Shell's - perhaps somewhat controversial - initiative to provide "CO2-neutral fuel" (NOS, 2019), to the new physical world that everyone comes into contact with on a daily basis: sustainable architecture. Like so many others, architects are with large numbers part of the movement that is in search of a more sustainable world. As a result of developments and innovations in the technical field, in business operations, in regulations and all kinds of other areas, we seem to be succeeding ever better in building a sustainable built environment. But mankind never stops wanting to do more and to do better, as befits mankind. So what would it be like if we were to achieve that ultimate form of sustainability? 100% sustainability? The Holy Grail of Sustainable Architecture?

Yes, that would be fantastic.

But, and unfortunately there is a *but*, the Holy Grail wouldn't be the Holy Grail if the search hadn't taken centuries before it was (claimed to be) completed in 2014 (Klein, 2014). Just as the search for the Holy Grail has lasted for centuries, so the search for the Holy Grail of Sustainable Architecture is a long one, which in this case we started on only a few decades ago. Today, unfortunately, the ultimate sustainable built environment is still an ideal image; a dream image for a - hopefully - beautiful future.

One part of the search for the Holy Grail is the urge to prove sustainability. It gives little satisfaction to claim that a solution is sustainable, without subsequently being able to prove the sustainable qualities and the sustainable functioning of that solution. There are therefore several methods available that attempt to calculate and demonstrate the sustainability of a project. It is essential to know these existing methods and to know what they consist of. That is why they are briefly discussed here.

1.1: Current approach

The internationally most well-known and widely used methods are LEED (US-

GBC, 2020), BREEAM (BREEAM NL, 2020) and WELL (WELL, 2020). Another, Dutch, method that is widely used is GPR (2020). Each of these methods approaches and assesses the sustainability of architectural projects on the basis of different topics. Due to the fact that the methods focus on a different selection of topics, however, one and the same project can be assessed differently by different methods. You may wonder whether there is "a correct" or "a better" method? Is a LEED-platinum building more sustainable than a BREEAM-excellent building? Also, a building's score can (unjustifiably?) be low when (innovative) techniques or solutions are used on which the chosen method does not give credit to. Does this mean that this building is less sustainable than a building that is better able to respond to the rules set by the assessment method?

In addition, the way in which these methods work - awarding points on the basis of whether or not the set rules have been met - means that in practice they are often seen as checklists. After all, achieving a good result is achieved by ticking as many boxes as possible. In view of the fact that these methods are very extensive, this makes for an enormously time-consuming, intensive and - unkindly put - boring process. The fact that sustainability is linked to architecture in this way ensures that many people see sustainability in a negative light. Because "sustainability is simply boring". And that of course contrasts sharply with the world where everyone is working to achieve the Holy Grail of Sustainability.

1.2: The purpose of the study

A number of issues already emerge when we look at how sustainability is proven today. It is clear that there is something inconsistent somewhere, that there is a discrepancy somewhere - although it is difficult to put your finger exactly on the sore spot. In the immense search for the Holy Grail, proof is an important step. It is worthwhile, therefore, to deepen an understanding of where the contradiction lies in this question of sustainability, in order to provide a deeply grounded answer to the main question of this research: *Why is it so difficult to prove sustainability in architecture?* The research takes into account the knowledge we have about the way this is done today. It is being investigated whether a deeper layer can be added to this, in order to uncover where the problems lie in proving sustainability.

The following four sub-questions have been drawn up to guide the research:

- What is sustainability in architecture today?
- What is not sustainable in architecture today?

- How can you design sustainability in architecture?
- How do you know if a building is sustainable a few years after it has been built?

On the basis of these questions, insights are sought into the main question. The expectation is that if you know that either 1) something is a sustainable solution or 2) does not belong to the category of unsustainable solutions (and therefore has to be a sustainable solution), and if you know 3) how to design that sustainable solution and 4) how to prove that that solution worked 5 years after completion, you can be sure that the solution that was devised was a truly sustainable solution.

1.3: Method

In order to be able to find an answer to the research question, we need practical experience; only theory will never allow us to find an answer to the problem at hand. That is why we are talking to seven professionals who are active in the field of sustainability in architecture, with the expectation that they will be able to tell and explain what sustainability is in their view, how they design it and how they (attempt to) prove it.

Such conversations are dynamic. That is why there is not so much as one template made with questions that are consistently asked in every conversation. Instead, a list of questions has been drawn up that functioned as the thread running through the conversations. This list has been divided into four parts, with each part consisting of a set of questions that address one of the four sub-questions. Examples of questions from this list are: “What is the ultimate goal when creating a sustainable building?”, “What is the opposite of sustainability in architecture?”, “Is it often the case that sustainability suffers as a result of financial choices?” and “Energy is relatively easy to express in numbers. How does that work with other forms of sustainability?

The interviews were held by telephone or via online communication services. Through talking to different people with different views, an attempt is made to approach sustainability from different points of view. This way multiple opinions are heard about what sustainability is or can be, what ways are used to measure and prove sustainability and how this should or should not be changed or improved.

In the analysis of the interviews, the complex nature of sustainability soon came to the fore. Although it was never mentioned during the discussions, it became clear that this problem cannot simply be solved because it can be characterised as a Wicked Problem. Therefore, theory is used to explain what a Wicked Problem is, in order to link this theory to the information on sustainability acquired during the interviews. By looking at this problem with this framework, the enormous complexity of proving sustainability is touched upon, and with this an understanding is created of why it is so difficult to prove sustainability in architecture.

Chapter 2

Wicked Problems

The one thing that was mentioned more than anything else during the interviews was that sustainability is a very broad field, approachable from countless different angles. During the interviews we have touched upon the past, present and future of sustainability. Current measurement methods were discussed and how these are generally rejected by architects for various reasons. The role of energy efficiency was discussed, as well as the role of circularity, regulations, innovation and possible future scenarios. It was noted that there are so many different parties involved in a building project that making the built environment more sustainable cannot be guaranteed by the architect alone.

More than anything else, the interviews made it clear that sustainability is enormously complex. This starts with the concept of sustainability, which is so broad that it can cover a number of subjects (such as sustainability, circularity, renewability and durability). Each of these subjects, in turn, can be subdivided into different aspects. Each of these aspects then offers different points of view, which are responded to by the market and the economy. Partly because of this, countless parties (architects, consultants, government bodies, clients, suppliers, producers, installers, users and so on) are involved in the construction process, which are all required to change the way they think and operate. And, of course, the scale is an important factor: we are not talking about a local issue; something that is only happening in the Netherlands. On the contrary: it is very much a global problem. Because of this enormous scale, the drastic changes that need to be made entail an enormous economic burden.

The aspects mentioned here are just a few of many more. It is a first indication that the problem of proving sustainability cannot be solved overnight. Problems such as these, with such vast (social, cultural, economic, political) consequences, are also referred to as Wicked Problems. Although this term has not been mentioned by any of the professionals, it has become abundantly clear that achieving sustainability and proving it is a Wicked Problem. Therefore, in order to answer the question posed by this research, proving sustainability must also be approached as such.

2.1: What are Wicked Problems?

A Wicked Problem is a major social or cultural issue that is impossible or very difficult to solve. One can think of problems such as poverty, illiteracy, inequality, health care, obesity and terrorism which carry the properties of Wicked Problems. Why large-scale problems like these are so difficult to solve can be summed up in four reasons (Kolko, 2012):

1) incomplete or contradictory knowledge;
2) the number of people and opinions involved;
3) the large economic burden it entails;
4) and the way in which different Wicked Problems are interconnected.

Look at the problem of sustainability from these points of view. First of all, it is clear that we are still a long way from achieving a sustainable built environment, despite the enormous amount of information, research and knowledge already available about sustainability in the built environment. For example, if we look at the enormous amount of old buildings built with low standards in the last century, it is easy to see that there is a huge task here. Today, we do not yet have enough knowledge to solve this problem in time (i.e. in line with the set climate objectives). Secondly, there are an awful lot of parties involved in construction; from the government to the municipalities; from the client to the user; from manufacturer to installer. In order to turn the conservative world of construction into a progressive, sustainable chain, all these faces have to turn in a different direction, while many of those faces are not inclined to do so in the belief that their current way of operation is the best. Thirdly, sustainability is still relatively expensive these days, which means that the sustainability of the built environment depends on huge financial support to succeed. This is already the case in the Netherlands, but even more so in third world countries where the financial

situation is much more dire. Finally, sustainability is an issue that cannot be solved on its own. Sustainability is inherently linked to prosperity, and prosperity in turn is linked to poverty, poverty to education, and so on. In essence, many Wicked Problems are connected somewhere, in one way or another, and that is no different for sustainability.

2.2: Ten characteristics of Wicked Problems

Rittel and Webber (1973) were among the first to write a theory on Wicked Problems. In their Dilemmas in a General Theory of Planning they list and discuss in detail ten characteristics that reveal the complex nature of Wicked Problems. The 10 characteristics - one more than the other - are applicable to the Wicked Problem of proving sustainability.

Characteristic 1: Formulating a Wicked Problem

It is impossible to formulate a Wicked Problem in a definitive way.

The first characteristic of Wicked Problems according to Rittel and Webber (1973) illustrates why it is important to approach sustainability as a Wicked Problem. It is impossible to formulate a Wicked Problem in a definitive way, because finding a description of the Wicked Problem is the same as finding the solution to that Wicked Problem.

This requires an explanation.

In order to describe a Wicked Problem entirely and in full detail, you need to understand all the aspects that are relevant to that problem. That means that you need to know, understand and answer all possible questions that may arise in advance. However, the questions you come up with depend on how well you understand the problem, and on the direction in which you are looking for a solution. Think of the sustainability problem. The more familiar you are with the problems and questions that arise in practice, the better you will be able to ask critical questions. For example, one of the people interviewed for this research specialises in the reuse of materials. With his extensive knowledge of circularity in construction, he is able to look more critically than anyone else at the problem of circularity, an increasingly important part of sustainability. At the same time, this makes the focal point with which he is looking for a solution for sustainability linked to circularity. The questions he comes up with are therefore more likely to be connected to circularity.

When you try to describe a Wicked Problem in its entirety, you need to be able to answer all the relevant questions. But in order to come up with each relevant question first, you need to be familiar with all possible solutions in advance. The multitude of ways of approaching Wicked Problems makes it impossible to come up with all possible solutions in advance.

Moreover, Rittel and Webber (1973) go on to say that – should you have succeeded in mapping out all possible solutions to a problem – after extensive analysis, you know exactly where to put your finger, so that you can say with confidence: "This is where the problem originates, this is the core of the problem". As you have been able to come up with all the solutions for all directions earlier in the process, it means that you also have a solution for the core of the problem. Therefore, formulating a Wicked Problem is the same as formulating its solution.

This first characteristic of Wicked Problems shows that it is impossible to formulate a complete, detailed definition of the sustainability problem. However, an important aspect in this story is the word *understanding*. In this research we want to understand why it is so difficult to prove sustainability. It is for this reason that this research approaches sustainability and its evidence as Wicked Problem. By using the framework set up by Rittel and Webber in 1973, we look at evidence in sustainable architecture, with the aim of better understanding the problem. In the next chapter the remaining nine characteristics will be discussed in relation to proving sustainability in architecture. Results from the interviews are used to provide explanations, clarifications and examples.

Chapter 3

Proving Sustainability, a Wicked Problem

Characteristic 2: Stopping rule

There is no condition or rule whereby it can be said that 'this fulfils the condition(s) that were set; this solves the Wicked Problem'.

When it comes to sustainability in architecture, you will never be done. As was explained during the explanation of the first rule, you may only find the solution when you fully understand the problem in its entirety. There are no criteria to indicate the extent to which you understand a problem, and you can always

continue to improve your understanding of a problem. According to Rittel and Webber, reasons such as "now it's good enough" or "this is the best I can do within the limits of this project" (p. 162) make the problem solver stop working on the project.

In architecture, the professionals indicated, this is a significant problem as well. The architect is limited in what he or she can do in a project; because they simply cannot do everything. On the one hand, practical matters can hamper the architect: finances, time pressure, location and whether or not a sustainability-oriented client or developer is involved in the project are just a few of the (external) factors that influence how sustainability is achieved in the project. On the other hand, the architect is limited by the extent to which he or she understands the sustainability issue and the way in which he or she wants (or is instructed to) approach sustainability.

With these influencing factors, it is impossible to draw up a condition or rule that can unequivocally prove whether "the design is sustainable, yes or no". It is not possible for the architect to claim: *now I have solved the sustainability problem for this project; it is finished.* The issue is simply so extensive and so diverse that it is impossible to say: *"this fulfils the condition(s) that were set; this solves the Wicked Problem"*.

Characteristic 3: Good versus bad

Solutions for Wicked Problems cannot be classified under 'true' or 'false', but under 'good' versus 'bad'.

An answer to a Wicked Problem is never binary. Solutions to a Wicked Problem should be sought within the domain of "good" versus "bad". This is also the case when attempting to prove sustainability. One of the interviewed professionals, for example, gave an example regarding locally produced concrete versus super sustainably managed wood, which has only one issue: it has to be shipped all the way from the other side of the world to the building site. Although arguments can be given that building with wood from a sustainably managed forest is more sustainable than building with concrete, those arguments may no longer apply when the delivery distance is also taken into account. Purely the choice of material does not determine that one option is more sustainable than another. In reality, there are many more factors involved, including the country of origin and the delivery distance to the country of use. A range of factors ensures that a choice is not "true/sustainable" or "not true/not sustainable", but that a choice

is better or worse compared to other possible choices. Solutions for Wicked Problems are to be classified on a scale from "good" to "bad". This can also be regarded through the difference between "efficiency" and "efficacy". Trying to make a certain process very efficient, does not necessarily mean it produces the most positive efficacy. On this scale from "good" to "bad", you would rather choose to make a positive efficacy over making a negative efficacy more and more efficient.

Characteristic 4: Ultimate test

There is no ultimate test for a solution to a Wicked Problem.

Due to the nature of Wicked Problems it is not possible to come up with a test that can be applied to every possible solution. Each solution will create a ripple effect from the moment the solution comes into effect over a long – even perhaps infinite - period of time. The waves of consequences that are caused are enormous, affect human lives and are difficult to follow. This makes it impossible to create a complete picture in advance of the consequences of the solution to be implemented. In theory, this complete picture can only be sketched when the entire domino effect is extinguished. If you want to develop an ultimate test to test a solution, you should take all possible ripple effects into account: an impossible task.

Characteristic 5: One-shot operation

Any solution to a Wicked Problem is a one-shot operation. This means that there is no possibility to learn by trial-and-error without expecting repercussions: every solution counts and has consequences as a result.

For Wicked Problems, there is no room to learn by trial-and-error. Every solution that is applied is a definitive one, with all of its consequences (positive and negative) as a result. For example, every building that is built will exist for a long time. It will be built with the intention that in decades, if not hundreds of years, the buildings that are being built today will still be used. The consequences of building a project are great, and cannot be reversed just like that: as soon as the building is built, it begins to live its life; you don't decide to demolish it after just a few years because you notice that it doesn't work quite right after all. That means that every choice made and every solution applied has consequences for a long time to come.

Characteristic 6: Possible solutions

It is impossible to prove that all possible solutions to a Wicked Problem have been identified and considered.

Today, we are somewhat blinded by the way in which sustainability is put on the market: sustainability is often equated with energy efficiency. Projects are praised for their energy-saving measures and energy-generating techniques. In the interviews conducted with the architects for this study, it became clear that this is partly due to the fact that we are very competent in realising energy-efficient buildings. In addition, we can measure energy consumption and energy generation in a very precise way and thus prove it. We know how to express how much energy has been generated and how much is being consumed. On top of that, energy efficiency is clear to the end user and is directly linked to a financial impulse: by increasing the amount of energy generated and reducing the amount of energy consumed, the end user immediately sees how much he saves. All of this makes energy efficiency an easy and safe solution to invest and innovate in.

However, energy efficiency is only one component, one part of making the built environment more sustainable. A sustainable built environment is also about water consumption, air quality, circularity, embodied energy, toxicity of materials, waste, future value, aesthetics, quality of life and user value (just to name a few). Luckily, the current measurement methods - in contrast to the generally prevailing view - do not only focus on energy efficiency. In addition to the subject of energy, each method also deals with other sustainability aspects, although the aspects mentioned differ per method.

Characteristic 7: Unique

Every Wicked Problem is essentially unique.

Of course, in addition to the many common factors between two different problems, there will always be trivial differences that make one problem slightly different from the other. However, what Rittel and Webber mean by the fact that every Wicked Problem is essentially unique, is that a Wicked Problem always has a distinguishing characteristic that is of predominant importance. Each situation will therefore require a unique, tailor-made solution in order to deal with these distinguishing characteristics. When we accept that, we realise that it will not always work to apply a solution that has worked in another project to a seemingly similar problem. Chances are that the comparable problem has other distinguis-

hing characteristics that make the solution incompatible with the problem.

Of course, this applies to Wicked Problems in the broadest sense of the word: the problem of world poverty has other characteristics than proving sustainability. But at the same time, each occurrence of a Wicked Problem is essentially unique as well. For example, proving the sustainability of an architectural project is different for every building due to for example its location, setting, users, architects, contractor and function.

Characteristic 8: Symptom for another problem

Every Wicked Problem can be seen as a symptom of another problem.

Solving a Wicked Problem becomes even more difficult when you realise that a Wicked Problem cannot be solved on its own. Because of the vast size and sphere of influence of Wicked Problems, every problem is at the continually a symptom of another Wicked Problem. Sustainability cannot be solved on its own, because sustainability is inherently linked to the prosperity of the country, region, city and neighbourhood in which a project is being built. The prosperity of an area, in turn, is directly related to poverty, poverty with education, and so on. While searching for a solution to the Wicked Problem of sustainability, you come across issues that lead you to another Wicked Problem. This means that no Wicked Problem can be solved on its own.

Characteristic 9: Different approaches

The existence of a discrepancy that represents a Wicked Problem can be explained in various ways. The explanation that is chosen determines the way in which a solution is sought.

Proving sustainability can be approached from many starting points; by saying that this is the job of the architect, or the job of a consultant, by claiming that producers of installations have to provide all the information, that there is not enough enforcement by public authorities, that regulations are not strict enough, that the economic benefits of 'bad' products are too high. Which of these starting points is correct? What is the origin of the problem? For Wicked Problems that is impossible to say, each starting point is part of the problem and starting point can be chosen to find a solution to it. However, the starting point that is chosen determines to a large extent the problem's solution. In every

project, a particular approach (or perhaps a multitude of approaches) must be chosen, and should one looks with logic at which approach is chosen, the choice will appear arbitrary as the choice depends on which way is best suited to the problem solver's motives, and on the way he/she looks at the world.

Characteristic 10: No mistakes allowed

Those who tackle a Wicked Problem are not permitted to make mistakes.

This characteristic is closely related to the characteristic number 5: one-shot-operation. Because every building, every intervention and every solution has major consequences that can affect the environment and the users of the building for years to come, it is the task of the problem solver not to fail. Because if mistakes are made, this has immediate negative consequences for the environment and users.

Chapter 4

Strategies to Approach Wicked Problems

Based on the theory about Wicked Problems' characteristics, it has become clear why it is so difficult to tackle Wicked Problems. No one can be blamed, therefore, should they think they will never be able to approach a solution to a Wicked Problem. Fortunately that is not necessary. Research shows that - however difficult it may be - there are strategies by which Wicked Problems can be approached.

4.1: Solving, taming and coping

Solving a Wicked Problem requires the creation of a holistic ideal image which, due to the complexity as described in chapter 4, is a near impossible task. Yet this is what one is often looking for, according to Daviter (2017). And even if this is what you want to work towards in an ideal world, finding a holistic solution is doomed to underperform. It is therefore essential, Daviter emphasises, to explore the alternatives in order to arrive at a more realistic strategy to approach Wicked Problems: *taming* and *coping* with Wicked Problems.

Taming a Wicked Problem means, according to Daviter (2017, p.578), the transformation of a Wicked Problem into a more manageable, more structured problem with the aim of simplifying decision making. This is done by separating a small and relatively easy to solve aspect of the Wicked Problem, in order to solve it as a stand-alone problem, thereby making the Wicked Problem smaller and more controllable.

Coping with a Wicked Problem does not aim to find a holistic solution either. On the contrary, this strategy benefits from a fragmented and serial problem management and aims to generate multiple indicative solutions evoked by the complexity of the problem. While Wicked Problems can be viewed through different glasses, when dealing with Wicked Problems it is not essential to bridge conflicting perspectives and competing evidence. Rather, the aim is to bring those competing problems together so that the problem can be viewed from multiple perspectives.

4.2: Systems thinking and agile methodologies

With systems thinking and an agile methodologies, it is attempted to keep the entire problem in consideration. In contrast to taming a problem, it focuses on the whole picture and individual aspects are not dealt with in isolation from each other, but are rather considered in relation to each other in order to find out what role they play in the big picture. The relationship between different aspects and how they influence each other is of enormous importance. Wong (2020) discusses 5 key points of Tom Wujec's TED Talk (2013), which you can use to apply system thinking and agile methodologies to your work.

1) Break the problem down into chunks of information with links in between. This involves dividing a major problem into comprehensible pieces and then clarifying the mutual relationship between them.
2) Visualise your information. Use images. Use drawings. Use sketches.
3) Work together with stakeholders.
4) Try out solutions to generate as much feedback as possible. Positive, and negative, feedback helps to come to an answer, where finding an answer is not so easy.
5) Perform several iterations. With each iteration you come across new things and you can process previously obtained feedback.

4.3: Authoritative, collaborative and competitive

Roberts (2000) suggests three generic strategies that can be used to tackle a Wicked Problem. Wicked Problems - Roberts summarises - are those problems where there is a conflict about both the problem (where does 'the problem' originate?) and the solution (what is the best solution to the problem at hand?). Roberts expands on this type of problem. By asking two "yes-no" questions, you arrive at one of the three generic strategies. Firstly, you ask whether the distribution of power between the parties involved is dispersed. If this is not the case, and there is only a small number of stakeholders involved, then authoritative strategies can help to identify the problem and the solution.

If the distribution of power between the parties involved is dispersed, a second question needs to be asked: Is the power of the parties involved contested? In other words: is there a struggle for the power that characterises their actions? If the distribution of power is dispersed, but not contested, collaborative strategies can be used. If the distribution of power is both dispersed and contested, then competitive strategies can be used.

The authoritative strategy reduces the degree of conflict in the problem by placing the resolution of the problem in the hands of a limited number of stakeholders. The selection of stakeholders can be based on a variety of factors. For example, their knowledge, expertise and hierarchical position within a company can be factors that influence this. Independently of the selection procedure, the selected persons or parties are seen as the authoritative entity and the decisions they make are to be followed by the other stakeholders.

The collaborative strategy is based on the principle that collaborating parties can achieve more collectively than the parties themselves could on their own. Basically, this means starting from a win-win situation by joining forces.

The competitive strategy is based on a simple principle: "if my opponent wins the right to solve the problem, I lose. If I win that right, my opponent loses". The win-lose mind-set encourages action, development and innovation.

Chapter 5

Strategies to Prove Sustainability

Chapter 3 taught us that in order to be able to prove sustainability, you need to understand and be able to describe sustainability in its entirety (characteristic 1). To discover the Holy Grail of Sustainable Architecture, you have to come up with all possible solutions that can make a project more sustainable in advance (characteristic 6). Unfortunately, this is impossible - at least with the current state of affairs - and you have to accept that simply "not everything is possible" (characteristic 2). Instead, you have to try to act as well as possible within the project's limits. You must always try to make the most sustainable choice possible, whatever it may concern: the installations, the materials, the finances, the social sustainability or whatever other aspect (characteristic 3). As a designer, you are not expected to make mistakes, as every mistake you make has consequences (characteristic 10). Moreover, there is no room for a trial-and-error process: you can't just demolish a building after two years because it doesn't quite work after all (characteristic 5). In order to get closer to the Holy Grail, it is important that sustainability is not measured in one way (characteristic 4), because every design and every building is unique. One standardised method of measuring sustainability can therefore not be the solution (characteristic 7). On the contrary, in order to prove sustainability, you have to be able to use different methods. No one method, or combination of methods can be seen as the "correct one". The designer and the project determine which methods are the most suitable (characteristic 9).

In chapter 4 we read about different strategies to approach Wicked Problems. In the world of sustainable architecture, taming and coping strategies as well as systems thinking and agile methods are important. For example, a supplier of a building component is taming the problem by solving one aspect of the whole as a stand-alone element. However, the architect's task is to keep the whole picture in mind and to examine the connections and relationships between the individual elements so that they work together as a whole.

The key message to be drawn from all of this is that it is essential to be able to prove several aspects of sustainability in order to solve them (from the architect's point of view) in relation to each other in the best possible way. Subsequently, it is important that these aspects of sustainability are not measured or attempted

to be proven in a single way (characteristic 4 of Wicked Problems). This means there is a need to extend the range of possibilities to prove or to demonstrate sustainability. During the analysis of the interviews, a number of possibilities were discovered that have a chance of being widely applied. These possibilities are discussed here.

5.1: The current standard

Despite the problems which can be encountered when using the current standard measurement methods, it should not be forgotten that these methods can also be very useful design tools. They are based on very extensive scientific research, are created by huge groups of specialists and draw information from thousands of projects that have already been certified. The amount of relevant information available to the companies behind these measurement methods is enormous. It is therefore still of enormous value that these methods exist to help architects raise their building projects to a higher level of sustainability.

5.2: The end user measures

We are good at measuring energy efficiency these days. An important aspect of this is the involvement of users. Users can easily see how much energy their solar panels have generated and can immediately experience the impact and how much money they have saved. This financial incentive helps to make measuring energy generation and use interesting for the public.

Encouraging users to measure sustainable aspects by ensuring that they can make an understandable and insightful profit (financial or otherwise) can therefore help to make sustainability aspects known and sought-after among the general public. It is therefore valuable to examine whether a similar method can be applied to other sustainability aspects.

5.3: Drastically tighten regulations

Practical experience has shown that the client plays an enormous role in the extent to which a sustainable building is realised. There are clients who set great store by the creation of a super sustainable building, and who are prepared to make additional investments in order to achieve certain objectives. There are also those clients who attach less value to this, who generally want to make more profit in the short term. As long as the legal requirements with regard to sustai-

nability are met, it is sufficient.

In this type of situation, tightening the regulations could have a great effect, as was indicated by various professionals. To put it in simplified terms: if it were compulsory from the outset to use at least 50% recycled materials in new buildings, then it would only have to be ensured that these requirements were met. In this way you could - in theory - in the short term force sustainable thinking on a large scale.

5.4: Material passport

When it comes to circularity in construction, you talk about material passports. Madaster (2020) is an example of this. Madaster is an online platform in which all material-related information of a project can be stored thus giving all materials an identity. For example, you can find out exactly which materials have been used in a building and how much of it has been used. With this information Madaster builds a database of materials that have been used in buildings. Because this information is (supposed to be) easily accessible, you create an enormously valuable building materials bank when the building is to be dismantled (or demolished). The materials are identified and can therefore easily be given a second life.

5.5: Information flow passport

A similar method to the material passport can be applied to other areas of sustainability. Imagine keeping an information flow passport. In fact, this is already done with energy generation and energy consumption. Users can directly see the yield of their PV panels on their phone, tablet or laptop. It just doesn't have to be energy generation; you could bundle all kinds of information in it. For example: energy consumption, water consumption, ventilation, waste produced, reused heat, heat emitted to the outside air and greenhouse gases emitted. Registering and documenting processes and activities helps to make sustainability measurable. This can be a good tool to make sustainability aspects in your design provable!

5.6: Make it competitive

Human kind is competitive by nature. This characteristic can be used to make the built environment more sustainable. An attempt was made to achieve this in

the Energy Academy, as was revealed in one of the interviews. The idea during the design phase was to provide insight into data on energy consumption per floor. In this way different floors can compete with each other, which can lead to a more conscious way of dealing with appliances that consume energy. By designing a competitive element, you motivate users to be more aware of the resources at their disposal. This way of motivation can be a smart approach to achieve a more sustainable project through user participation.

5.7: Registering and using user patterns

Logically, users have an enormous influence on the functioning of a building. After all, the user turns on the lights, raises the temperature, opens windows and leaves appliances on when they leave. It is therefore enormously valuable to register user patterns and use these in architecture. Because, as was rightly said in one of the interviews, a user who is in a room and leaves the window open is different from a user who leaves and has left his heating on. The use of information provided by user profiles can perhaps be applied to many sustainability aspects. It is a challenge for the designer to see how he or she can use user patterns to make the building more sustainable.

5.8: User experience

Another important part of sustainability - as the interviews showed - is the user experience. The finer and more beautiful a building is, the more inclined the user is to take good care of it, the more pleasant he feels in the building and the healthier he can work and live in it. It is the task of the architect to create a pleasant and healthy living and working environment for the user. The interviewed architects mentioned how architects always try and always have tried to design to make people better. Better in the sense of happier, healthier and more satisfied. A simple example that was given is the creation of a particularly beautiful and fine staircase, to convince the user to take the stairs more often instead of the lift.

Chapter 6

Conclusion

In a world where people are looking for the Holy Grail of Sustainable Architecture - a dream image of a bright future - this research was started from the belief that there is a discrepancy somewhere in the way sustainability is measured and proven in architecture today. Current measurement methods are seen as checklists, are difficult to compare with each other, are expensive and therefore almost exclusively applicable for large projects. They carry negative connotations among architects, despite the scientific basis, the thousands of projects from which practical experience is drawn and the large teams of specialists who compile the lists. For this reason, the causes of this contradiction have been investigated in order to provide a more in-depth answer to the question of why it is so difficult to prove sustainability in architecture.

The main question of this research is *why is it so difficult to prove sustainability in architecture?* The sub-questions that have supported this main question are: *What is sustainability in architecture today?*; *What is not sustainability in architecture today?*; *How can you design sustainability in architecture?* And: *How do you know if a building is sustainable a few years after it has been built?* On the basis of these questions, a more extensive list of questions has been drawn up which has been used as a guide when interviewing professionals in the world of sustainable architecture. These professionals told about their vision on sustainability, how they design sustainability, what kind of solutions they are looking for and how they think sustainability can be proven.

While analysing the interviews, it soon became clear that the questions as formulated in this study were approached and answered in all kinds of different ways. The results of the interviews slowly but surely revealed the complex nature of proving sustainability. The issue is so broad that - in order to gain a better understanding of it - it needs to be approached as a Wicked Problem. Wicked Problems are large-scale social or cultural issues that are impossible to solve for four reasons.

1) incomplete or contradictory knowledge;
2) the number of people and opinions involved;
3) the large economic burden it entails;
4) and the way in which different Wicked Problems are interconnected.

In addition, Wicked Problems can be characterized by a ten features. The first characteristic shows how formulating a Wicked Problem equals formulating its solution. In order to arrive at a solution to a Wicked Problem, however, you must have thought up all possible solutions beforehand, which - given its size and complexity - is practically impossible. Nevertheless, it is important to understand the issues of a Wicked Problem through and through. That is why the problem of proving sustainability has been looked at by considering it as a Wicked Problem.

This taught us that in order to be able to prove sustainability, you need to understand and be able to describe sustainability in its entirety (characteristic 1). To discover the Holy Grail of Sustainable Architecture, you have to come up with all possible solutions that can make a project more sustainable in advance (characteristic 6). Unfortunately, this is impossible - at least with the current state of affairs - and you have to accept that simply "not everything is possible" (characteristic 2). Instead, you have to try to act as well as possible within the project's limits. You must always try to make the most sustainable choice possible, whatever it may concern: the installations, the materials, the finances, the social sustainability or whatever other aspect (characteristic 3). As a designer, you are not expected to make mistakes, as every mistake you make has consequences (characteristic 10). Moreover, there is no room for a trial-and-error process: you can't just demolish a building after two years because it doesn't quite work after all (characteristic 5). In order to get closer to the Holy Grail, it is important that sustainability is not measured in one way (characteristic 4), because every design and every building is unique. One standardised method of measuring sustainability can therefore not be the solution (characteristic 7). On the contrary, in order to prove sustainability, you have to be able to use different methods. No one method, or combination of methods can be seen as the "correct one". The designer and the project determine which methods are the most suitable (characteristic 9).

In chapter 4 we read about different strategies to approach Wicked Problems. In the world of sustainable architecture, taming and coping strategies as well as systems thinking and agile methods are important. Subsequently, it is important

to have multiple methods available to use when it comes to proving sustainability. This means there is a need to extend the range of possibilities to prove or to measure sustainability. "Measuring" should be read in the broadest sense of the word. It is about being able to measure how well a particular solution works on the scale of "good" versus "bad" (characteristic 3). "Measuring" therefore does not necessarily have to be expressed quantitatively, but can also be approached qualitatively.

During the analysis of the interviews, a number of methods were discovered that can be applied to measure sustainability in new ways. Characteristic 6: *It is impossible to prove that all possible solutions to a Wicked Problem have been identified and considered* dictates that this list cannot possibly be an exhaustive one. It is a challenge for the world of construction to constantly expand this list, optimise it and make it practically feasible.

1) The current standard;
2) The end user measures;
3) Drastically tighten regulations;
4) Material passport
5) Information flow passport;
6) Make it competitive;
7) Registering and using user patterns;
8) User experience.

It is up to the designer to decide which methods he or she wants to use, even if it may feel arbitrary. It is the way in which the designer (or the problem solver) thinks he can solve the problem and the way in which the designer looks at the world that determines the direction in which solutions are sought.
Despite the fact that the problem seems unsolvable, despite the fact that the Holy Grail of Sustainable Architecture still seems so far away, we should not allow ourselves to be side-lined. It is clear that there is no single solution, there is no single formula for creating sustainability. But that offers opportunities to look for the way that best suits you as a designer, the way that best suits the project or the way that best suits today's society. There is so much to discover, so much to prove, so much to learn. Let that be an invitation to experiment, to go on a voyage of discovery in search of a more sustainable world like the one you envision.

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