

BUILD SOLUTIONS

Roadmaps, guidelines, and outreach activities

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1 – FOREWORD

Building Urban Intelligent Living Design Solutions

Cities currently host more than half of the world population, which is projected to increase up to 70% by 2050 (UN, 2014). Already, cities account for 70% of global CO₂ emissions (C40). With the expected population growth, cities would hence be the source of an estimated 85% of global GHG emissions.

There is a growing recognition and awareness that nature can help to provide viable solutions by using and deploying the properties of natural ecosystems and the services that they provide in a smart and 'engineered' way (EC). These living solutions provide sustainable, cost-effective, multi-purpose and flexible alternatives for various objectives. Working with nature, rather than against it, can further pave the way towards a more resource efficient, competitive and greener economy. It can also help to create new jobs and economic growth, through the manufacture and delivery of new products and services, which enhance the natural capital rather than deplete it (EC).

With that in mind, the big question is, why are nature-based solutions not used more to address the global urban challenges?

The main answer would be that there's a distinct skill and financing gap in the biotechnology sector. While we currently have great researchers in biotechnology, too often the commercialization and hence the implementation of their discoveries stumble due to a lack of personal experience in entrepreneurship and cooperation with industry leaders (Fritsch, 2010).

And even when most of those skills are present in a team attempting to commercialize a technology, another obstacle rears its head: the lack of short-term funding available to biotech start-ups and spinoffs (Swamidass, 2008). Recently, the High-Level Group for the European Innovation Council published their first recommendations which state that funding for disruptive, market-creating start-ups with deep-tech solutions (like biotech) is severely fragmented and doesn't meet the needs of the start-ups for developing the technology (http://ec.europa.eu/research/eic/pdf/eic_recommendations_set-1_2017.pdf). The lack of funding can be attributed to multiple factors, chief amongst them being the perceived risk and the huge capital expenditures necessary to develop sound biotechnology solutions.

Building Urban Intelligent Living Design Solutions (BUILD Solutions) project aims to set up transdisciplinary cooperation among universities and business, engaging students, teachers and researchers and providing them with the necessary entrepreneurial skills and connections to bring intelligent living solutions to the market, by investigating biological systems, creating smart design prototypes, business plans, plans for start-ups and working with accelerators.

The project's objective is to develop an experimental transdisciplinary educational system linking biology, intelligent design and business through several kinds of activities, such as courses for students and trainers, symposiums, development of educational resources, the set-up of an accelerator programme, launching an international call for ideas and creating new networks.

The project is co-funded by the Erasmus+ Programme of the European Union.



Living design solutions provide sustainable, cost-effective, multi-purpose and flexible alternatives for several urban challenges.

2 – ROADMAPS FOR SETTING UP AND SCALING STUDENT START-UPS

2.1 Introduction

As part of BUILD Solutions, we have chosen to create an environment of self-learning (and responsibility thereof), trans-disciplinarity and co-creation through the use of student start-ups. The core idea of having students create start-ups was to include entrepreneurship as a driver to achieve a higher degree of trans-disciplinarity and overall higher degree of educational benefit for the students with a changed role of the trainers.

By having the students identify the (global urban) challenges they cared the most about and own the Nature-Based Solutions they devised to face said challenges, the students were presumed to acquire a higher sense of agency and empowerment (Stenger, 2014). Furthermore, the students were presumed to be forced to work across cultural differences stemming from both geography and educational background to solve said challenges since the challenges were of such a scope that no single student or educational background would be sufficient to overcome the challenges on their own.

Another important aspect was for the BUILDs trainers to change the way they envisioned themselves as they engage with the students. Rather than being the source of knowledge and strict authority figures, they change into more of a coaching role based on their subject matter expertise. BUILDs trainers helped the students explore different avenues of enquiry by asking questions, not providing answers.

The end results positively astonished all the project partners in BUILD Solutions. During the first 5 days together (during the 5-Day Workshop celebrated in Barcelona in January 2020), the average student group went through more than 10 scientific articles from some of the world's leading universities, conducted more than 40 interviews with end-users, envisioned 5 different solution models (and discarded 4 of them based on the interviews), had their first 3D-renderings done of the proposed solution, and had prepared their first investor pitch alongside a draft of their business and scaling plans.

2.2 Motivational boost to self-learning through agency and ownership

Student ownership and responsibility are two key factors that have a big impact on a student's quality of academic performance. These were the findings of a report made by the National Center on Scaling up Effective Schools (NCSU). The report was based on a five-year research project that aimed to identify the types of programs, practices, and processes that support better outcomes for students. The report indicated that increasing student ownership and responsibility was a notable feature of schools with higher student achievement.

“The idea of the report was to develop the concept that students are willing to take on challenges and persevere and to provide a set of skills to focus that effort on achievement” (Marisa Cannata, Associate Director at NCSU and the study’s lead researcher). According to researchers, based at Vanderbilt University’s Peabody College of Education and Human Development, students who take responsibility for their own learning are personally invested in their education and are more committed to understanding their subject matter, which in turn helps to boost confidence.

The research by NCSUs showed that students who are encouraged to take ownership for their own learning are better able to identify and work toward learning goals and are more likely to believe that it is within their control to succeed in school and more likely demonstrate life skills such as initiative, self-direction and productivity.

During the BUILD Solutions project, the students had ownership of their work and thus were responsible for how their work turned out. The students had mentors who guided them by challenging them to think outside the box, instead of going the traditional way of providing answers. It can be said that the students were motivated because they had total responsibility and ownership of their project and in turn business. By the first practice pitch the students had done between 40-100 interviews and read more than 10 scientific articles per team.

With more of a coaching aspect taken to the trainers’ role, a vital task became goal visualization. Hence a significant part of the first two days were spent helping the students narrow down the problem they wanted to solve and imagine how the world, and their place in it, would look once the problem was solved. This process of visualizing goals included societal, social, and personal benefits (including personal wealth and degrees of freedom).

2.3 Transdisciplinarity through impact start-ups

“Transdisciplinarity is the intellectual space where the nature of the manifold links among isolated issues can be explored and unveiled, the space where issues are rethought, alternatives reconsidered, and interrelations revealed” (Yersu Kim; Director Division of Philosophy and Ethics IV).

“Students experience deeper learning and start thinking outside the box when their teachers collaborate to present different aspects of the same subject across various disciplines”. (Matt Levinson).

The Institute for the Future (ITF, 2016) has identified transdisciplinarity as a key and essential skill for the future workforce. In their report on future work skills, the ideal worker for the next decade is described as being T-shaped, which means that: *“They bring a deep understanding of at least one field but have the capacity to converse in the language of a broader range of disciplines. This requires a sense of curiosity and a willingness to go on learning far beyond the years of formal education”*. ITF reports that *“Many of today’s global problems are just too complex*

to be solved by one specialized discipline (think global warming or overpopulation). These multifaceted problems require transdisciplinary solutions".

Thus, there is a need for educational institutions to enable students to acquire a transdisciplinary mindset and position students with the skills and habits of being interdisciplinary thinkers and team players. However, trainers must be cautious that encouraging students to engage in transdisciplinarity does not deter the students from pursuing deep content knowledge. Students are the ones going to be tasked with solving future life problems and that requires a mix of an appreciation of transdisciplinarity combined with deep professional expertise.

For BUILD Solutions, the key question became: how can we improve transdisciplinarity amongst students? Nature-Based Solution (NBS) start-ups were chosen as a solution since they are good examples of how transdisciplinarity provides value. Through their creation, but especially in the process of making NBS start-ups grow, students become self-motivated to learn useful transdisciplinary skills.

In starting a NBS start-up, you need an idea and knowledge in different fields to identify how NBS can fit into a given context. There is a need for an understanding of architecture to decide how a given city is shaped and where solutions can fit in, biology to determine which living elements are fitted for the climate and environmental context, and business to examine the market and economic sustainability of the given NBS.

Nature-Based Solutions need to provide all of the above, while still providing ecosystem services that combat climate change.

Hence giving the teams in the BUILD Solutions the task of starting their project from scratch as a start-up encourages them to be transdisciplinary thinkers. In BUILD Solutions, the teams were made of students from diverse disciplinary backgrounds and this enhanced their synergy and ability to learn from each other and create better solutions consequently. In the report "Transdisciplinarity: stimulating synergies, integrating knowledge" by Yersu Kim (1998), transdisciplinarity is referred to as "*the meeting point of people and minds*".

Climate change was chosen as the core challenge at hand for the students to address for three reasons. One, the challenges the EU and the world face as a result from climate change are immediate and training students to learn how to deal with said challenges provide a net benefit to society at large. Two, the challenges caused by climate change are acute in the mind of the younger generation and hence a problem that is motivating for them to address and solve. Furthermore, the global challenges of climate change and the impact of climate change on cities and their urban context necessitates a transdisciplinary approach (Levinson, 2016).

As the BUILD Solution students came together in their respective teams, they exchanged ideas across professional, academic, and national cultures and

became better equipped for creating solutions for real life problems affecting our world today while also learning skills that could enhance their future careers.

3 – METHODS FOR SETTING UP AND SCALING STUDENT START-UPS

3.1 Lean start-up methodology

Developed and popularized by Eric Ries in his blog and book “The Lean Start-up” (2011), the LEAN start-up method has brought many start-ups to success. It is based on ideas and principles that are not entirely new and resonate with some of the principles of Lean Manufacturing, which derives from the Toyota manufacturing revolution (McFarlane, 2020). The Lean Start-up provides a scientific approach for any *“human institution designed to create a new product or service under conditions of extreme uncertainty”* to navigate the many challenges of new product development and real value creation while accelerating growth to a maximum and reducing resource waste to a minimum (Ries, n.d.).

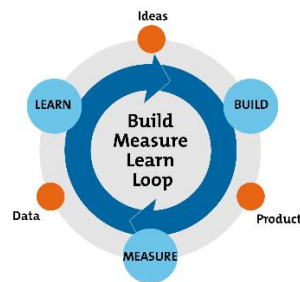
The method described by Ries prioritizes customer feedback during product development and short iteration phases to not waste resources and increase the value created for the consumer. The idea is that by the time the product is ready to be widely distributed it will not only have solved real problems but also it will already have established customers. This is based on giving up rigid planning of a product and business model and instead building a minimum viable product (MVP) first. An MVP is the simplest form of a product that can be built and used for testing the hypotheses, instead of putting a lot of resources into it and fully designing it upfront. This MVP is then continuously improved through so-called Build-Measure-Learn loops (see figure 1).

Therefore, experimentation and testing of hypotheses, as well as speed are the essence of the product development.

In order to measure and learn, Ries suggests following the “Five Whys”¹, which will show whether the company is going in the right direction with their product and business model or whether a pivot to a new hypothesis about the product, strategy, and engine of growth is necessary (Ries, n.d.). When testing the hypothesis, it is important to choose actionable metrics that reflect the real value and progress of the product. Ries calls this concept “validated learning”, which means drawing conclusions from data derived from actual customer behavior and customer product interactions (McFarlane, 2020). This means it is crucial to get out of the building and interact with real customers and collect their feedback.

¹ <https://hbr.org/2010/04/the-five-whys-for-start-ups>

Figure 1: Build, Measure, Learn Loop



Source: www.mindtools.com

Another concept that is important in the lean start-up method is “Innovation Accounting”. Innovation Accounting goes hand in hand with the Build-Measure-Learn loop (see figure 1) and validated learning as it enables companies to prove objectively that they are learning how to grow a sustainable business (Woods, 2016).

It requires three steps: firstly, establishing a baseline for data points which represents a starting point from which to improve. This can be done by running a first MVP test and collecting some feedback on interest from potential customers. The second step is about fine-tuning by making small single changes which can be carefully tested one by one. Lastly, the decision whether to pivot or to persevere needs to be taken based on the results from the iteration rounds. This process allows you to fully understand your customer’s needs and pivot where a hypothesis was not supported.

The lean start-up method thus enables companies or in this case the BUILD Solution students to develop a product and business model that solve real problems and match real needs by quickly learning from failures while producing the fewest waste of resources in the process.

3.2. Prototyping

Building on the ideas of the Lean Start-up, a methodology called prototyping has emerged. The basic idea is simple: sell it before you build it.

Furthermore, as you build and design your solution, constant market feedback ensures market uptake once the solution is complete. By using prototyping as a design and development methodology companies, in this case the student start-ups, potentially save years and years (and bucket loads of money) on research and development since the risk of designing and developing a solution for which there is no market is drastically reduced (Savoia, n.d.).

In practice, prototyping aims at finding out whether people are interested in a product, whether they use it as expected, and whether they will continue to use it. In contrast, prototyping aims at answering the question if something can be built, for what price and at what speed and if it will work as expected. To summarize,

pretotyping looks at the appeal of a project whereas prototyping looks at the feasibility of a product.

The pretotyping methodology as theorized by Savoia consists of five steps. Firstly, the key assumption which if proven wrong brings the whole idea to failure needs to be isolated (i.e., are people interested in living walls that reduce noise and air pollution). Once that has been identified, an appropriate type of pretotype testing needs to be chosen. Extremely simplified versions of that product can help test the premise if that product is built it will actually be used by customers. The third step is making a market engagement hypothesis. This is closely linked to Ries' concept of first building an MVP in order to test product hypotheses. In pretotyping, the hypothesis aims at testing how many and what kind of people will do what with the pretotype. In the fourth step, it is all about getting out of the building again and testing real-life interactions with the pretotype to get a better understanding of what the customers want and what features they would use. The last step, similarly to the Build-Measure-Learn cycle of the Lean start-up method, revolves around the evaluation of the results and subsequently, the refinement of the pretotype based on the new data or further testing in other situations, which is also called "hyperzooming" (ibid).

Following these two methodologies, the student teams conducted between 40 and 100 interviews with customers that allowed them to build solutions that will be used and solve real problems.

4 – TOOLS FOR SETTING UP AND SCALING STUDENT START-UPS

4.1. Alignment and roles

“Great teams are about personalities not just skills” (Winsborough and Chamorro-Premuzic, 2017)

According to Winsborough and Chamorro-Premuzic (2017), getting the right mix of personalities in a team is almost as important as the right mix of skills. In order to get the right mix of personalities in a team, one must consider the role that a person can play in the team. This could either be a functional role based on their formal position or technical skill, or a psychological role based on the kind of person they are.

When forming the teams in the BUILD Solutions project, teams were not only made up of students from different disciplinary backgrounds but also from a mix of different personalities. This enabled the teams to benefit from the diverse personalities of their team members. As studies have shown (Winsborough and Chamorro-Premuzic, 2017), different personalities bring out different skills and capabilities. For example, people who have the personality trait of self-confidence are likely to be good organizers and take charge. People who are detail-oriented tend to be highly organized and make good rules and guidelines for the team. They are also likely to make sure that the project is effective as well as efficient. People who have vivid imaginations and are curious are likely to bring in new ideas and people who are diplomatic, are more likely to ensure that the team overcomes their differing opinions and differences. These different personalities enhance the team and enable them to achieve their final goal. In BUILD Solutions, all students took a personality test on the second day of the five-day intensive workshop in Barcelona. Getting a mix of all four major personality types was a key metric used for setting the teams alongside having the students in each team more or less aligned on global sustainability problems they would aim to solve.

4.2. Remote working

Even in the absence of the COVID-19 crises, the teams from the BUILD Solutions project had to work remotely because there were students from several different countries in the same team. Each team had to overcome the challenge of working remotely. This was a bit of a challenge since the kind of projects they were working on involved a lot of practicality. Since the projects were practical in nature, constant hands-on participation as well as regular communication were needed. In order to overcome the challenges of remote work, the teams communicated regularly through digital meetings (Zoom, Skype, Microsoft Teams, Whereby, etc.) and digital communication platforms (such as Slack). The teams regularly assessed their progress, set milestones and goals for each month and week, and ensured consistent feedback amongst team members in case of unforeseen challenges.

Despite there are challenges to remote working, it entails some benefits as well. For example, team members are able to save hours of commute time and thus be more productive. Also, there is a flexibility as team members can work whenever they are able to (which was great when the BUILD teams had different class and exam schedules) as well as following individual preferences for when they feel most productive. Also, working remotely can increase focus as off-topic conversations are typically minimized.

4.3. Shareholders' agreement

A shareholders' agreement is a private contract between all shareholders of a company with the aim of regulating their relationships, rights, and obligations, as well as the daily operations of the company². When beginning a start-up, founders expect the start-up to be of great success and have projections where the start-up will be in a couple of years. But a start-up path is full of ups and downs, and the future is pretty much unknown. In most cases of start-ups, most changes are going to be made in the first 3 years of a start-up. The main reason for a shareholder's agreement is to determine the rules and the framework of the company. Shareholder's agreement sets the rights and obligations, relationships, and daily operations of the company. Not having a shareholder's agreement from day one of a start-up is risky and can have a negative effect on the company. Shareholder's agreement anticipates and helps solve issues that arise out of the growth of a start-up. Thus, it acts as a safeguard against various inconsistencies that may arise, as well as a tool to solve various disagreements between shareholders. A shareholder's agreement ensures that various distractions are prevented, the founders/shareholders stay on course and keep their eyes on the goal, which is usually, the growth of the company.

The teams from the BUILD Solutions chose their start-up projects with sustainability and growth in mind. Hence, it was important for them to draw up a shareholders' agreement in order to have a framework that covers various issues from day-to-day operations, organization processes, business activities, and relationships between the shareholders.

4.4. Forecasting

Forecasting involves making predictions about the future based on past and present data or sometimes trends. Forecasting is vital in an investment such as a start-up because you get the opportunity to anticipate and safeguard against common problems that may arise in the future. One way of doing forecasting is Discounted Cash Flow (DCF)³. DCF usually involves estimating the value of an investment today based on the predictions of how much cash the investment will generate in the future and discounting for risk and opportunity cost (what could your money have earned in a risk-free investment). In the case of start-ups, founders are usually in an uncharted territory thus making historical data and accuracy of

² www.law.cornell.edu/wex/shareholders%27_agreement

³ www.investopedia.com/terms/d/dcf.asp

predictions is difficult to obtain. Most founders of start-ups are more likely to make predictions based on present data and common trends of similar start-ups. However, it is still necessary to do a proper forecasting of the start-up. Drawbacks and adverse surprises are inevitable in a start-up, but forecasting helps anticipate some of these issues based on acquired data. Thus, proper actions are put in place beforehand to handle these issues.

Asheesh Advani in the “Starting a Business” article advised that it is much more difficult to predict the future cash flows of a start-up than it is to predict that of a public company. Hence, it is prudent to forecast the expenses of a start-up before the expected cash flow.

All the teams in BUILD Solutions were engaged in projects that were basically start-ups in nature, thus, it was necessary for them to do a proper forecast and estimate their expected expenses and revenues. Forecasting gave the teams an idea of how much value their investment had at the moment, an idea of future expenses and cash flow, an idea how much they would prefer their investment to be, and what work needed to be done in order to reach that goal.

4.5. Detailed 3-year business cases

When building a start-up it is common practice to anticipate future developments and needs by designing multi-year business plans. As nobody can accurately project the future at any given time this comes close to a guessing game and involves some dreaming. While the accuracy of that might not always be given, the aspect of dreaming is crucial in order to aim high. Hence, the most important part of the 3-year business case is to set goals for potential impact and find where current resources do not match the level of ambition described. It is by doing this exercise that the need for funding (investment) is usually first identified.

4.5.1. Dream big, the dream bigger

David J. Schwartz wrote in his book “The Magic of Thinking Big” (2015) that “*the size of your success is proportional to the size of your dreams*”. Hence, in the world of start-ups it has become a mantra that if you want to have big success you have to dare to dream big. This was the approach that was taken by the students in tackling the challenge of writing a 3-year business plan. When following this idea, it is critical to turn doubts and fears into positive thoughts and to drop all excuses that could prevent one from following such high targeted goals (Schwartz, 2015). Dreaming big is essential as it keeps up motivation. Entrepreneurs often go through tough phases, especially in the beginning, where seemingly not much can be gained from the business while it soaks up a lot of resources and energy. At the same time, not all external feedback will be positive and one has to handle discouragement. During times like this, keeping up motivation can be incredibly challenging. Thus, dreaming big and knowing what one is working towards and being passionate about how to get there can be a powerful source for self-motivation (Wilson, 2013).

But the power of dreaming big goes beyond that. Dreaming up goals that are so big that the currently available solutions seem insufficient is the way to find radical solutions where creativity becomes a necessity. Sparking creativity that way enables the mind to find ways to solve seemingly impossible problems by seeking new input, experimenting, and going for new approaches, which fosters innovation (ibid).

4.5.2. Reverse engineering success

Rather than developing an overly detailed business plan the students were instructed to think about what solution was currently possible and then imagine a ten times bigger solution, regardless of whether it seemed attainable or not. Once the bar had been set inspiring (preferably impossibly) high, the idea was to backtrack month for month in order to methodically identify the gaps in resources and the must-win battles for the student-start-ups along the way. This included considering what resources and support would be required in terms financing, customer acquisition, and product development to achieve that vision (Lavinsky, 2013). This process enables the development of a clearer long-term strategy that will help to ensure the development of concise action plans that can be broken down into smaller and attainable short-term milestones. By doing so, and paired with the approach of the Lean Start-up and Pretotyping methodology, young entrepreneurs are equipped with tools that will allow them to maximize value creation and growth while minimizing mistakes, that will eventually lead to success.

5 – CONCLUSION AND RECOMMENDATIONS

This document has compiled several methods and tools relevant for setting up and scaling student start-ups to provide a roadmap for those looking to drive entrepreneurship and transdisciplinarity among their students.

The use of methods such as prototyping and the lean start-up methodology seem to have enabled the creation of start-ups that meet an actual market need, as four of the five established start-ups are still up and running.

The experience with the BUILDS programme has confirmed that student ownership and responsibility have a big impact on students' performance and enthusiasm.

We also confirmed that the students gained a high sense of agency and empowerment by identifying the (global urban) challenges they cared the most about and developing their own the nature-based solutions to tackle said challenges.

As mentioned in the introduction, the end results positively astonished all of the project partners in BUILDS, as the students dove into numerous scientific articles from some of the world's leading universities, conducted more than 40 interviews with end-users, envisioned different solution models, created their first 3D-renderings of the proposed solution as well as preparing their first investor pitch alongside a draft of their business and scaling plans.

The BUILDS approach of creating student ownership and engagement while changing the role of the teacher from an authoritative source of knowledge to a coach have thus indeed proven successful and have inspired all partners.

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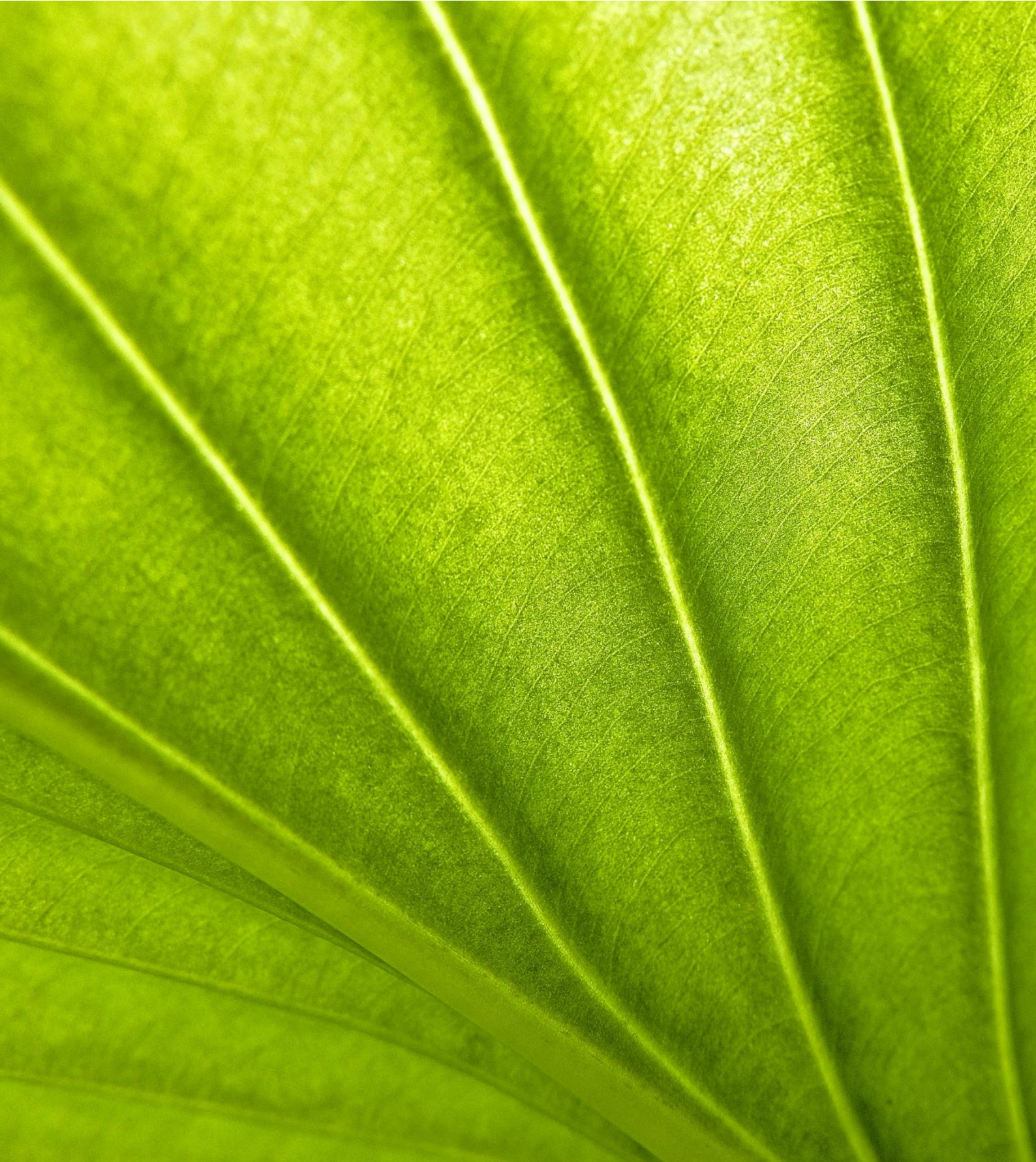
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