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BUILD SOLUTIONS

COMMON EDUCATIONAL RESOURCES

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CONTENTS

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 – COMMON EDUCATIONAL RESOURCES

In order to facilitate the adoption of "BUILD Solutions" educational approach, a common resources repository is being expanded in the project website platform with the aim of serving as technical guidance to other HE institutions for the implementation of interdisciplinary educational programmes.

The BUILDs online repository includes:

- Case studies: a curated selection of best-case studies to better understand urban intelligent living design solutions.
- European eco-businesses: review of successful European eco-businesses to find out more on how they combine bio-tech and design solutions to building greener cities
- Videos: interesting multimedia in order to understand what are urban intelligent living design solutions.
- Recommended readings: a compilation of selected readings from the different fields of biotechnology, design and architecture, and eco-business and entrepreneurship.

In addition, a glossary has been developed to help students and professionals to identify and acquire the vocabulary of the different disciplines that were integrated in BUILD (architecture, business economics, biotechnology), as well as to understand our approach to key concepts employed, including core terms as multidisciplinarity (MD) interdisciplinarity (ID) and transdisciplinarity (TD).

Furthermore, an interdisciplinary syllabus template was also developed and agreed among all partners with the aim of using it during the implementation of the BUILDs One-Year Programme by each of the HEIs.

All these resources were designed and developed to facilitate the adoption and understanding of BUILD Solutions.

The following two sections contain both the Glossary and the Syllabus template.

3 – Building Urban Intelligent Living Design Solutions Glossary

The glossary is aimed at helping both students, teachers, and professionals to get familiar with concepts belonging to the fields of biotechnology, design for urban resilience and business through a transdisciplinary lens. This tool is meant to overcome the usual disciplinary barriers and therefore facilitates the communication and work of the multidisciplinary teams to address innovative solutions holistically.

The glossary was divided into four sections and have identified the following 44 key terms, essential for BUILDs core work (with color legend):

Business Industry

- Business angel
- Business Model Canvas
- Business Sustainability 3.0
- Crowdfunding
- Discounted Cash Flow (DCF)
- Entrepreneurship Ecosystem
- Five Whys
- Lean Startup Methodology
- Pitch
- Shareholders' Agreement
- Spin-off
- Start-up
- Startup Accelerator
- Sustainability Driven Entrepreneurship
- Sustainable Business Model Canvas
- Value Proposition

Biology Biotech

- Agromining
- Nature-based solutions
- Sustainable Cities
- Urban Agriculture
- Phytoextraction
- Hyperaccumulator Plants
- Green Infrastructure
- Ecosystem Services
- Biodiversity (ies)
- Urban Heat Island
- Urban Soil
- Urban Ecology
- Ecological Resilience
- Biology Project
- Socio Ecosystem
- Urban Ecosystem
- Biomimicry

Design

- Living Design
- Modular design
- Pretotyping
- Digitally Fabricated Prototype
- Computational Design

Sinergy

- Multidisciplinary
- Interdisciplinary
- Transdisciplinary
- Challenge-Based Learning
- Learning by Doing
- Transformational Learning

Business angel

Investor angels, or business angels, are people who invest their money in the initial phase of startups, in exchange for a participation in capital. They also usually carry out the role of a mentor and offer their consent and experience to entrepreneurs.[1]

Business Model Canvas

The Business Model Canvas is a very popular tool for a startup to create a new business model. While filling out it gives the startup a valuable insight about the customer and the value proposition of their product or service. The Business Model Canvas consists of 9 building blocks: Key Partners, Key Activities, Key Resources, Value Proposition, Customer Relationship, Channels, Customer Section, Cost Structure and Revenue streams. It was a strategic management tool that the BUILD students used. Usually you start with filling in the sections with post-its, especially in the brainstorming phase, in order to be able to shift and change content easily. Alex Osterwalder created the Business Model Canvas.[2] The Business Model Canvas can be downloaded from Strategyzer[3], an online platform also offering explanation videos and further valuable materials.

Business Sustainability 3.0

The “Business Sustainability Typology” was developed by Dyllick and Muff. They cluster sustainable business performance in four stages, enabling a practical distinction between early, intermediate and advanced stages of business sustainability in practice. They herein determine three different shifts away from 'business as usual' towards Business Sustainability 1.0, 2.0 and 3.0.[4]

Business sustainability 0.0 - business as usual, based on purely economic interest.

Business sustainability 1.0 - mostly CSR activities, where businesses recognize and embrace challenges and opportunities that occur from societal and environmental

[1] https://www.bbva.com/en/what-is-business-angel/
[2] https://www.businessmodelsinc.com/about-bmi/tools/business-model-canvas/
[3] https://www.strategyzer.com/canvas/business-model-canvas
[4] Explanation video: ttps://www.youtube.com/watch?v=AEFqUh4PMmI

concerns and incorporate them into given practices and processes "without changing the basic business premise and outlook" (Dyllick/Muff 2016:392).[5] In this stage, creating economic value remains the main target while addressing sustainability issues results in benefits for the business itself.

Business sustainability 2.0 - following the triple bottom line approach, hence balancing the social, environmental and economic impact of the business activities. In practice, this means to broaden the value of shareholder value by the addition of social and environmental values and by implementing particular programmes and actions to reach intendedly set-up sustainability goals.

Business sustainability 3.0 - considered as truly sustainable business performance. Characterized by its outside-in perspective, where businesses start by looking at the external world and related challenges first, before developing the actual business idea. Emphasis is not on minimizing or outbalancing negative business performance but rather on creating positive impact for the greater good.

Crowdfunding

Crowdfunding explains the method of raising money from a large number of people (crowd) giving smaller amounts of financial contributions than a larger investor would and often combine with an online campaign to raise this money to a desired goal.[6] Within BUILD, some startups were interested in crowdfunding and an Austrian platform that was suggested was greenrocket.at having a strong focus on sustainability.

Discounted Cash Flow (DCF). Forecasting Methodology

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).

[5] Dyllick, Thomas/ Muff, Katrin (2016): What does sustainability for business really mean? And when is a business truly sustainable? In: Jeanrenaud, Sally/ Gosling, Jonathan/ Jeanrenaud Jean-Paul(eds.): Sustainable Business: A One Planet Approach, Chichester: Wiley 2016, 381-407.

[6] https://www.merriam-webster.com/dictionary/crowdfundingslack

Entrepreneurship Ecosystem

Support systems are crucial in the development of a startup, starting from the early stage onwards. The concept of 6 domains in an entrepreneurship ecosystem derives from Isenberg (2010) and are: Finance, Capital, Policy, Markets, Supports, Human Capital.

According to Mason and Brown (2014), *"The Entrepreneurial Ecosystem is a set of different individuals who can be potential or existing Entrepreneurs, organizations that support Entrepreneurship that can be businesses, venture capitalist, business angels, and banks, as well as institutions like universities, public sector agencies, and the entrepreneurial processes that occur inside the ecosystem such as the business birth rate, the number of high potential growth firms, the serial entrepreneurs and their Entrepreneurial ambition."*

The BUILD startups were encouraged to insert themselves in the entrepreneurship ecosystem, using already existing support structures to their advantage and getting to know other startups outside of the BUILD network.[7]

Five Whys

Five Whys[8], which has its origins in the Toyota Production System, and posits that behind every supposedly technical problem is actually a human problem. Applied to a start-up, here is how it works:

1. A new release broke a key feature for customers. Why? Because a particular server failed.
2. Why did the server fail? Because an obscure subsystem was used in the wrong way.
3. Why was it used in the wrong way? The engineer who used it didn't know how to use it properly.
4. Why didn't he know? Because he was never trained.
5. Why wasn't he trained? Because his manager doesn't believe in training new engineers, because they are "too busy."

[7] https://101entrepreneurship.org/entrepreneurial-ecosystem/
[8] https://hbr.org/2010/04/the-five-whys-for-startups

Lean Startup Methodology

Developed and popularized by Eric Ries in his blog and book "The Lean Startup" (2011), the lean startup method has brought many startups 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 Startup 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.)[9]. The lean startup method enabled BUILDs 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. The methodology was applied to the second semester part of the one-year programme, when business students developed and constantly updated the project and startup business plan according to the marketable product and its prototype development.

Pitch

Pitch is a presentation of a business idea to potential investors. People pitch a business idea because they need resources. If the goal is to raise startup cash, the target of the pitch is an investor. Other businesses pitch to potential customers to sell their product. Finally, some organizations pitch because they need a partner or resource to help them accomplish their mission. Very popular is the term 'elevator pitch' depicting the imagery of only having a short elevator ride to convince someone of the idea and having to present all the important facts in a concise and convincing manner.

Spin-off

A spinoff is the creation of an independent company through the sale or distribution of new shares of an existing business or division of a parent company.[10]

[9] The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Eric Ries, crown 2011

[10] https://www.investopedia.com/terms/s/spinoff.asp

Start-up

"A startup is a company working to solve a problem where the solution is not obvious and success is not guaranteed".[11] A Startup counts as a startup if it is younger than 5 years (definitions vary from 3-7 years) and differentiates itself from a small enterprise by starting up a new business idea, driven by force of innovation and scalability. As a startup does not have to be a legal entity yet, it does not necessarily mean profit is being made (yet). Generally speaking, 7 out of 10 startups fail to establish themselves properly and long-term on the market. Compared to conventional startups, sustainable startups may face more obstacles, as the supporting ecosystem is not as established yet.

Startup Accelerator

Startup accelerators support early-stage, growth-driven companies through education, mentorship, and financing. Startups enter accelerators for a fixed-period of time, and as part of a cohort of companies. The accelerator experience is a process of intense, rapid, and immersive education aimed at accelerating the life cycle of young innovative companies, compressing years' worth of learning-by-doing into just a few months.[12]

Sustainable Business Model Canvas

The Sustainable Business Model Canvas is a version of the Business Model Canvas. It adds two categories that especially focus on the sustainability of a business: eco-social costs and eco-social benefits[13]. Adding these two categories to the financial section in a business model is beneficial to define and elicit the advantages and disadvantages the startup has on society and the environment.

Value Proposition

[11] https://www.forbes.com/sites/natalierobehmed/2013/12/16/what-is-a-startup/

[12] https://hbr.org/2016/03/what-startup-accelerators-really-do

[13] https://www.case-ka.eu/wp/wp-content/uploads/2017/05/SustainableBusinessModelCanvas_highresolution.jpg

A value proposition refers to the value a company promises to deliver to customers and why they should choose to buy their product. Hence, it is crucial for a startup to be very clear about what their value proposition is and to be able to communicate it to the customers. It clearly identifies what the customer gets for the product or service they pay. For a startup, this usually is a process and not instantaneously clear. However, very important as it identifies the advantage and what differs you from the competition.[14] To understand your customers better, BUILD students worked with the Value Proposition Canvas and focused on their customers' needs, pains and gains.

The Value Proposition Canvas can be downloaded from Strategyzer: https://www.strategyzer.com/canvas/value-proposition-canvas

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 company.[15]

Sustainability Driven Entrepreneurship

Sustainability driven entrepreneurs act as agents of sustainable change. They counter current sustainability problems with entrepreneurial answers. At the core of their business models is their objective of making a positive social or/and ecological impact.

Agromining

Agromining involves cultivation of selected hyperaccumulator plant species ('metal crops') on low-grade ore bodies or mineralized (ultramafic) soils, or anthropogenic metal-rich materials (e.g. contaminated soils, mine spoils, industrial sludge), prior to harvesting and incineration of the biomass to recover target metals or salts.[16]

[14] https://www.investopedia.com/terms/v/valueproposition.asp
[15] https://novobrief.com/why-every-startup-needs-a-shareholders-agreement/3988/
[16] https://doi.org/10.1007/978-3-319-69626-3_102-1

Nature-based solutions

Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions. (EC)

Sustainable Cities

Building sustainable cities requires investment in (a) renewable energy sources, (b) efficiency in the use of water and electricity, (c) design and implementation of compact cities, (d) retrofitting of buildings and increase of green areas, (e) fast, reliable and affordable public transportation and (f) improved waste and recycling systems. Cities in poor countries need resources to support green technology transfer, and capacity development, and to improve access to soundly constructed housing, water and sanitation, electricity, health and education.[17]

Urban Agriculture

Urban and peri-urban agriculture occurs within and surrounding the boundaries of cities. It includes products from crop and livestock agriculture, fisheries and forestry. It also includes the provision of multiple ecosystem services that are beneficial to urban areas. Some BUILD solutions could be integrated in urban agriculture.

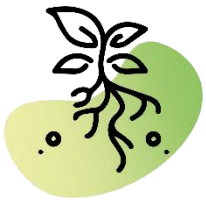
Phytoextraction

Phytoextraction is one of the methods of phyoremediation that uses plants that absorb and concentrate in their aerial parts the pollutants contained in the soil. It is the main mechanism responsible for agromining, the process developed by Econick, partner of the BUILD project.[18]

[17] https://www.un.org/en/development/desa/policy/wess/wess_current/wess2013/Chapter3.pdf

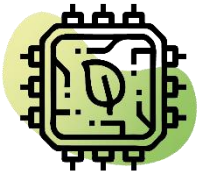
[18] Phytoextraction of Cadmium with Thalspi caerulescens, Plant and Soil 249: 27–35, 2003

Hyperaccumulator Plants



Hyperaccumulator plants have the ability to grow on metalliferous soils and to accumulate extraordinarily high amounts of heavy metal in the aerial organs (leaves, stems, flowers). They are used by Econick (partner of the BUILD project) to develop agromining.

Green Infrastructure

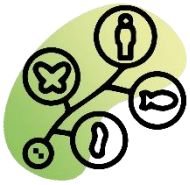


Green infrastructure is defined as engineered environmental design features built in interconnected natural and urban spaces to provide multiple ecological functions. The innovations developed in the BUILD program are intended to be inserted in the urban green infrastructure.[19]

Ecosystem Services

"Ecosystem services are the ecological characteristics, functions, or processes that directly or indirectly contribute to human wellbeing: that is, the benefits that people derive from functioning ecosystems".[20] Ecosystem services were expected to face the major environmental issues in urban areas; ecosystem services are provided by living systems in BUILD.

Biodiversity (ies)



Biodiversity (ies) is the variability among living organisms from all sources at different scales: genes, cells, species, populations, communities, in all managed and unmanaged ecosystems (terrestrial, aquatic). This is a high quantity of organisms (visible and invisible) in interaction with one another with different needs, different functions, and a high range of tolerance and adaptation abilities to the cocktail of human disturbances, especially in cities. Biodiversity is still moving through space and time. Finally, biodiversity is functional and can provide benefits to human (ecosystem services). The needs of biodiversity must be taken in account in BUILDs project to create sustainable living solutions in cities.

[19] https://doi.org/10.1007/s10980-014-0083-2
[20] https://doi.org/10.1016/j.ecoser.2017.09.008

Urban Heat Island

Urban Heat Island (UHI) is an urban area or metropolitan area significantly warmer than its surrounding rural areas due to human activities. It is caused by anthropic production of energy, lower albsedo of urban building materials, urban morphology, air pollution and lack of vegetation and permeable soils. There are multiple consequences of UHI such as health issues, consumption of energy for air-cooling, degradation of urban water quality. Green infrastructures implemented in BUILD, such as green walls and green roofs, are expected solutions to mitigate UHI.

Urban Soil

All soils under human influence that can be found not only in urban areas, but also in a wider range of locations. NBS that are developed during the BUILD program partly or totally rely on urban soils, which are the central compartment of the urban ecosystem.

Urban Ecology

Ecology is the science that is studying interactions between organisms (biodiversity) and between organisms and their environment at all spatial and temporal scales. In this way, urban ecology is an adaptation of ecology to urban areas. Increasing our knowledge in this science might help in designing sustainable projects in BUILDs.[21]

Ecological Resilience

Ecological resilience is the ability of an ecosystem to maintain its normal patterns of nutrient cycling and biomass production after being subjected to damage caused by an ecological disturbance. The resilience concept was interesting for the sustainability of BUILD solutions.

[21] https://doi.org/10.1016/j.scitotenv.2019.02.410

Biology Project

From the biology perspective, a project is the organization in terms of: i) definition of milestones; ii) scheduling; iii) division of work that aims at answering a request/question. The contribution of the biology students in the BUILD program was defined by such standards.[22]

Socio Ecosystem

From the biology perspective, the socio ecosystem is defined as all the stakeholders that need to be taken into account in the development and implementation of a project.

Urban Ecosystem

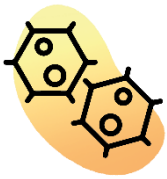
"Any ecological system located within a city or other densely settled area or, in a broader sense, the greater ecological system that makes up an entire metropolitan area. Urban ecosystems are composed of biological and physical components that interact with one another within a specified area. The biological complex includes human populations. The physical complex includes buildings, transportation networks, modified surfaces, and the environmental alterations resulting from human decision-making. The physical components of urban ecosystems also include energy use and the import, transformation, and export of materials".[23] The complexity of urban ecosystem were taken into account to create sustainable NBS in BUILDs.

Biomimicry

Biomimicry is the copy of the models, living systems, and elements of nature for the purpose of solving complex design problems. We used Biomimicry in BUILDs with the aim of taking inspiration from nature and translating the natural selection solutions found in nature into the process of design and manufacturing of the start-up products. By mimicking nature and its biological systems in the design process, we end up having products that are more efficient, resilient and sustainable.[24]

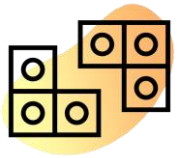
[22] https://ensaia.univ-lorraine.fr/
[23] https://www.britannica.com/science/urban-ecosystem
[24] https://youmatter.world/en/definition/definitions-what-is-biomimicry-definition-examples/

Living Design



Living design is defined as “the use of forces and possibilities given by natural living organisms to help and build low-cost and sustainable construction. Achieving real living design requires not only using nature as it is but also shaping it to the required form” (Vallas & Courard, 2017).[25] Living design, through Nature-Based Solutions (NBS), can provide sustainable, cost-effective, multi-purpose and flexible alternatives to today’s global urban challenges. In BUILD, we used living design into the process of using and shaping nature in the design and manufacturing of the start-up products.

Modular design



Modular design is a design approach that creates things out of independent parts with Standard interfaces. This allows designs that can be aggregated in different shapes, forms, and orientations. A very well-known example of modular design is LEGO plastic construction toys.[26]

Pretotyping

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 pretotyping as a design and development methodology companies, in this case the student startups, 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.)[27].

In practice, pretotyping 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 as opposed to prototyping which aims at answering the question if something can be build, 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.

[25] https://doi.org/10.1016/j.foar.2017.05.003
[26] Adapted from: https://simplicable.com/new/modular-design
[27] https://www.pretotyping.org/

Digitally Fabricated Prototype

A prototype is the simplest form of a designed product that can be digitally manufactured and used for testing, instead of putting a lot of resources into a fully designed and manufactured product. At BUILDs we built several prototypes for the start-ups and continuously improved them through many iterations. Therefore, experimentation and testing of the product, as well as speed, are the essence for a project's success.

Computational Design

Computational design is the application of computational strategies to the design process. Computational design aims to enhance design strategies using a computer language. The goal is not to document the final result necessarily, but rather the process required to create a new approach of designing. We used computational design methods to facilitate the development and fabrication of several start-up product designs.

Multidisciplinary

As defined by UNESCO is an approach to curriculum integration which focuses primarily on the different disciplines and the diverse perspectives they bring to illustrate a topic, theme or issue. A multidisciplinary curriculum is one in which the same topic is studied from the viewpoint of more than one discipline. In BUILD Solutions, we found very useful Jo Bailey´s analogy and visualisation of multidisciplinary as a salad. "As in a salad, bowl ingredients remain intact and distinguishable".[28] In a multidisciplinary collaboration, several different disciplines provide different perspectives, approaches, tools and methods.

Interdisciplinary

An approach to curriculum integration that generates an understanding of themes and ideas that cut across disciplines and of the connections between different disciplines and their relationship to the real world. It normally emphasizes process and meaning rather than product and content by combining contents, theories, methodologies and perspectives from two or

[28] http://makinggood.design/thoughts/tasty/

more disciplines (UNESCO).[29] In BUILD we also used Jo Bailey´s analogy and visualisation of interdisciplinary as a stew. “In a stew, ingredients mix/much into each other and are only partially distinguishable. In interdisciplinary collaboration integration of disciplinary contributions is required”.

Transdisciplinary

BUILD Solutions aimed to experiment with a transdisciplinary approach. According to Formas (2006), the definition of transdisciplinary “is not a process that follows automatically from the bringing together of people from different disciplines or professions, but requires an ingredient that some have called ‘transcendence’, principle that implies the giving up of sovereignty over knowledge, the generation of new insight and knowledge by collaboration, and the capacity to consider the know-how of professionals and lay-people on equal terms” (cited in Dunin-Woyseth, 2010).

In BUILD, we used Jo Bailey´s analogy and visualisation of transdisciplinary collaboration and design production as a cake, “where the ingredients are no longer distinguishable and the final product is a different kind”. In BUILD Solutions, students work in a transdisciplinary manner crossing over the disciplinary boundaries when pretotyping their start-ups. By working each startup towards the same goal, the team diversity brought consciousness about the different lenses and perspectives of a same challenge and therefore the sensitivity to address it holistically.[30]

Challenge Based Learning

BUILDs aimed to boost innovation, entrepreneurship and subsequent market uptake of intelligent living, biotech and biomimicry solutions to help greening cities. In this regard, a CBL approach provides an efficient and effective framework for learning while solving real-world challenges. A CBL experience is defined as “a learning experience where the learning takes place through the identification, analysis and design of a solution to a sociotechnical problem. It is typically multidisciplinary, takes place in an international context and aims to find a solution,

[29] http://makinggood.design/thoughts/tasty/
[30] http://makinggood.design/thoughts/tasty/

which is environmentally, socially and economically sustainable" (Malmqvist et al., 2015).[31]

Learning by Doing

Learning-by-doing is the pedagogy firstly articulated by the educator John Dewey (1916) based on the general idea that hands-on experiences leave deeper marks towards the development of the creative individual than those induced by uniform second-hand knowledge. Today "Dewey's legacy and learning by doing is at the core of a widely practiced model of design education with the design studio at its centre. A design studio is ideally an atelier, open 24 hours, inhabited and kept by the students. It is an environment where students test out theories, ideas, materials, constructions, and similar productions as part of their design processes. Because it is a shared space, students are able to work together, and follow each other's processes" (Özkar, 2007)[32].

Thanks to recent developments in digital fabrication, architecture schools are now equipped with fast prototyping tools, as, for example, 3D printers, laser cutters, CNC machines and robotic arms. These artefacts enable students to develop working prototypes, through which it is possible to test project performances. A Learning-by-doing approach was included in BUILD methodology in order to engage learners in more hands-on, creative modes of learning and to develop functioning prototypes, testing the performances of their marketable project throughout the second semester of the One-year Programme.

Transformational Learning

The process of transformative learning is characterized by a quality shift in perception and meaning making, which brings the learner to the crucial point of questioning and reframing his/her world views, assumptions, and habits (Mezirow, 2000)[33]. In line with this process, BUILDs sought to provide a programme where students could venture out of the traditional parameters of their disciplines and adapt their knowledge becoming entrepreneurial agents of sustainable change, able to

[31] https://www.researchgate.net/publication/350207474_Challenge_based_learning_in_higher_education-_A_systematic_literature_review

[32] https://www.researchgate.net/publication/226086576_Learning_by_Doing_in_the_Age_of_Design_Computation

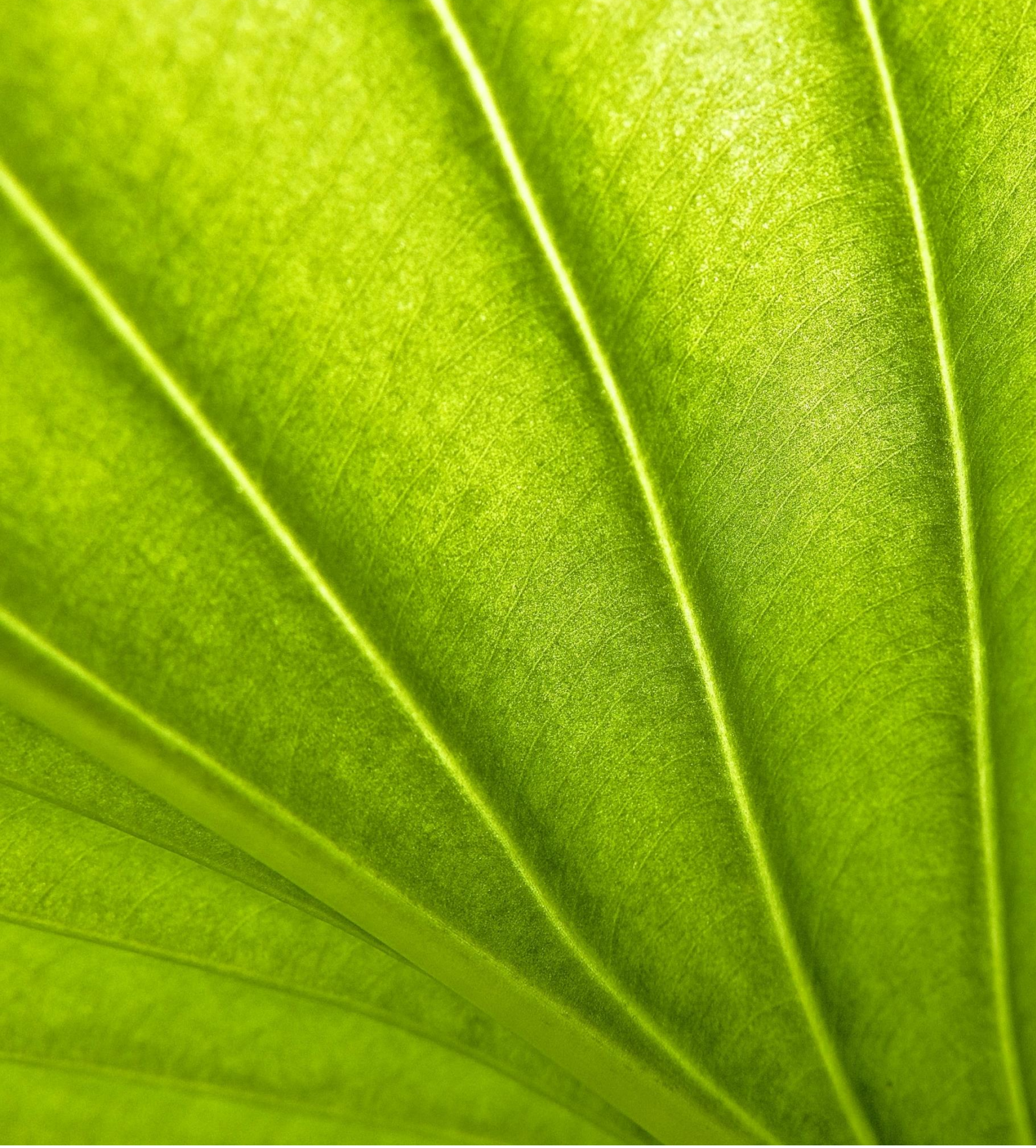
[33] https://www.researchgate.net/publication/249634386_The_Evolution_of_John_Mezirow's_Transformative_Learning_Theory

collaborate across different disciplines and sectors. An increasing body of literature already exists that highlights the efficacy and benefits of transformative learning and the abilities it imbues into its students. Abilities such as participating in interdisciplinary teams, cooperative and creative problem solving, bridging theories with practice or actively dealing with conflicting values, knowledge domains and legitimated interests are recommended to be enhanced during the learning process (Thomas, 2009; Taylor and Cranton, 2012).[34] In BUILD the arrangement of the learning setting was of particular importance as it addressed the substantive challenges of the students, such as collaboration in interdisciplinary teams and the translation of theoretical approaches, into the dynamic and applied environment of the marketplace.

[34] https://www.wiley.com/en-am/The+Handbook+of+Transformative+Learning%3A+Theory%2C+Research%2C+and+Practice-p-9780470590720
https://www.researchgate.net/publication/249634386_The_Evolution_of_John_Mezirow's_Transformative_Learning_Theory

4 – BUILDs Educational Programme Syllabus Template

BUILDs TEMPLATE SYLLABUS AND METHODS ADOPTED	
DATE	*Academic semester dates*
COURSE TITLE	*Title of the course in English (and in original language)*
TUTORS	*Name(s) of the tutor(s)*
OBJECTIVE OF THE COURSE	*What is expected to be transmitted to the students in this course and in relation to the BUILDs project*
COURSE CONTENT	*What are the key topics of the course and its relation to BUILDs*
OVERVIEW OF THE ACTIVITIES	*List the activities performed, including the time devoted to each one*
RATIONALE FOR SEQUENCING AND PACING ACTIVITIES	*Explain how the course has been organized to allow the interconnection with the other two disciplines and why it has been structured like this*
ASSESSMENT	*How will you assess the success of this course? What outcomes will illustrate that students have met the goals and objectives of this course in relation to BUILDs?*
MATERIALS/RESOURCES	*List the bibliography and materials used in the course*
SUPPORT AND FOLLOW-UP	*Means of communication with students, frequency, assignments, etc.*



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