

A Work Project, presented as part of the requirements for the Award of a Master's degree
in Management from the Nova School of Business and Economics.

Application of the Value Creation Wheel to increase the impact of Earth Observation on Urban Planning

VCW 1 - Identifying the Most Attractive Geographical Market for the Urban Heat Island
Monitoring Solution by Latitudo 40

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Abstract:

Urban Planning enables functional cities while maintaining high quality of life for citizens. However, rapid urbanization and increasing effects of climate change are raising the need for sustainable urban areas worldwide. Earth Observation can provide valuable insights to local governments, allowing for more informed decisions and therefore helping to mitigate climate risk. For this individual contribution, close collaboration with Italian company Latitudo 40 was used for finding an attractive new geographical market for their Urban Heat Island monitoring solution. Application of the Value Creation Wheel identified the Petah Tikva subdistrict of Israel as the final target region.

Keywords: Innovation, Value Creation, Urban Planning, Earth Observation, Technological Markets

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1. Introduction

Urban planning is a key requirement for enabling functioning cities and providing a high quality of life to citizens (Taubenböck et al. 2010). However, rapid urbanization and the effects of climate change are a growing challenge for sustainable urban development (UNEP 2017). Global efforts such as the Paris Agreement and the Sustainable Development Goals (SDGs) have been undertaken to limit climate impact and enable a just transition towards a sustainable civilization (UN 2015a; UN 2017). On a municipal level, these efforts also translate into cities' Environmental, Social, and Governance (ESG) targets (McGrath 2020).

Until recently, in-situ sensors measured the urban environment to help with planning activities and achievement of ESG goals. This method is often resource intense, as it requires high up-front investments and continuous maintenance, as well as a certain degree of technical know-how by the municipality (D'Amico et al. 2020). Innovative solutions in the field of Earth Observation (EO) allow for remotely monitoring indicators such as urban heat, flood risk areas or building health with great accuracy and high cost efficiency (European Commission 2019b). Large datasets allow for in-depth analysis and thereby enable municipalities to support urban planning activities.

This Field Lab (FL) aims to apply the Value Creation Wheel (VCW) (Lages 2016) to three EO based urban planning solutions to identify attractive, new geographical markets of high impact. The work consists of four main sections. The first section gives a contextual overview on which this FL is based. The second section showcases the practical use of EO for urban planning, explains alignment with the SDGs and highlights current challenges. The third section introduces the VCW as a problem-solving tool for complex challenges and describes the five main framework phases. In the fourth section, the student's individual contributions will be presented. This includes the application of the VCW to an existing company and solution.

2. Literature Review

2.1. Urban Planning

Urban Planning describes the design and regulation of city spaces with regards to their physical appearance, economic function, and social impact on its citizens (Huxley and Inch 2020). Nowadays, city planning activities include a wide range of disciplines and activities with increasing complexity due to the need of anticipating future situations. The goal of urban planning is to successfully steer settlement development into a qualitative, liveable and sustainable direction (Taubenböck et al. 2010). Sustainable development is thereby defined as the process of meeting “[...] the needs of the present without compromising the ability of future generations to meet their own needs.” (Simon 1987, p. 8).

Historically, the need for modern urban planning activities emerged between the late 19th and early 20th century, as growing industrialized cities faced worsening sanitary, economic, and social conditions (McGill University 2015). In the beginning, civil engineers and architects formed the basis for practically all planning activities. Engineers were tasked with significant improvements to the city’s water supply and sewerage systems to enable constant urban population growth. Architects on the other hand saw an increasing amount of early regulatory laws regarding minimal standards for housing construction and safety to comply with. Later, public health experts and sociologists became involved, as the need for a better urban environment emerged. Green city spaces were built to offer a visual relief and relaxation opportunity for citizens. With increasing economic activities in cities (Lampard 1955), economists became involved in the planning process more frequently. To facilitate the movement of goods through the cities, pedestrian and vehicular traffic was separated, large transportation corridors and dedicated commercial spaces established. Lastly, the increasing use of motorized vehicles represented a significant factor for changing the

physical form of cities. Residential, industrial, and commercial districts could be further apart, as workers and goods moved more rapidly from one place to the other (McGill University 2015; Erickson 2012).

As the historical evolution shows, an increasing number of involved activities and responsibilities are required for urban planning. Ongoing developments such as climate change are additionally adding to the complexity of the process.

2.2. Climate Change Impact on Urban Environments

As of today, cities host over half of the global populations, with this number being forecasted to reach 70% by the mid-century (UNEP 2017). At the same time, the effects of climate change have an increasing impact on cities worldwide (Hunt and Watkiss 2011). Rising temperatures and sea levels cause a high frequency of extreme weather events to occur, such as floods, storms, or droughts. This heavily affects cities' basic services, local infrastructure, and overall citizen quality of life. Effects are thereby not limited to developing countries but are felt globally. São Paulo in Brazil was recently hit by severe droughts, bringing the local water supply reservoir to a fraction of its capacity, and forcing residents to strict water rationing (Purvis 2016). This year saw the US National Weather Service announcing a flash flood warning for New York City for the very first time after heavy rainfall caused streets, apartments, and subway lines to be flooded (Sullivan 2021). Additionally, in summer 2020, India experienced one of the strongest typhoons since the beginning of recordings. As a result, over 2.5 million people from densely populated areas had to be evacuated, as the tropical storm made landfall near Kolkata and threatened the 15 million inhabitant city. Economic damages were estimated at \$14b for the 5-day weather event (PTI 2021). Even without the direct destructive effects of extreme weather, cities are impacted by climate

change. Notable effects can be observed on human health and overall city infrastructure. Air pollution is already estimated to cause 7 million deaths per year globally, with current trends indicating a growing reason for concern (Schmale et al. 2014). Low air quality due to elevated amounts of fine particles in the atmosphere has severe health impacts. Human exposure to atmospheric pollutants has been shown to cause an overall cognitive decline, as well as increased premature mortality due to cardiovascular and respiratory diseases. The continuing degradation of air quality is expected to have a major impact on urban human health by the mid-21st century (Kumar 2021). Apart from causing health issues, particles in the air are also interconnected with climate change, as they influence local meteorology. As a result, increasing temperatures due to trapped heat, as well as interferences with humidity, windspeed or rainfall are further accelerating climate change and its effects (Kumar 2021; Schmale et al. 2014).

In addition to human health, and environmental factors, increasing urban temperatures are posing a risk to infrastructure safety. High air temperature causes the creation of Ozone near the surface, which has damaging effects on urban structures such as roads and buildings (Kumar 2021).

Resulting from the increasingly strong climate effects on cities and their negative impact on urban populations, adaptation to climate change is now at the core of many urban planning activities (Blanco et al. 2009).

2.3. International Climate Change Mitigation Efforts

When addressing the important challenge of climate change and guiding cities into a more sustainable direction through effective urban planning, a variety of different aspects and stakeholders must be considered. While it is not sufficient to only aim to reduce economic losses incurred by climate change, efforts must also incorporate an environmental and social benefit to

have a strong and lasting impact (Schweikert et al. 2018). In this context, the Triple Bottom Line (TBL) becomes relevant.

2.3.1. Triple Bottom Line

The TBL is a concept introduced by Elkington (2004) which advises firms to measure their impact in three dimensions instead of purely focusing on profit generation. These three pillars can be defined as Profit, Planet, and People – or the 3 Ps.

Profit is the historical standard bottom line in a capitalist economy. Firms are generally successful when they achieve good financial performance and therefore generate value (in the form of profit) for their shareholders. Planet describes the environmental impact of a company's business operations. Large corporations have significantly contributed to climate change since the industrial revolution and generally possess the necessary resources to help reduce their carbon footprint. This could be in the form of sourcing material in a sustainable way, lowering overall energy consumption, and optimizing shipping to reduce transportation emissions (Miller 2020). Lastly, People measure the social contribution of a firm. Instead of purely committing to shareholders, a wide range of stakeholders should be accounted for. With an increasing focus on sustainability, modern companies need to create value for all stakeholders affected by their business operations. This must naturally include customers, employees, and community members, but also humanity in general. Committing to people on a larger scale could mean partnering with external organizations and sharing a common goal to work towards (Kraaijenbrink 2019).

With respect to the TBL, several key measures were undertaken to address the urgent need for climate action.

2.3.2. COP 21 – 26 and the Paris Agreement

On a global scale, the Paris Agreement, resulting from the 21st Conference of the Parties (COP 21) in 2015, represents a landmark agreement for tackling climate change on a large scale by aiming to limit the average atmospheric warming to well below 2°C. The agreement is unique as it represents a legally binding document, committing all 196 signatory nations to undertake serious efforts to adapt to current climate change effects and limit its future increases. This includes both intensifying current actions and providing the required investments for a sustainable civilization. Individual states presented Nationally Determined Contributions (NDCs) to better track progress and reevaluate achievements in 5-year intervals (UN 2015a). The recently held COP 26 in Glasgow reviewed the realized progress since the Paris Agreement in 2015. While all countries confirmed their resolution of collaboratively achieving a global temperature rise of less than 2°C, it was found that many countries' individual ambitions had not been strong enough. Unfortunately, most of the major carbon-emitting countries had not set ambitious NDCs to achieve a 45% CO₂ emission reduction and resultingly net zero global emissions by the mid-century. Therefore, all countries were called upon to present significantly stronger individual commitments by next year (UN 2021a). To achieve that, industrialized countries are requested to provide \$100b in annual investments to less-developed nations for climate protection. In return, emerging countries are obliged to reinforce their climate protection measures through their own NDCs (bpb 2021).

2.3.3. Sustainable Development Goals

To establish a development framework for achieving a better and more sustainable future for humanity by the year 2030, the UN introduced the Sustainable Development Goals (SDGs) (UN 2017). The 17 SDGs address a wide range of urgent issues, from eliminating poverty and hunger, to reducing overall climate impact and protecting other species on earth, to building sustainable

cities and enabling decent economic growth. Thereby, each SDG is aligned with at least one dimension of the TBL (Figure 1). Additionally, goals were further divided into specific targets and deadlines (usually 2020 or 2030), explaining what action and timeframe were needed to reach the overall goal. Through a variety of assigned quantitative indicators, global progress could be accurately monitored over the years.

While all SDGs can be assigned to one of the TBL dimensions, Goal 17 provides the overall framework through which the previous 16 Goals and targets would be realized. Thereby, partnerships and global collaboration would be the essential requirement for tackling climate change on a large scale and succeeding with the ambitious targets.

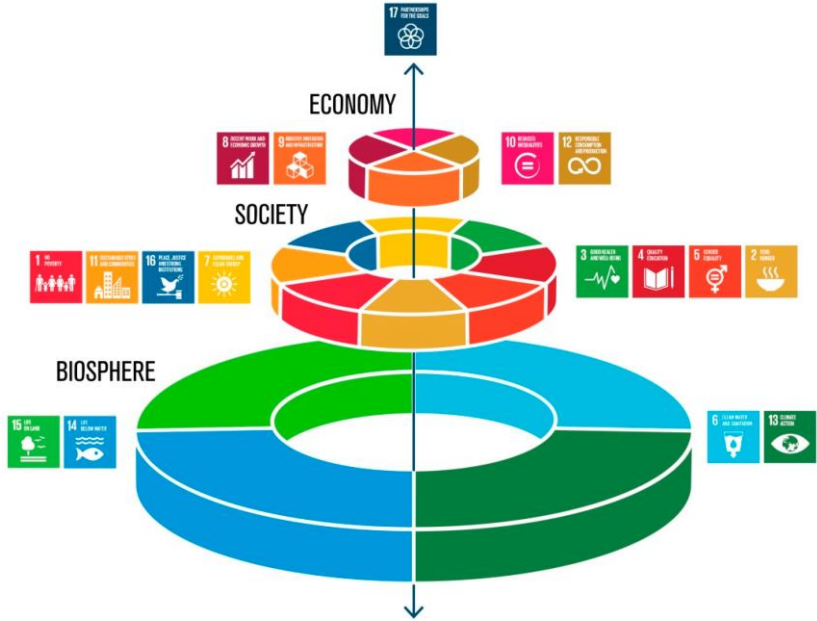


Figure 1: SDG Alignment with the TBL dimensions (Bergman et al. 2018)

Although the SDGs are representing the most global and therefore far-reaching development framework, various regional agendas have been formulated in recent years.

2.3.4. Urban Agenda for the EU

As an example of regional collaboration, the EU has recognized its role in effectively reducing climate change impact on cities by leveraging international partnerships. One notable example is the Urban Agenda for the EU (also known as the Pact of Amsterdam) launched in 2016 to address the increasing urbanization and the growing effect of climate change on cities within the EU (European Commission 2016). The agenda represents a coordinated approach dealing with European and national urban policies and legislation for increasing urban quality of life. As part of the agenda, several priority themes have been defined. In particular, the focus was on Circular Economy, Digital Transition, Air Quality, and Housing, as well as Sustainable Use of Land and Nature-Based Solutions. Thereby, each of the priority themes is aligned with the dimensions of the TBL. Like the SDGs, national and international partnerships represent a key pillar of the EU Urban Agenda, with special emphasis on innovative solutions, such as smart city technology.

2.3.5. European Green Deal

The urban agenda also plays into the later formulated European Green Deal from 2019 (European Commission 2019a). The Green Deal represents the EU's primary growth strategy and aims to transition its economy towards a sustainable model (Figure 2).

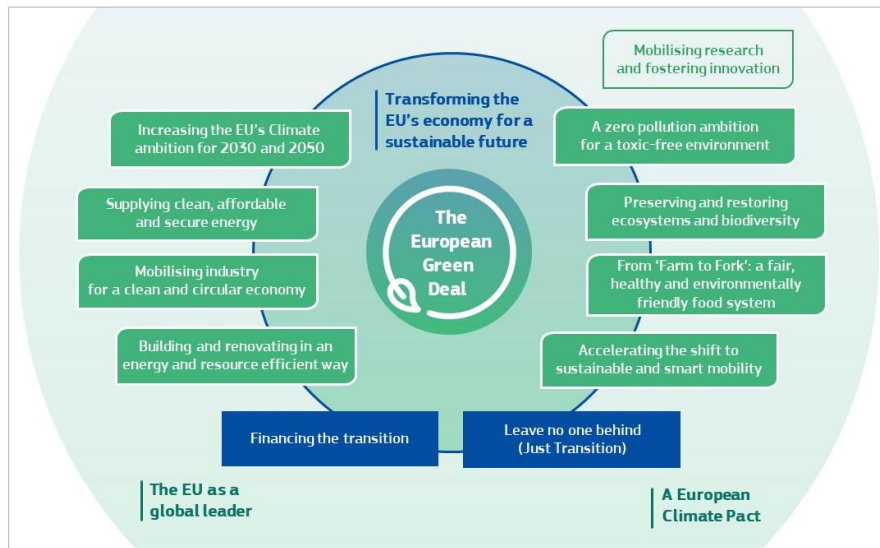


Figure 2: The European Union Green Deal with its goal and main elements

The EU strategy's overarching objective is to make the continent climate-neutral by the mid-century. As a result of the ambitious goal, the EU would see strong environmental benefits, more cost-efficient clean energy, increased use of smart transportation methods, and added new jobs in sustainable industries, resulting in a significantly improved quality of life for all its citizens (Norton Rose Fulbright 2021). The Green Deal consists of several main elements to be addressed, such as climate action, clean energy, and sustainable industry, as well as energy-efficient buildings and renovations, eliminating pollution and preserving biodiversity.

As an example of the ambitious targets of the new strategy, the EU aims to cut greenhouse gas emissions by 55% compared to 1990 levels. Furthermore, as buildings are estimated to cause 40% of the continent's energy consumption and 36% of greenhouse gas emissions from energy production, cleaner buildings are a key requirement. By renovating inefficient buildings and forcing decarbonisation of heating and cooling, energy efficiency will be significantly increased. Lastly, a heavy reduction of pollution for fewer premature deaths, mental and physical diseases

will be enforced until 2050. To achieve that, strong emphasis will lie on pollution elimination measures being part of all future policy developments within the EU. Over time, this will lead to a further decoupling of economic growth and greenhouse gas emissions (European Commission 2019a).

As the EU Green deal represents an international effort with an ambitious goal, a significant amount of funding is required. To finance the individual projects and targets, the EU Green Deal Investment Plan has been created. The plan seeks to allocate a total of €1 trillion, made up of two primary financing streams. The first stream worth €528b is provided directly from the EU budget, with the remaining being sourced from the InvestEU program. The latter program combines funds from the public and private sectors, as well as national co-financing (European Commission 2020b; Norton Rose Fulbright 2021).

One of the various innovation programs funded under the EU Green Deal is the Horizon 2020 initiative, of which Nova SBE received a significant investment for a sustainability project (European Commission 2021; Nova SBE 2020). The EU sees innovation as a key driver in achieving these ambitious challenges. To build innovative new value chains in different markets, both new technologies and new applications of current technologies need to be developed and demonstrated. As financing for adaptation and mitigation action is readily available, innovative solutions are needed to bridge the gap between the two (GERICS 2015).

2.4. Innovation and Value Creation

Innovation is a key driver for solving many modern challenges. Innovation is associated with the commercialization of a new idea or invention. This can be in the form of new products, processes, and services or a combination of them. The innovation does not have to be the result of a single

invention but may also incorporate a variety of already existing knowledge and previous inventions (Grant 2019). Companies are nowadays seeking to innovate in a sustainable way. Therein, they create new products or services with positive net environmental and social impact, without reducing their economic viability (Weidner et al. 2021). By doing this, they are contributing to the TBL and creating value for a range of direct and indirect stakeholders.

The concept of value has been studied extensively over the past centuries and plays a key role in innovation. The famous British economist Adam Smith defined value as a concept that "[...] expresses the utility of some particular object, and sometimes the power of purchasing other goods which the possession of that object conveys." (Smith and Channan 1976, p. 48). According to him, the value could be distinguished into value in using an object and value in exchanging that object for other goods or services. This laid the basis for highlighting the subjectivity of value depending on a person's individual preferences and needs. Other scholars, such as Porter, connected value and value creation with a firm's competitiveness. Value is what the buyers (or customers/users) were willing to pay for a product or service. The more use value could be created by a company, the better would be its competitive position in the market. In order to achieve superior value over the competition, the product or service either had to have a lower cost while delivering the same level of quality or provide more benefits to justify the higher price (Porter 1985).

More recently, the term value has been incorporated into a value proposition, which describes a company's bundle of products and services to satisfy its consumer's needs. The more these needs are fulfilled, the more value is created for them. Modern businesses do not purely strive to achieve value for their direct customers, but a variety of stakeholders simultaneously. Amongst others, these can include employees, shareholders, suppliers, partners, governments, or NGOs (Freudenreich et al. 2020).

2.5. Earth Observation Applications

A particularly relevant industry for promoting constant innovation and therefore creating value for many stakeholders is EO (GEO 2017).

EO describes the process of monitoring our planet using remote sensing technologies. This allows for accurate insights into Earth's land, marine (rivers, lakes, and oceans), and atmospheric environment. In the context of satellite-based remote sensing, payloads are mounted on satellites to collect imaging data about a wide range of Earth's characteristics. Collecting, processing, and analysing this data, in turn, allows for the extraction of information relevant to various types of applications and industries. Apart from satellites, other forms of remote sensing can be employed, such as with an in-situ sensor or using drones. However, only satellites can cover wide geographical areas in a short time frame with their imaging sensors (European Commission 2019b). For the scope of this Field Lab report, we will therefore refer to remote sensing done via satellites.

To gain insights about the Earth, satellites carry a range of different instruments as their onboard payload. Thereby, sensors can be divided by two main characteristics: type of sensor and sensor resolution (European Commission 2019b).

There are two main sensor types currently used by remote sensing satellites. Optical or thermal sensors passively monitor the amount of energy reflected off the Earth's surface or atmosphere. By being sensitive to both visible and infrared electromagnetic radiation, they can reveal details otherwise hidden to the human eye or a normal photo-sensor (Figure 3). Radar sensors make up the second type of commonly used satellite payloads. By actively sending out energy towards the Earth and measuring the reflected amount from the surface or atmosphere, they can operate during the night and therefore yield valuable information at all times of day and weather conditions.



Figure 3: Example of satellite imagery for forest fire scar identification. Standard true-colour image (left) vs shortwave infrared (right), revealing extent of fire damage (NASA 2021)

After sensor type, the resolution is the second essential differentiator of remote sensing technology (NASA 2021). Thereby, spatial, and temporal resolution become relevant. Spatial resolution refers to the amount of area that each pixel represents (such as 100m x 100m per pixel, 30m x 30m per pixel, etc.). Finer resolutions allow for increased image details and more in-depth information to be extracted from the data (Figure 4).

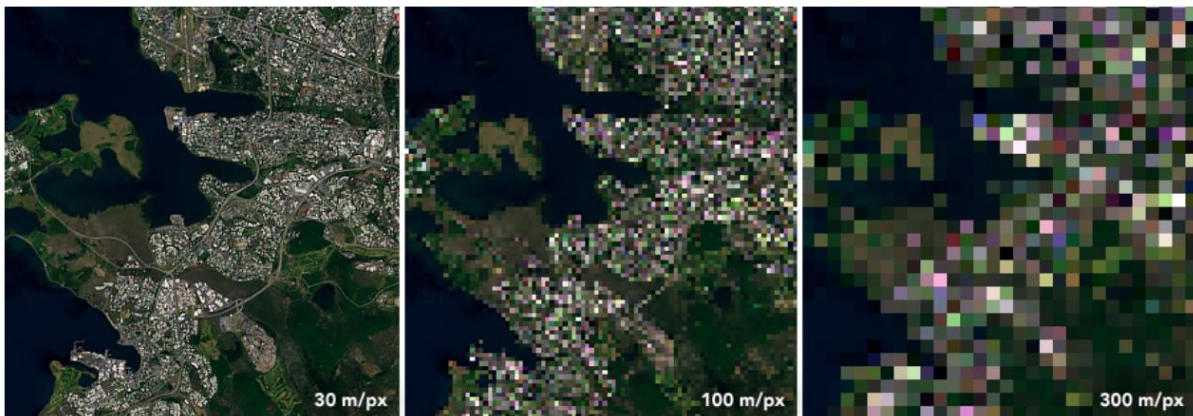


Figure 4: Example of different resolution scales for standard true-colour images (NASA 2021)

Temporal resolution describes the time needed for the satellite to pass over the same exact same location on Earth again. This is dependent on the type of orbit and other technical characteristics, such as width of the area (swath width) that the sensors can capture at a given time.

EO technology can be applied to a variety of undertakings. Examples include the management of energy resources, response to disasters such as floods and earthquakes, as well as defense, and health issues (GEO 2021). Further fields of application can lie in Forestry & Agriculture, Maritime, or Infrastructure (European Commission 2019b).

For example, with the help of EO in the infrastructure area, the progress of large construction projects can be monitored from space and an overall view of the changing urban landscape can be obtained (Preston 2021). Another possible application of EO in the maritime area is the use of oil spill detection. Satellites can be used to monitor larger areas of oil spills at a small fraction of the cost compared to monitoring by aircraft or ship (KSAT 2021). The findings of these space-based technologies provide valid results and are very useful to react quickly to new situations, such as extreme weather events or in times of conflict between nations or groups of people (UN 2015b).

2.5.1. Earth Observation Value Chain

As highlighted in the previous part, EO applications span a wide range of use-cases and industries. Data acquisition through satellites forms the basis for all following activities. These activities are making up the industry's value chain and are required to deliver a final product or service to the end user (European Commission 2017). The value chain can be divided into three main segments and the final users (Figure 5).

The upstream segment consists of companies specialized in the necessary hardware for making spaceflight and satellite operations possible. These naturally include manufacturers and operators of satellites, mission control facilities, and launch service providers. The midstream segment focuses on collecting, processing, and analysing the previously acquired raw data. Therefore, midstream companies are often specialized in IT or software engineering disciplines. Lastly, the

downstream segment uses the processed data to create value-added services for the end-users. These companies are close to the potentially non-tech savvy users and provide consulting services or intuitive applications for the visualization of EO data (European Commission 2019b).

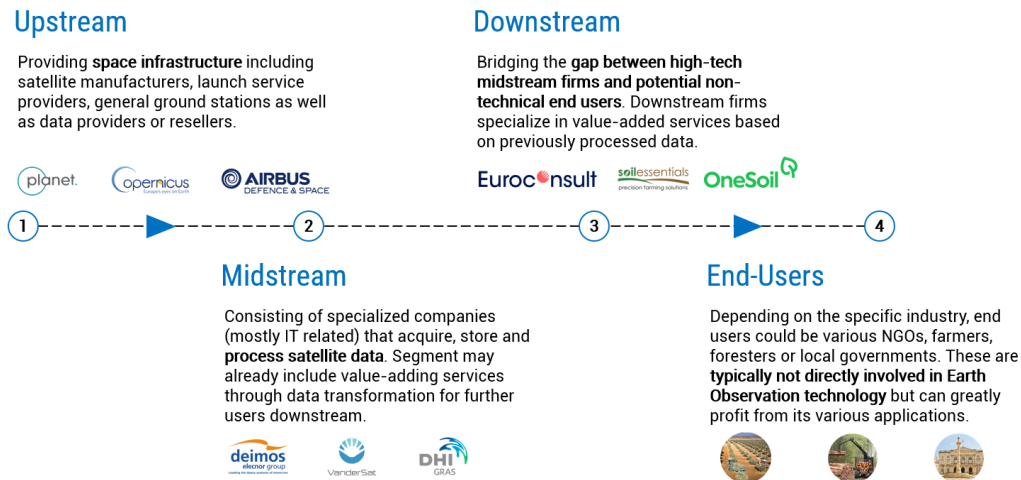


Figure 5: Earth Observation Value Chain, own illustration, adapted from (European Commission 2019b)

2.5.2. Earth Observation Market Size and Notable Players

Overall, EO represents a promising, high-growth industry. A report by the European Commission (2019b) estimated global EO revenues in 2017 at €9.6b to €9.8b, representing an almost 30% increase to 2015. At €7b, most revenues came from the upstream industry, which also noted an about 40% increase compared to the two previous years. The overall industry is predicted to have a CAGR of 8,3 % over the 2021-2026 period. While the Asia-Pacific EO market currently exhibits the highest growth rate, North America remains dominant in terms of market share and is expected to remain a leader for now (Mordor Intelligence 2020). This is mainly attributed to a significant amount of ongoing research studies and investments in the market, as well as the resulting fast and high adoption of commercial satellite imaging for a wide range of industries within the continent (Globe NewsWire 2020).

When looking at the EO value chain, growth fluctuation is primarily expected in the upstream segment due to varying satellite launch demand. As for the downstream market, Europe remains a significant player, capturing about €950m or 33% of the global downstream market share. This market is expected to grow to over €1.3b by 2022, with an annual stable growth rate of 6% (European Commission 2019b; EUSPA 2021).

Regarding the competitive landscape, the European EO market has several major players present, often possessing their own satellites for raw data acquisition. Depending on the type of application, different providers are commonly used. Commercial weather and agriculture data are mainly provided by cloudeo, while infrastructure monitoring information sees e-geos as the main supplier. For commercial urban planning data, both Airbus and Hexagon Geospatial is showing significant market share. The market concentration tends to be rather consolidated than fragmented, however, it remains a highly competitive industry. One important, non-commercial player to mention is the EU's Copernicus Program, which has been providing free-to-use raw satellite data for a wide range of applications since 2014. The European initiative has proven highly successful. In 2018, Copernicus-based value-added products are estimated to have enabled over €300m revenues for Agriculture end-users and over €77m in Forestry. Currently, revenues from Urban Monitoring applications are lagging with only €24m enabled revenues, although forecasted to show a 17% growth rate over the next years (European Commission 2019b).

3. Earth Observation for Urban Planning

3.1. Earth Observation for Mitigating Climate Change Impact on Cities

Urban areas hold an important position in today's globalized and technological world, as they play a vital role in bridging the gap between international development and environmental goals, such as the Paris Agreement and the SDGs (European Commission 2020a). Additionally, growing cities and strengthening effects of climate change are causing increased calls for more ecological and social urban planning (UN 2018). The next part will highlight some important use cases for EO-based solutions for assisting in urban planning activities.

Urban populations are becoming increasingly vulnerable to the effects of climate change. Therefore, various measures have been presented to improve the adaptation of cities. These include the so-called Nature-Based Solution (NBS), as described by Chrysoulakis et al. (2021). Also referred to as natural measures against climate change, they can include the restoration, conservation, and improved management of urban ecosystems with the aim of capturing and removing CO₂ from the local atmosphere and thereby increasing citizen health and well-being (American University 2021). In this context, urban planning and development will play a decisive role by combating climate change and improving the adaptation to new climate challenges. To ensure the monitoring and evaluation of the NBS in the best possible way, satellite-based earth monitoring is used. EO can provide valuable objective data from space, which can assess changing ground conditions, air quality, or consequences of natural disasters (Chrysoulakis et al. 2021). When interpreted by experts, this data can reveal important information and enable more effective urban planning, ensuring overall population safety.

For the main part, severe climate change-related threats to urban regions are mainly due to heat waves from overall rising temperatures and increased flood risks caused by heavy rainfall. Both pose a serious risk to the well-being of citizens. EO provides opportunities for successful monitoring of both the thermal behaviour of cities and the mitigation of flooding in urban areas to protect the local population (Mitraka and Chrysoulakis 2018).

Regarding further potential fields of application, the images provided by the satellites can be used for urban management and planning purposes in specific areas, such as for the analysis of urban sprawl and for general land use mapping (European Commission 2020a). Additionally, it may be employed for the monitoring of green areas (Figure 6), building footprints, and population density, as well as giving insights about the transport infrastructure and highlighting flood and landslide risk (Bartalis 2020).



Figure 6: Urban Green Areas Assessment - (Bartalis 2020)

EO can also have a reporting function. In this way, it can help to review international agreements and conventions from space and ensure objective, unbiased information (European Commission 2020a). With the obtained data, further analysis for a variety of specific topics can be done. As an example, for progress monitoring of global climate objectives, the Japanese Aerospace Exploration

Agency uses EO for the long-term observation of greenhouse gases with the aim of achieving the Paris Agreement and their NDCs (JAXA 2020).

3.2. EO and Urban Planning Contributions to SDGs

As highlighted in the previous part, EO data can be used for various urban applications. Therefore, the related services are directly supporting the monitoring and achievement of key SDGs. The SDG 11, Sustainable Cities and Communities is the primary goal dealing with the development and planning of urban areas. The main aim of this SDG is to enable inclusive human settlements, enhance their overall safety and resilience against threats and steer their transition into a sustainable way. Thereby, the SDG consists of several individual targets (UN 2021b). These include strengthening sustainable urban planning, reducing the number of people affected by disasters, ensuring access to safe green spaces, and limiting the environmental impact of cities in general (BMZ 2021).

As can be seen in Figure 7, various SDGs and targets are supported by EO activities (Gill and Kavvada 2020). Although not specifically mentioning it like in Goal 11, many of the other SDGs and targets are still indirectly linked to urban planning activities and can be assisted by them.

Target Contribute to progress on the Target, not necessarily the Indicator								Goal	Indicator Direct measure or indirect support to the Indicator						
			3.3	3.4	3.9	3.d	3	Good health and well-being	3.9.1						
6.1	6.3	6.4	6.5	6.6	6.a	6.b	6	Clean water and sanitation	6.3.1	6.3.2	6.4.2	6.5.1	6.6.1		
			7.2	7.3	7.a	7.b	7	Affordable and clean energy	7.1.1						
			9.1	9.4	9.5	9.a	9	Industry, innovation and infrastructure	9.1.1	9.4.1					
			13.1	13.2	13.3	13.b	13	Climate action	13.1.1						

Figure 7: Selected SDGs, Targets and Indicators directly and indirectly addressed by EO, adapted from (Gill and Kavvada 2018)

The focus lies especially on SDGs 3, 9, and 13. The SDG 3 promotes well-being and ensures a healthy life with its target 3.9 related to reducing the number of illnesses and death due to environmental pollution such as bad air quality. Solutions from urban planning can significantly contribute to achieving these objectives. With the use of satellite and continuous monitoring, air quality and pollution can be effectively surveilled and addressed. EO also helps further in the development of smarter cities by monitoring urban heat waves and the green areas of a city. This can improve general wellbeing and health issues. Regarding SDG 9, which focuses on building inclusive, resilient, and sustainable infrastructure, EO imagery permits to map areas for better and smarter space use. Some EO solutions help to monitor roads, bridges, or buildings, helping governments and construction companies to make efficient and sustainable decisions. EO can hereby provide data for infrastructure process monitoring and thereby assist with urban planning. Finally, SDG 13 is supporting actions to combat climate change and its consequences in general. Target 13.1 aims to reinforce resilience and adaptivity to natural distress and climate-related hazards. With the use of EO technology, zones revealing high risk can be highlighted to efficiently allocate resources and take better actions.

3.3. Current Challenges

Although EO provides many advantages, there currently are several challenges slowing down its increasing use for urban planning activities. In certain cases, there is a discrepancy between municipalities in terms of technology adoption. While some are eager to use innovative solutions, others represent late adopters. Low cost-efficiency of some existing solutions and local decision-makers not wanting to change their routine procedures in urban planning can worsen this effect. In some cases, local regulations even prohibit satellite monitoring to a certain extent (Prakash et al. 2020; European Commission 2019b). Another challenge is represented by a potential lack of

technological know-how required for the application of EO solutions. Especially in less developed countries, finding qualified personnel for processing and interpreting EO data can be difficult. Additionally, municipal records are also often not updated or available (Prakash et al. 2020; Musakwa and van Niekerk 2015).

The last challenge is more related to the solution providers than the end-users. Compared to other sectors like Agriculture or Forestry, EO companies for urban planning are not that well represented yet. This is also highlighted by the amount of end-user revenues enabled through Copernicus data, which was significantly lower for urban monitoring. Therefore, related EO companies are lacking exposure and the resources for identifying new attractive markets where their solutions would have a strong and lasting impact with regards to the TBL. One tool facilitating the choice of which new market to enter is the Value Creation Wheel (VCW).

4. The Value Creation Wheel

The VCW (Figure 8) is a dynamic meta-framework with the aim of enabling Key Decision Makers (KDMs) to solve complex organizational challenges, and simultaneously create and capture shared value in the process (Lages 2016).

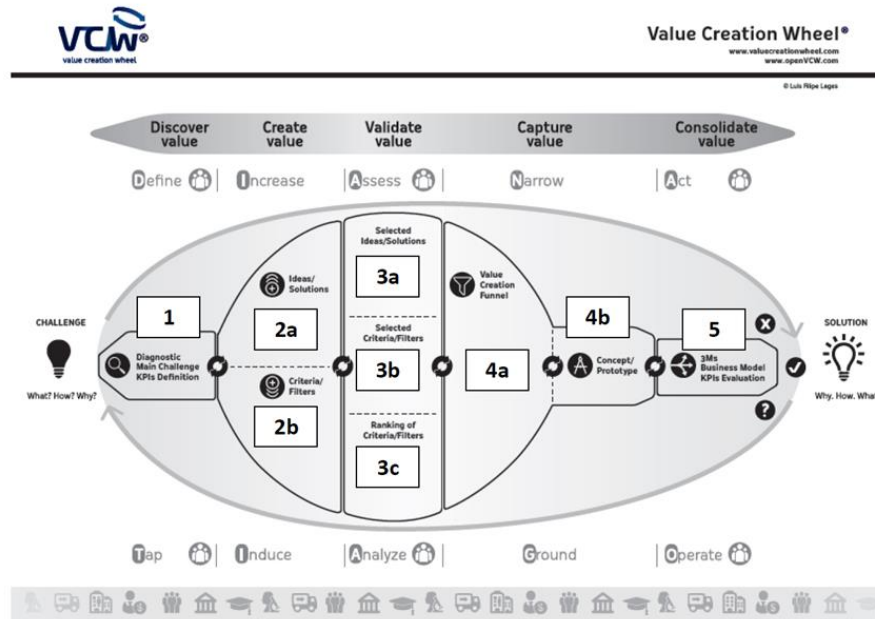


Figure 8: The Value Creation Wheel (VCW) with its main phases & sub-phases (Value Creation Wheel 2020)

4.1. Challenges of Modern Key Decision Makers

A KDM can be described as a unique and powerful person that is able to achieve substantial impact through their actions. KDMs can exist in various contexts and functions, such as CEOs of companies, department directors, entrepreneurs, or even people making important decisions in their everyday lives. The key requirement for becoming a KDM lies in the possession of necessary resources to go through with their decision. Those resources can be summarized as the 3Ms—Manpower, Minute, and Money (Value Creation Wheel 2020), further explained in Phase 5.

However, modern KDMs are facing a variety of challenges. While multiple options to consider for a decision might seem to facilitate the process of making a good choice that they will be happy with, it actually has the opposite effect. An abundance of choice requires significantly more time and effort in evaluating options and can cause a general unsatisfactory feeling related to the final decision. This phenomenon is known as the Paradox of Choice (The Decision Lab 2021).

In a corporate context, the Paradox of Choice can be amplified by several factors, posing an additional challenge to KDMs. First, the overall complexity of the problem faced might increase its successful and thorough understanding. Furthermore, the available teams could show a lack of support or creativity for successfully tackling a challenge. Lastly, the integration of various stakeholder perspectives might be difficult, as it is not clear whom to involve and at what time of the project (Value Creation Wheel 2020). The VCW offers a convenient solution for these problems. By applying the framework, KDMs can make highly informed, relevant, and impactful decisions for a wide range of challenges (Lages et al. 2020). Thereby, the framework follows five main phases.

4.2. Phase 1 – Discover Value

The first phase (1), Discover, helps the team applying the VCW to discover value, characterize the general context and identify main challenges as well as establish KPIs that will be used to measure impact and success during and after the project (Reis-Marques et al. 2019). It is crucial to get a good understanding of the context and environment of the challenge, as this will reveal relevant market characteristics, help gather technological and practical know-how and gain industry-specific insights into the value chain. As a result, the various stakeholders to involve in the project will also become clear (Lages 2016). A variety of supportive, more traditional frameworks can be

used to assist in the initial phase. The PESTEL (Political, Economic, Societal, Technological, Environmental and Legal) analysis (Aguilar 1967) may be used for gaining a macro view of the industry and its influencing factors. Additionally, Porter's Five Forces (Porter 1980) can be employed for insights into a specific industry's attractiveness by revealing competitive forces that influence business performance. For a more internal contextualization, the SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis (Humphrey et al. 1960) can be conducted for better understanding where firms' internal capabilities and disadvantages lie, as well as highlighting external factors that could present opportunities or challenges in the future. Extending on the SWOT analysis, TOWS can help forming actionable tactics, leveraging strengths and opportunities while mitigating the company risks.

4.3. Phase 2 – Create Value

The second phase of the VCW creates value by generating a wide range of potential solutions (2a) and filters (2b) for narrowing down these solutions. To facilitate this process, various methods can be employed, such as brainwriting, brainstorming, conducting literature reviews, surveys, or stakeholder interviews (Reis-Marques et al. 2019). Especially the involvement of internal and external stakeholders is critical for phases 2a and 2b, as multiple points of view and opinions should be considered for higher quality input. It is also key to collect all ideas and not to discard any at this stage. Therefore, the organizational hierarchy should not play a role in the assumed relevance of an idea, and every employee or member should have the same weight in their opinion (Lages 2016).

4.4. Phase 3 – Validate Value and Poker Method

In the third phase, Validate, the previously created value is reviewed. By involving the KDMs, solutions (3a) and filters (3b) are refined by narrowing down to the most relevant ones. The third phase is concluded by establishing a ranking of filters (3c) in accordance with their importance to the KDMs (Lages et al. 2020). In the third phase, KDM involvement becomes critical.

One way to obtain effective feedback in larger groups and therefore refine solutions and filters is the framework-specific POKER method (Lages 2015). It is based on the principle that each received feedback can be grouped into one of four possible categories, which will determine the further necessary process for each solution or filter. Thereby, ideas may either be Kept, Killed, Reviewed, or Multiplied, in accordance with the feedback.

4.5. Phase 4 – Capture Value and Value Creation Funnel

The fourth phase of the VCW, Capture, aims to capture the previously created value by applying the generated, validated, and ranked filters to the solutions (4a) using the Multi-Criteria Decision Analysis (MCDA) and Value Creation Funnel (VCF). Subsequently, a concept or prototype of the final solution(s) must be prepared, allowing for identifying the ideas with the highest potential (Lages 2016). As mentioned previously, the VCF (Figure 9) is of key importance for the fourth phase, as it allows for a structured, logical, and unbiased approach for narrowing down solutions.

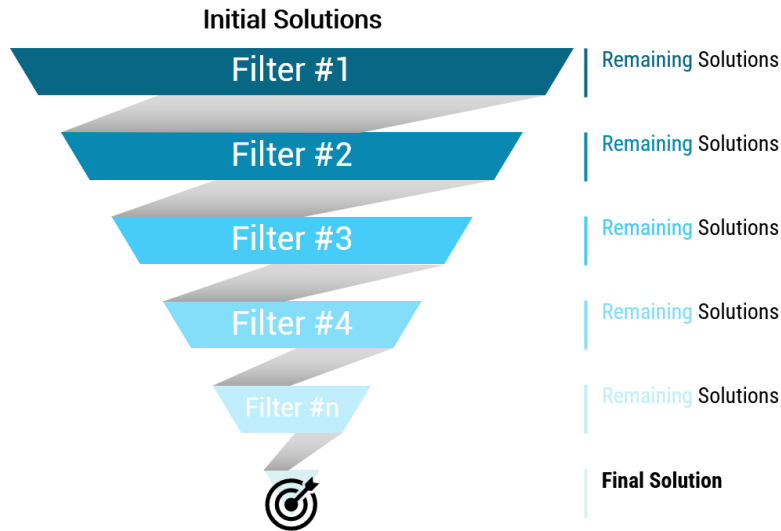


Figure 9: Visual Representation of the Value Creation Funnel (VCF), adapted from (Fonseca et al. 2018)

Establishing filter threshold (cut-off) values and applying them to all the solutions will gradually eliminate solutions until ideally, only one remains (Lages et al. 2018). In some specific cases, such as when finding the most attractive geographical market for a product or service, after the development of a global VCF at the country level, a second local VCF might be needed at the regional level to achieve more substantial results (Fonseca et al. 2018).

4.6. Phase 5 – Consolidate Value

The fifth and final stage, Consolidate, allows the project to develop an action plan for the initially launched challenge. As an example, this could take the form of a business model or a go-to-market strategy. To estimate the required resources for their implementation, the 3Ms analysis can be conducted. Thereby, Manpower refers to the number of required employees and their respective expertise and abilities. Assigning the right employee to the correct task translates into efficiency and productivity. Minute describes the time allocation for the implementation of the final solution. This could be in the form of a timeline to chronologically organize and prioritize tasks and actions.

Lastly, Money refers to the monetary resources required for successfully going through with the decision. In the case of a market entry, this could include the marketing budget, local registration fees, and additional salaries for potential staff expansion.

At the very end of the VCW project, the solution and its implementation plan are presented to the KDMs. As they possess the required resources, they can review the work and give final approval. Depending on their judgement, they might conclude on a Go, No-Go, or Check decision for the project. As the VCW is a dynamic and non-linear framework, in the case of a No-Go decision, the team is always able to go back to previous phases to revise them (Lages 2016).

VCW 1 - Identifying the Most Attractive Geographical Market for the Urban Heat Island Monitoring Solution by Latitudo 40

This individual part of the FL is dedicated to finding the most attractive geographical market for Latitudo 40's Urban Heat Island monitoring solution while applying the VCW framework (Lages 2016; Lages et al. 2020). The two KDMs involved in the project are Mr. Vincenzo Veccio, Co-Founder, CMO and Head of Business Development at Latitudo 40 and Mr. Gaetano Volpe, the company's Founder and CEO. Both were critical for the project by providing regular feedback and guidance as well as sharing relevant company information otherwise not available. Additionally, a range of other internal and external stakeholders were involved (Appendix 1 and 2).

1. Phase 1 – Discover Value

1.1. Issues and Relevance

Urban Heat Islands (UHIs) describe “bubbles” of intense heat in urbanized areas, where the ambient temperature can be up to 10°C higher compared to the surroundings (CNRS News 2021). There are several factors promoting the formation of UHIs (Parrott 2020). Urban areas are often replacing vegetation cover, and therefore reducing evaporation, and limiting shadows from trees. High and dense buildings interfere with local airflow, trapping heat in one area. Lastly, air-conditioning (A/C) and car traffic release hot air and fine particles into the atmosphere.

Nowadays, many cities around the world experience the effects of UHIs, which have a serious impact on quality of life of citizens, as well as economic and ecologic implications. While the average annual death toll related to heat is about 700 in the US (Taylor et al. 2018), the most severe heatwaves have caused up to 35,000 fatalities in Europe during the summer of 2003 (Feudale and Shukla 2011). Besides the health impact, heat-related reduction in productivity has severe economic implications. Reduced labour productivity from heat exhaustion is estimated to cause

about 0.3-0.5% loss of annual European GDP and could reach 1% by the 2040s (García-León et al. 2021). Every 1°C increase in outside temperature causes up to 9% more energy demand from A/C units (Santamouris 2020). Electricity production releases substantial amounts of greenhouse gasses, and thereby accelerates climate change. Lastly, UHIs impact aquatic species due to increasing local river and lake temperatures (Geilman 2020).

1.2. Latitudo 40

One company addressing this important issue by providing local municipalities with a UHI monitoring solution is Napoli-based Latitudo 40. The EO service provider was founded in 2017 by four aerospace, remote sensing, and IT experts, each with over a decade of experience in the sector. Latitudo 40 strongly believes that satellite images, Artificial (AI) and geospatial intelligence lead to better Environmental, Social and Governance (ESG) decisions by local municipalities. The company's value proposition is supported by a fully automated data acquisition and analysis, fast processing of large datasets due to advanced AI and Machine Learning (ML) algorithms, significantly lower cost compared to traditional methods such as manual measurements or remote sensors, and an available global dataset for every city on Earth.

1.3. Latitudo 40's Urban Heat Island Monitoring Solution

Latitudo 40's UHI monitoring service is delivered to the end-users in three major steps (Figure 1, App. 4) that rely heavily on the freely available satellite images from the EU's Copernicus program. First, the raw satellite data is acquired and combined with local weather forecasts or ground sensor data (if available). In a next step, the information is processed using own AI / ML algorithms to accurately identify UHIs and their intensity. Lastly, the data is visualized by overlaying it on the city map and presented in the company's intuitive ESG dashboard (App. 5).

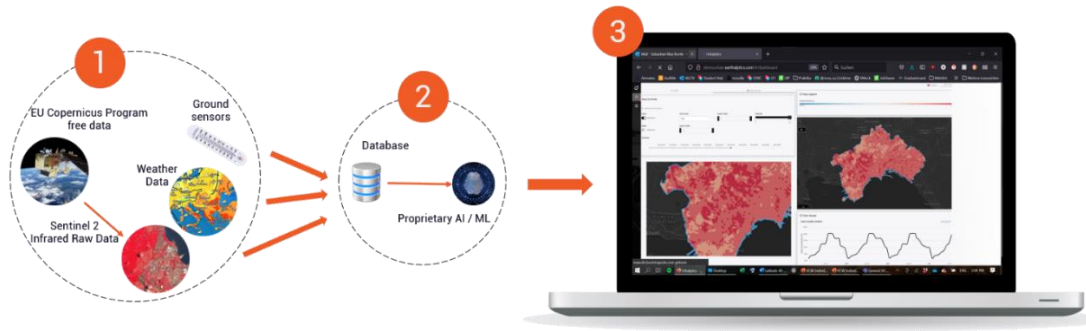


Figure 1: UHI monitoring 3-step-process

Latitudo 40 puts great emphasis on its contribution to the SDGs, with a dedicated website explaining how they help achieving them¹. Thereby, the UHI Monitoring solution is aligned with a total of 3 SDGs and 5 targets, as shown in Figure 2. For the full list of covered SDGs by all offered Latitudo 40 solutions, please refer to App. 3.

SDG / Target	Urban Heat Island (UHI) Monitoring Solution
Goal 3: Good Health and Well Being	Explanation
3.9: Reduce number of deaths from environmental pollution	Establishing green spaces in cities helps with cleaner urban air. Lower ground temperature causes less ozone formation, reducing health impact.
Goal 7: Affordable and Clean Energy	
7.3: Double the global rate of improvement in energy efficiency	Less UHIs will significantly reduce city's energy consumption due to A/C use.
Goal 11: Sustainable Cities and Communities	
11.3: Enhance inclusive and sustainable urbanization	UHI dashboard helps cities deal with rapid urbanization rate while still maintaining QoL for citizens. Allows for prioritization of areas where action is needed the most.
11.6: Reduce adverse per capita environmental impact of cities	Less energy consumption by cities results in less pollution through energy production elsewhere. Moderating temperature helps local flora and fauna to recover, as well as restoring aquatic life in nearby rivers and lakes.

Figure 2: Latitudo 40 UHI monitoring solution alignment with SDGs

The UHI solution was chosen due to two important aspects. First, it has a high relevance to the 3Ps (as explained in part 1.1) and is clearly aligned with multiple SDGs, making it an important contributor to more sustainable urban planning and generally improved quality of life, such as citizen EU health and well-being. Second, out of personal interest, since my home city of Berlin has

¹ <https://www.latitudo40.com/agenda-2030/>

been experiencing increasingly warm summers with partially unbearable inner-city temperatures in recent years (Der Tagesspiegel 2021).

1.4. Users & Market Size

Latitudo 40's service is currently used by various cities around the world. One major user is the Ajuntament de Barcelona, the city's municipal government. Beginning in September 2021, the Mediterranean city is analyzing its UHIs to highlight priority areas and provide an improved citizen quality of life. The specific goal in this use case is to achieve a 30% reduction in UHIs within 12 months (App. 6). This will be done by implementing several mitigation measures. Common solutions for reducing UHIs are the establishment of green spaces (trees, grass cover) and rooftop gardens, which will provide an overall cooling effect on surrounding air through evaporation. Additionally, local traffic regulations for less congestion might be established in the form of traffic-free areas (Louiza et al. 2015). Lastly, several cities have experimented with applying a white coat to streets and other urban surfaces, effectively reflecting heat off the ground (Capatides 2018).

Currently, Latitudo 40's main user segment lies in the Business-to-Government (B2G). However, as reinforced by Vecchio in the initial meetings, the company sought to explore new user segments to increase its impact in the B2B. Possible options to consider were Real Estate & PropTech companies. As Latitudo 40's main offering is a SaaS in the form of the ESG dashboard, the company is addressing the general Smart City Platforms Market. According to a recent dossier (statista 2021b) global revenue amounted to \$116b in 2020, as can be seen in Figure 3.

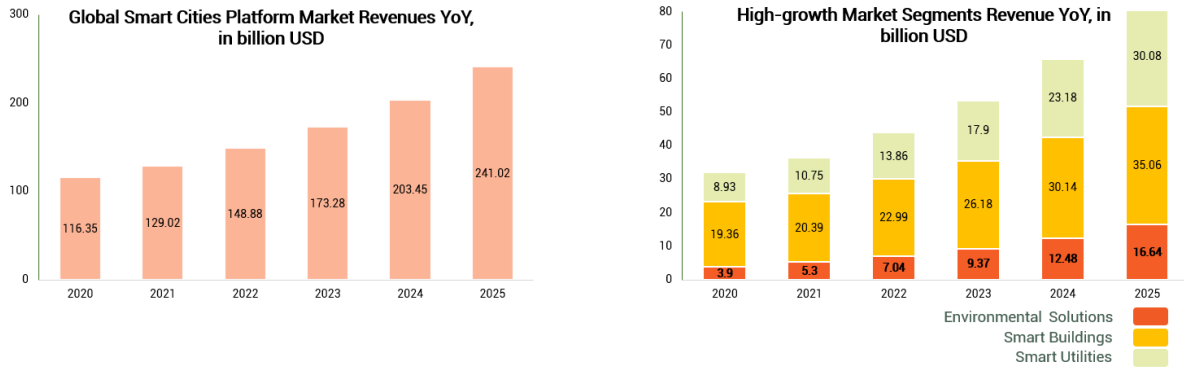


Figure 3: Smart Cities Platform market forecast with its high-growth segments

This number is predicted to increase to over \$241b until 2025, with especially the Environmental Solutions segment forecasted to show significant growth within the next years. With around 30% market share, the US is currently the largest market but is supposed to be overtaken by Asia soon.

1.5. External & Internal Environment

To give a better understanding of Latitudo 40’s external environment, a PESTEL analysis was conducted (App. 7). The main takeaways were that cities around the world are experiencing increasing effects of climate change and generally ill prepared for it (Short 2021). Therefore, countries are allocating budgets for ESG projects and the general promotion of smart cities. The overall market conditions were favourable due to high projected growth. The legality of EO applications was given in virtually every country on Earth, with freely accessible data from various providers such as Copernicus.

The SWOT and resulting TOWS analysis (App. 8 and 9) revealed a mix of Maxi-Maxi and Mini-Mini strategies to be the most appropriate. Thereby, Latitudo 40 would expand to new markets and establish a local regional presence before new competitors could do so. There would be a scan of potential users, including new B2B users, with the solution being offered where it would have the

biggest impact. This would enable Latitudo 40 to gain long-term partnerships by optimally addressing user needs.

As a last step, the current (and future) competitors were identified. This was done in a 3-step approach. First, the general EO industry was scanned to find companies offering general Urban Planning solutions (Level 2 competitors). Then, companies were further narrowed down to the ones offering UHI monitoring (Level 1 competitors). Lastly, their individual services were compared according to technical characteristics (Figure 4).

Reference						Public	Planned (2023)
Characteristic	Latitudo40	GET Map	Green Urban Data	Planetek Ita.	KERMAP	Copernicus	SatelliteVu
Public / Private	Private	Private	Private	Private	Private	Public	Private
Service Name	Urban Planning ESG Dashboard	LIFE ASTI	SaaS Temperature Regulator	Rheticus Urban Dynamics	Urban Planning - Heat Islands	Climate Data Store	Building Insights
Global Availability	✓	-	✓	✓	-	-	✓
Off-the-Shelf	✓	-	✓	-	-	✓	✓
10m Resolution	✓	-	✓	✓	-	-	✓
7-year Historical Data	✓	-	✓	-	-	-	-
Forecasting	✓	✓	✓	✓	-	-	?
Consulting Service	✓	✓	✓	-	✓	-	?

Figure 4: Service-level comparison of current and future UHI monitoring competitors

Both KDMs were surprised to learn there are very few international direct competitors, and all of them being European. Additionally, they often implemented the service on a project-basis with local municipalities, a very long and resource intense process compared to an off-the-shelf solution. Global availability of the service, historical data, and the possibility of UHI forecasts gave Latitudo 40 a competitive edge over other firms.

2. Phase 2 – Create Value

2.1. Induce Solutions

In a subsequent meeting, Vecchio reinforced that all countries represent potential markets, as the impact of climate change on cities was a global phenomenon. Since the company's available datasets allow for worldwide coverage, all 193 UN member states would initially be considered.

2.2. Induce Solutions

Several methods were employed for filter generation, each involving different internal and external stakeholders (see App. 1). First, individual research through primary and secondary literature was conducted to get a better understanding of the topic and identify relevant scientific research papers dealing with UHIs. Afterwards, a group discussion amongst the 3 VCW Lab members was held to conduct a brainwriting session using a modified version of the 6-3-5 brainwriting method. Then, several expert interviews were conducted, together with E-mail and LinkedIn exchanges. Overall, 78 potential filters were generated by the end of VCW phase 2.

3. Phase 3 – Validate Value

3.1. Selected Solutions

At this stage of the project, the KDMs decided to keep all the 193 UN countries as potential target markets.

3.2. Selected Filters

To narrow down the filters for presentation to the KDMs, the VCW's POKER Method was applied (App. 10). It was found that many filters could be combined into one. Furthermore, some filters had to be further adjusted to be measurable through an existing dataset. The final process resulted in 23 filters being presented to the KDM, of which 13 were killed during the meeting, resulting in 10 final filters to be ranked.

3.3. Ranking of Filters

Vecchio liked the fact that individual filters covered several important categories such as environmental, socio-demographic, and economic. Furthermore, he strongly agreed with the idea of the three highest-ranked filters already covering three different categories. As a result, the six most important filters decided by the KDM were: GDP per capita, PM2.5² exposure, population density, % of urban population, average annual precipitation, and the Traffic Index³. A full list of the 10 final filters, their justification and cut-off values can be found in App. 11.

4. Phase 4 – Capture Value

4.1. Value Creation Funnel

By combining the collected country data, filter ranking and cut-off values, the VCF could be built, with each filter sorting out additional countries. This process was repeated until filter 6, after which only Israel remained (Figure 5). Both KDMs were very interested by this selection method. Volpe was especially curious about this quantitative, unbiased method of business development.

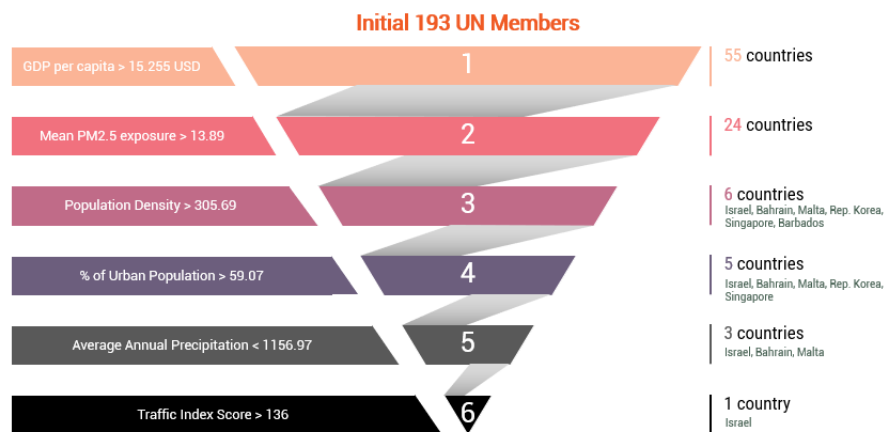


Figure 5: Country Funnel leading to Israel

² Describing atmospheric particles of under 2.5 micrometres diameter

³ Index measuring the intensity of congestions, travel time and CO₂ emissions caused by road traffic

According to the last census, Israel had more than 130 cities with over 10 thousand population as well as 16 cities with over 100 thousand inhabitants. UHIs in various cities have been identified and studied since the 1990s (Goldreich 1995) with increasing research focus in the past years (Mandelmilch et al. 2020). Vecchio was pleased to hear that several smart city initiatives had been recently initiated (Orbach 2018) and that the passed state budget included an allocation of \$4.8b for climate action (Gilad 2021). Furthermore, Israel had a high level of regulatory quality, indicating the government's effectiveness in formulating and implementing policies and regulations (statista 2021a).

The discussion also concluded that two additional, local funnels should be built to further narrow down the geographical area within Israel. This was mainly to address the fact of varying climate zones within Israel, caused by its diverse topography (Encyclopedia Britannica 2021). Latitudo 40 would need to identify the region in which its UHI service was needed the most. Israel is divided into 6 administrative districts, with some further split into sub-districts (App. 12). However, relevant, and complete datasets are increasingly difficult to find on a district level. Therefore, the filters for the second, local funnel were modified to reflect the available information. During a subsequent meeting with Vecchio, a total of 6 filters were agreed upon, with two new filters added to the ranking. These filters were used to give better insights about population age in each district as well as the number of urban areas within a population range of 10-50 thousand. As Vecchio had explained during the meeting, Latitudo 40 relied mostly on a direct marketing approach, where the business development team would call local municipalities to promote their service. This worked best for cities with up to 50 thousand population. As a result of the second (district) funnel, and the third (sub-district) funnel, the final region with the highest potential was identified to be the Petah Tikva sub-district, part of Israel's Central District (App. 13).

Locally, two main market pains could be identified. First, a high technological discrepancy within municipalities meant that some cities were early adopters of Smart City Technology while others fell significantly behind. Second, there was a highly one-sided relationship between municipalities and technology suppliers in Israel. Municipalities were often reliant on a single solution provider who could then heavily dictate the terms (Flanders Investment & Trade 2018).

While conducting a potential user analysis in Petah Tikva, 6 promising municipalities for the UHI monitoring service were identified. Over 20 relevant contacts could be found through initial online research, such as the mayor's phone number and email address, as well as key city council members related to environment, health, and infrastructure. Several native Israeli real estate companies were present, as well as multinational firms with subsidiaries in Israel, those companies could be targeted for Latitudo 40's potential B2B customer segments.

Vecchio and Volpe were also positively surprised that a significant number of promising partners were in the region. Most notably, the Bar-Ilan Center for Smart Cities and the Israel Smart Cities Institute. The latter was an NGO providing consulting, workshops, and technology training for supporting digital transformation of municipalities. Bar-Ilan University's Center for Smart Cities represents a digital innovation hub connecting stakeholders such as municipalities and solution providers to understand a city's needs and provide impactful solutions. Both potential partners would be crucial in promoting the UHI monitoring service and connecting Latitudo 40 to various municipalities within the region. Another interesting partner was the company SP interface, which connected solution providers and political stakeholders for improved policies and decision making. SP interface was an expert on projects involving remote sensing and sustainability and was therefore identified as an important distributor of the UHI monitoring solution.

4.2. Conceptualization

As expected by Vecchio, scanning for local competition revealed a few highly specialized companies providing drone-based monitoring solutions. While none of them explicitly mentioned UHI monitoring services or even Urban Planning solutions in general, the drones were able to carry heat-sensitive equipment for infrastructure inspections. In accordance with the KDMs, it was concluded that these companies, although not direct competitors, could therefore potentially offer limited UHI monitoring (App, 14). Drones fly close to the ground and offer higher resolution images. Additionally, flying out multiple times a day allows a more continuous monitoring. However, they lack historical data archives, and the operating companies do not offer data processing or visualization. Drones are also significantly more expensive as they can only survey small areas at a given time and need a trained pilot. Latitudo 40’s UHI monitoring solution was deemed very suitable for serving the local market and addressing major market pains. Due to the lack of direct competition, entering the Petah Tikva region represented a Blue Ocean Strategy.

5. Phase 5 – Consolidate Value

5.1. Business Model



Figure 7: Proposed Business Model for market entry

In one of the final meetings with Vecchio, the Business Model for market-entry was presented (Figure 7). To his delight, Latitudo 40 was already very well positioned to address the local market needs. The two major market pains would be addressed by offering an overall cost-efficient and intuitive solution in form of the ESG dashboard, allowing even smaller municipalities with less technology knowledge and little budget to profit from the service. Late-adopter municipalities would be approached with free online workshops on sustainable and smart cities, highlighting the benefits of EO in Urban Planning (App. 15). Furthermore, to overcome the one-sided relationship between solution providers and municipalities, Latitudo 40 was already working with multiple current end-users to customize the solution for optimal fulfilment of their needs.

For entering the local market with Latitudo 40's UHI Monitoring solution, a direct export mode was proposed to Vecchio and Volpe. The company would distribute the service directly to end-users through their own website and the related ESG dashboard. Interested municipalities could subscribe to the UHI and other needed services, with each user obtaining 5-10 login credentials for various city employees to use. At the same time, local partners such as the Smart Cities Institute and the Center for Smart Cities would introduce and showcase the service to local municipalities wanting to fulfil their digital transformation or ESG targets. Companies like SP Interface would actively promote the solution to end-users, receiving a commission when new subscriptions were made through them.

As no cost benchmarking with local competitors was possible for the region, Vecchio proposed to maintain their standard subscription model. The monthly fee would be dependent on several factors, such as the total area to be monitored, amount of services used in the dashboard, image resolution and frequency of data point updates. In its cheapest configuration, the service would cost €50 per km² per month, or around 180 Israeli New Shekel.

5.2. 3Ms – Manpower, Minute, Money

After finalizing the Business Model, the required resources for market-entry had to be defined. For Manpower, it was determined that Vecchio, Head of Business Development, would oversee the go-to-market strategy and handle the demo presentations of the dashboard. Additional support was to be provided by Philip Jonitz, part-time Business Development Manager based in Berlin. Latitudo 40's four-people digital marketing team would be responsible for creating promotional material related to the workshops and demo presentations. As highlighted by Vecchio and based on his previous experience, a local sales staff was a key for reaching out to the smaller municipalities with less English proficiency. Related to Minute, a market-entry timeline for the year 2022 was designed (App. 16). Starting in January with the transfer of related VCW Lab documents to Vecchio and Volpe, the company was proposed to initiate marketing activities in April. Several relevant conferences and fairs were identified to take place in Israel that year, such as the International Conference on Smart Cities and Sustainable Development or the Muni World Expo, where mayors from various cities share best practices and exchange expertise. Lastly, Money, the required budget for market-entry was assessed. Latitudo 40's previous experience with digital marketing such as Search Engine Optimization (SEO) and pay-per-click ads allowed for more accurate cost predictions. Additionally, the average local base-pay for a sales staff in the Tel Aviv area was researched, giving an estimate of the expected salary. Then, registration or exhibition fees for the local fairs were checked. Overall, Latitudo 40's market entry into the Petah Tikva sub-district of Israel was expected to cost a little under €50.000 from April to November 2022. Vecchio was pleased to see this number, stating it was a perfectly justified amount for entering a smaller country.

5.3. KDMs Final Decision and Next Steps

During the final weeks of the VCW Lab, the project together with its recommendation was presented to Vecchio and Volpe. The tool was able to effectively solve the paradox of choice and delivered data-backed arguments for why the Israeli market and the Petah Tikva sub-district were an attractive one to enter. Both the CMO and CEO were very impressed with the level of detail of the project and the significant amount of data for backing up the final proposal. One of the main advantages Volpe saw was the use of the funnels to objectively narrow potential markets to identify high-impact ones. From the KDMs perspective, the funnel was a helpful new tool to approach business development. The conducted MCDA also revealed two additional attractive markets, who would have passed 9 out of 10 filters without considering the filter ranking (App. 17). While both agreed Israel to be an interesting market to explore, Volpe explained that the 2022 budget for market expansion had already been allocated. It was possible to request further funds from their investors, but these would have to be used for the European market only. Vecchio revealed that Latitudo 40 had previously been in talks with Israeli high-tech investors, however nothing concrete had resulted at this point. Therefore, a suggested next step by the KDMs was to further investigate and approach potential Israeli VC funds, such as Pitango Ventures, TLV Partners or Type 5 for funding requests. For the moment, Vecchio and Volpe kindly asked for the supporting VCW documents and scheduling of a future call for a more in-depth introduction of the country funnelling process in Microsoft Excel. Both were eager to find out what potential European candidates were under the Top 10 country ranking according to the funnel. As a pleasant surprise and a nice reward for the work, at the end of the presentation, Volpe extended a job offer in business development. It remains to be seen for what upcoming challenges Latitudo 40 will be using the VCW and what the future holds for the promising Italian EO company.

Appendices

Appendix 1: Internal & External Stakeholders Involved in the Project Phases



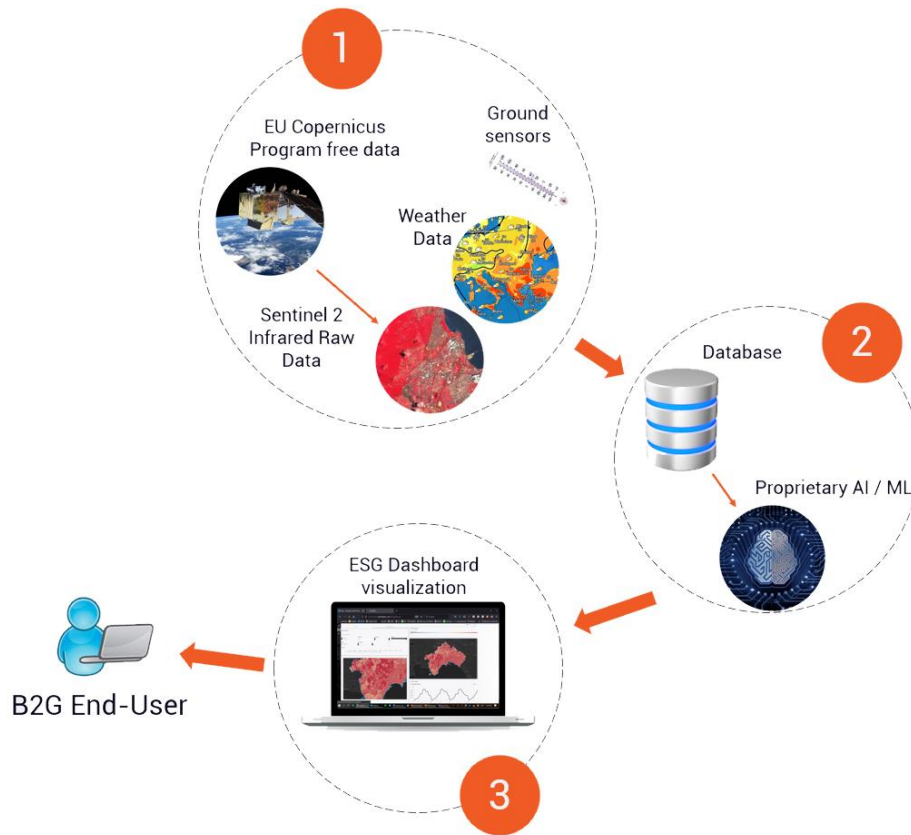
Appendix 2: Stakeholder Names, Positions, and Related Organization

INVOLVED STAKEHOLDERS			
STAKEHOLDER TYPE	NAME	POSITION	ORGANIZATION
INTERNAL	Vincenzo Vecchio	CMO, Head of Business Development	Latitudo 40
INTERNAL	Gaetano Volpe	CEO	Latitudo 40
INTERNAL	Mathilde Blanc	VCW Field Lab member	Nova SBE
INTERNAL	Tim Lütge	VCW Field Lab member	Nova SBE
EXTERNAL	Utku Serhatli	LFI member	Nova SBE
EXTERNAL	Rémi Charpentier	CEO	Tesselo
EXTERNAL	Keren Vasconcelos	Spatial Data Scientist	Tesselo
EXTERNAL	Tim de Weerd	Sales Development Representative	Picterra
EXTERNAL	Rob Beck	Managing Director	NEO BV
EXTERNAL	Patricia Gerber	Head of Customer Service	Cloudeo
EXTERNAL	Maria Pahoula	Project & Business Development Manager	GET Map
EXTERNAL	Chetan Pradhan	Head of Institutional Engagement	Earth-i

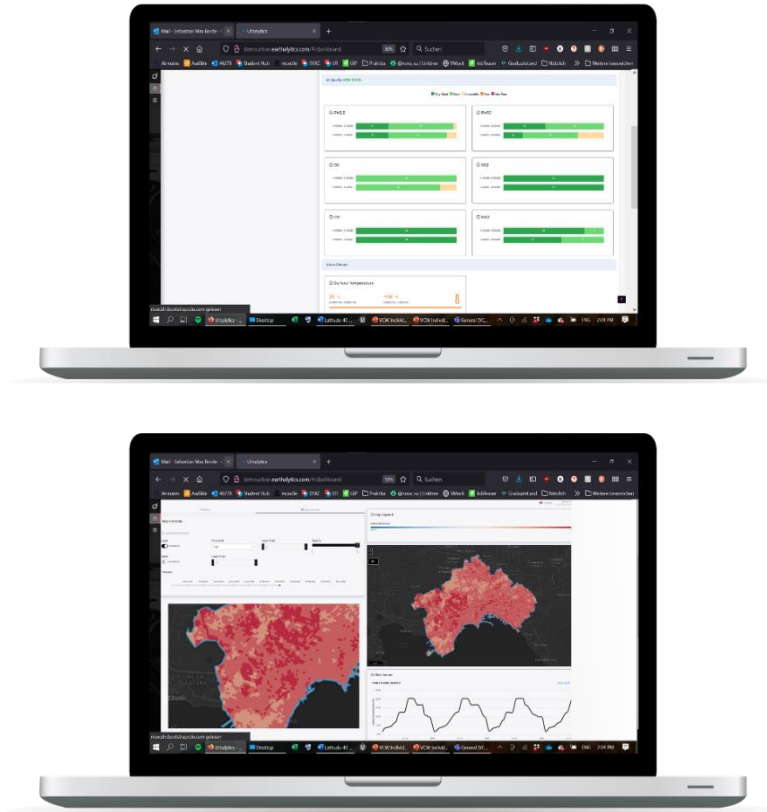
Appendix 3: Latitudo 40's Service Alignment with SDGs and Targets

SDG and GOAL	Related Services from ESG Dashboard							
	(1) UHI	(2) Building Health	(3) Air Pollution	(4) Urban Water	(5) Roads	(6) Traffic	(7) Landfills	(8) Urban Vegetation
Goal 3: Good Health and Well being								
3.6: halve global deaths and injuries from road traffic accidents								
3.9: reduce the number of deaths from environmental pollution								
3.d: strengthen the capacity for early warning, risk reduction and management of national and global health risks								
Goal 6: Clean Water and Sanitation								
6.1: access to safe and affordable drinking water for all								
6.3: improve water quality by reducing pollution								
6.4: substantially increase water-use efficiency								
6.6: protect and restore water-related ecosystems								
Goal 7: Affordable and Clean Energy								
7.2: increase substantially the share of renewable energy in								
7.3: double the global rate of improvement in energy efficiency								
Goal 9: Industry, Innovation and Infrastructure								
9.1: Develop quality, reliable, sustainable and resilient								
Goal 11: Sustainable Cities and Communities								
11.1: ensure access for all to adequate, safe and affordable								
11.2: provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety								
11.3: enhance inclusive and sustainable urbanization								
11.5: reduce the number of deaths by disasters, including								
11.6: reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and								

Appendix 4: Three-Step Process for UHI Monitoring Solution



Appendix 5: Latitudo 40's General ESG Dashboard (Upper) with UHI-related View (Lower)



Appendix 6: UHI Monitoring Use Case Example from the Company's September 2021 Pitch Deck


LATITUDO 40

Use Cases



Analysis of urban heat islands and evolution in the last 5 years.

Goal: -30% urban heat islands in 12 with public green spaces

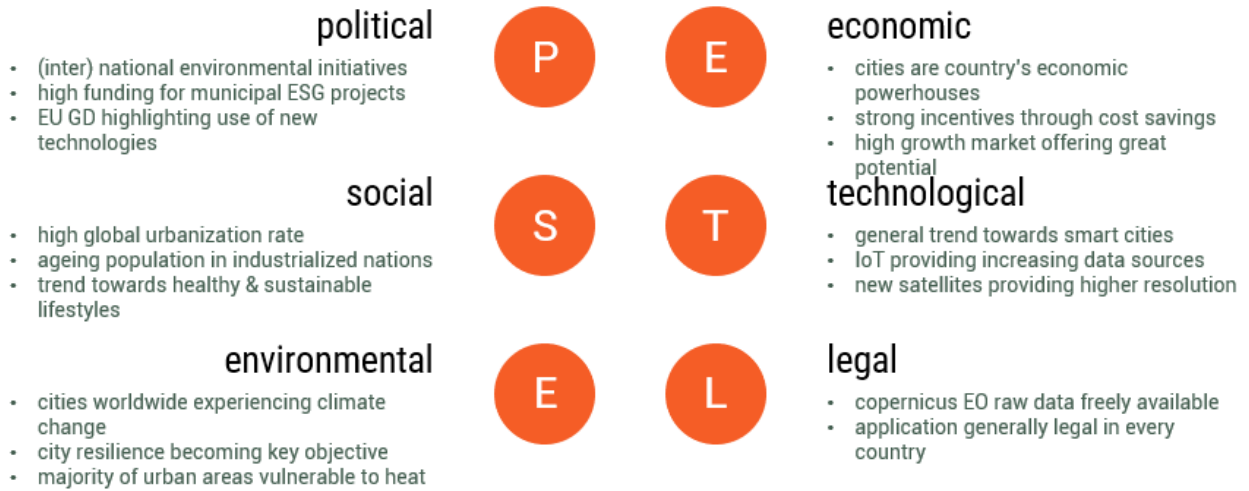


Evolution of green areas in the city and impact on pollution and air quality

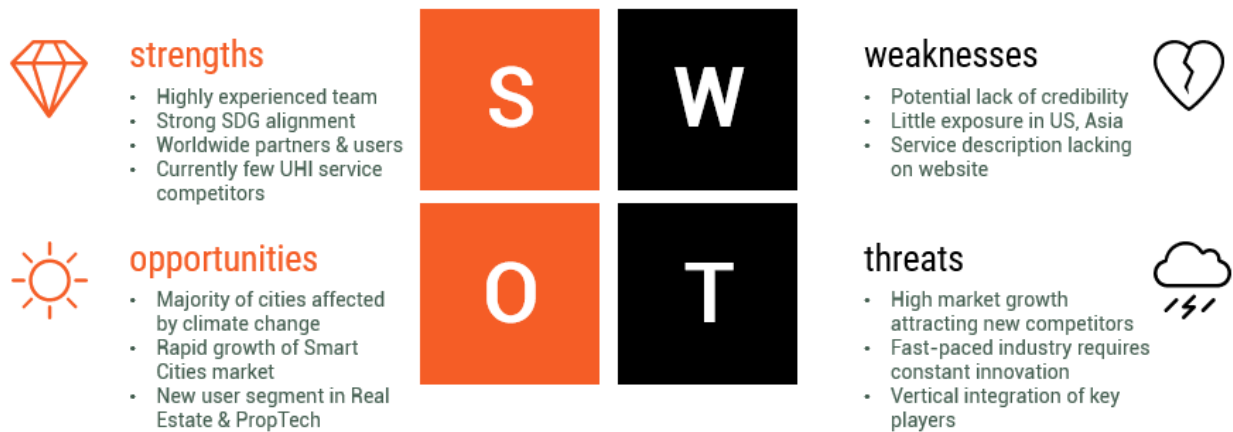
Goal: -20% pollution in the city centre




Appendix 7: Latitudo 40's External Environment Through the PESTEL Analysis



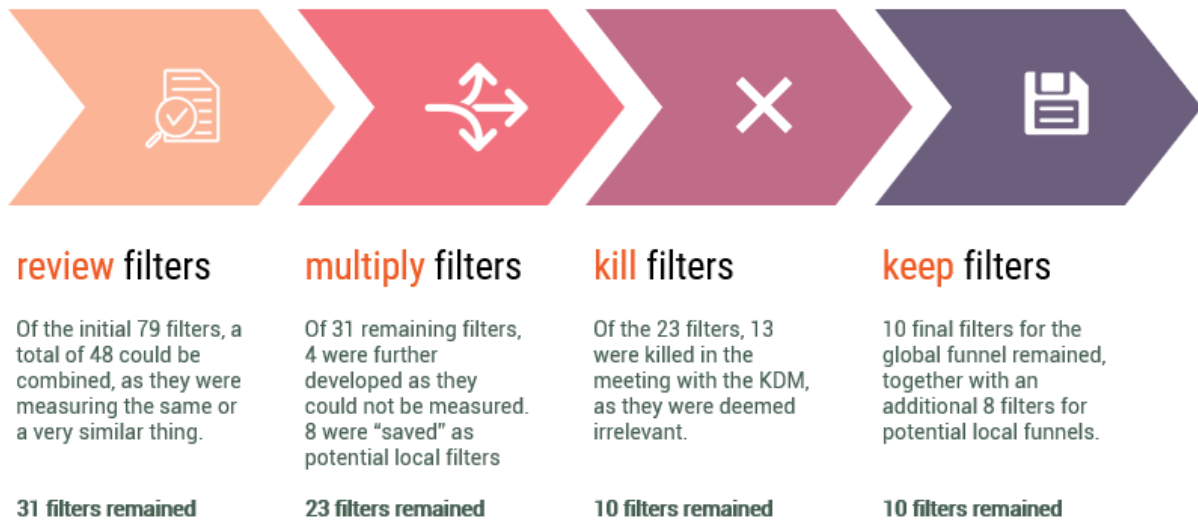
Appendix 8: Latitudo 40's SWOT Analysis



Appendix 9: Latitudo 40's TOWS Analysis



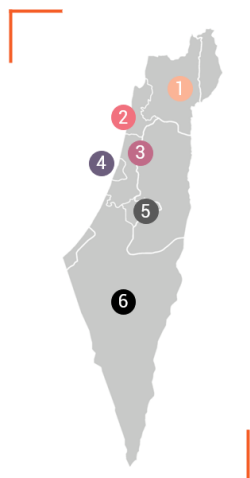
Appendix 10: Application of the POKER Method to Reduce Filter Number



Appendix 11: Filter and Threshold Justifications

Filter Name	Threshold Value	Filter & Threshold Justification
1. GDP per Capita	> 15,255.16 (average)	Indirectly hints at ability to pay for environmental monitoring services. Higher GDP generally includes more industrialized, wealthy nations that might have to deal with effects of climate change and have the budget to mitigate its effects, such as reducing Urban Heat Islands (UHIs). Above-average to only include countries with certain level of wealth and therefore representing attractive markets.
2. PM2.5 Air Pollution	> 13.89 (1 st Quart.)	Fine particles in the air are generally an indicator of higher air pollution. Air pollution traps heat more efficiently near the ground and might also cause UHIs. First quartile to still include countries with elevated pollution levels without discriminating against larger area countries. In these countries the average PM2.5 exposure will be lower due to the large surface area of territory.
3. Population Density	> 305.69 (average)	Describes the average amount of people living on one km ² of national territory. Higher values imply that also cities will be denser, generally resulting in higher buildings, narrow street and intense traffic. All these factors are leading to heat accumulation in cities. Above-average to ensure not mostly city-states are included, but also larger countries with many small to medium sized cities.
4. % of Urban Population	> 59.07 (average)	Describes the share of population living in urban areas compared to total country population. High percentage of urban population implies that government will put effort into increasing quality of life for its urban citizens as it affects a large amount of total population. Above-average to ensure the (urban) citizen group potentially affected by UHIs is substantial and relevant to the country's government.
5. Annual Precipitation	< 1156.97 (average)	High precipitation is an indicator of urban heat island likelihood, as regular and heavy rainfall will effectively "wash" fine particles out of the air, therefore lowering the chance of UHIs forming. Below-average rainfall to include countries with long dry periods or low rainfall overall.
6. Traffic Index	> 136.01 (median)	Traffic is one of the major factors contributing to urban heat. The worse the road infrastructure, together with overcrowded cities and pollution, the more likely UHIs are to be formed. This filter measures traffic time, congestions and CO2 emissions from road vehicles. Above-median for this filter as the dataset is quite incomplete, thus taking an average or quartile could be biased.
7. Climate Risk Index	< 82.54 (average)	Climate Risk is the likely exposure of a country to extreme weather events. This considers both the recent loss of life due to climate change, as well as economic damages resulting from it. A high climate risk could imply the country would prioritize monitoring and mitigating its effect and making the budget available for it. Below-average (higher is better) climate risk to include countries heavily affected by climate change effects and therefore increasing importance of implementing measures.
8. Median Population Age	> 29.74 (average)	One citizen group especially affected by urban heat is the older population. Countries with a higher median age would likely also have a higher percentage of elder people (65+), for which UHIs are a serious concern due to heat stress. Above-average population age to include countries with an older population generally more susceptible to heat stress.
9. Political Risk Index	> 0.65 (average)	Establishing a successful and long-term business relationship is heavily dependent on the political environment. Countries with unstable political systems and a risk of violent change / civil unrest / economic sanctions might not be a desirable choice to establish year-long partnerships with. Above-average political risk score (higher score indicates less political risk) to include countries with a strong political system.
10. Corruption Index	> 56 (3 rd Quart.)	Since Latitudo40 is mostly focused on the B2G market as of now, it needs to be sure to receive payment for the service by the local governments. In countries with high likelihood of corruption, these payments might never reach Latitudo40. Third quartile (higher score equals less perceived corruption) to ensure only including trustworthy public sectors in the potential countries.

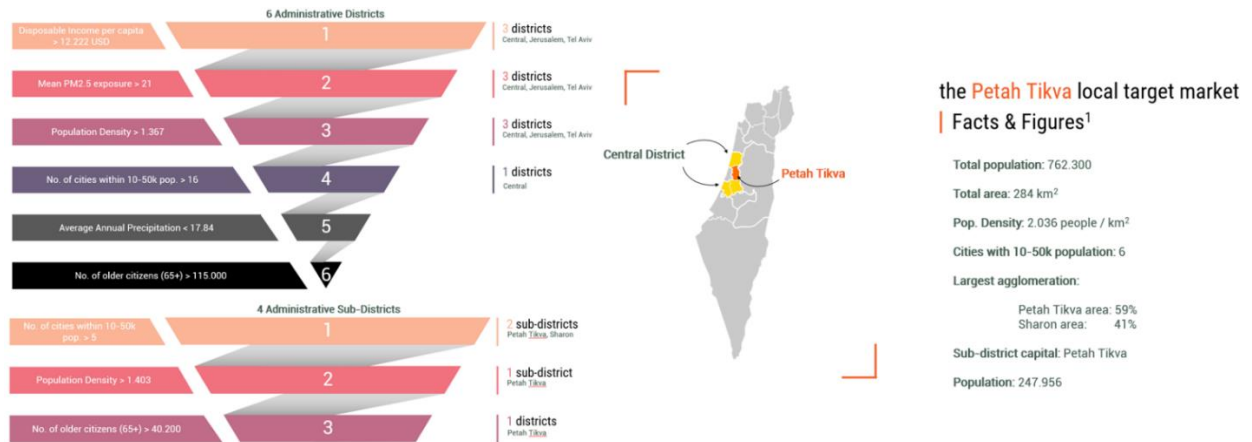
Appendix 12: Administrative Districts and Sub-Districts of Israel



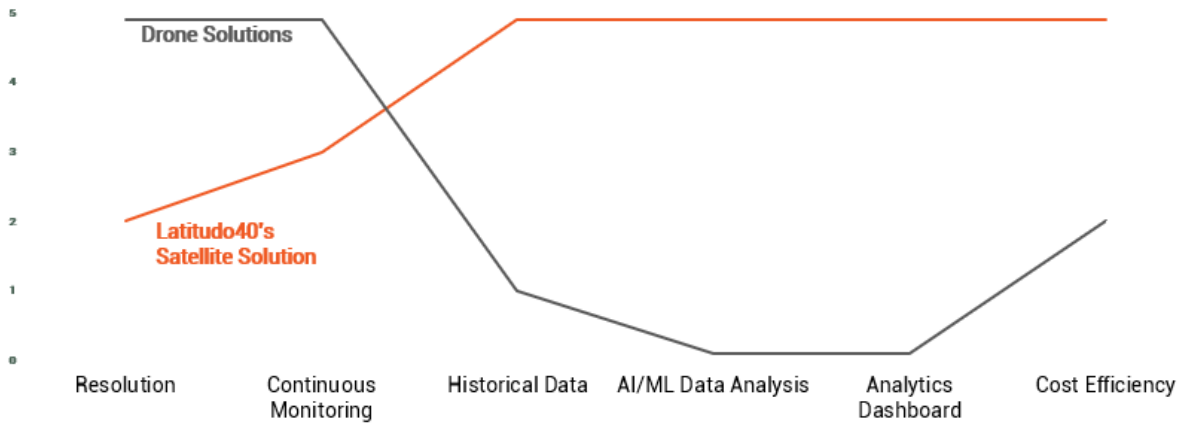
	Urban Areas w/ 10-50k population	District Capital	No. of Sub-Districts ¹
1 Northern	35	Nof Hagalil	5
2 Haifa	22	Haifa	2
3 Central	20	Ramla	4
4 Tel Aviv	4	Tel Aviv	-
5 Jerusalem	2	Jerusalem	-
6 Southern	13	Beersheba	2

¹City district

Appendix 13: District and Sub-District Funnels Leading to Petah Tikva Region




Appendix 14: Value Innovation Curve Comparing Satellite and Drone Solutions



Appendix 15: Exemplary Workshop Flyer by Latitudo 40

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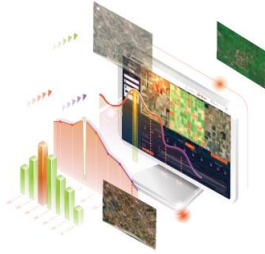







Free Workshop

Space Monitoring for Green Cities

A free & online workshop for sustainable cities

Space monitoring is one of the most innovative industries constantly monitoring our planet, land & ocean surface and atmosphere, to increase sustainable decision-making. This workshop aims at cities of all sizes who are actively working on their sustainability strategies.





-  100% free and fully online
-  30-45 minutes duration
-  Exclusive workshop for your city
-  Introduction to space monitoring applications
-  Discussion about your sustainability challenges


Get a free report with space monitoring insights for your city!


[Book here](#)


Latitudo40 offers a data analytics platform for cities to make more sustainable decisions, increase the quality of life and monetize their decarbonisation efforts.



Urban heat Islands analysis



Pollution Monitoring



SAR analysis


A new model to use CO2 sequestration capacity to finance sustainability in the cities


area

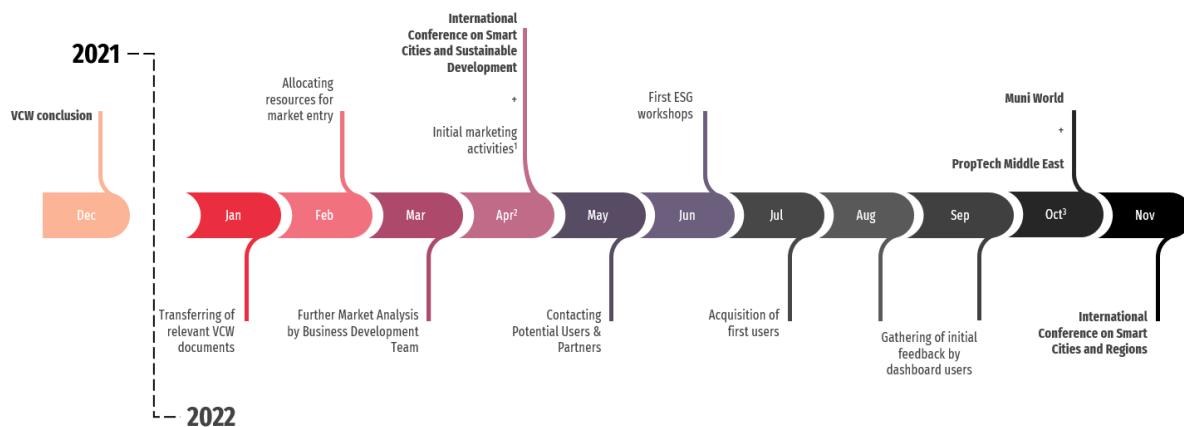

carbon storage 2020


carbon storage 2050


delta storage 2050

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Appendix 16: Proposed Market-Entry Timeline



Appendix 17: MCDA Results from the Country Level Data

Multiple Criteria

Decision Analysis

- ✓ Assessing how many filters a potential solution (country) would have passed in total
- ✓ Disregarding filter rankings and purely assessing threshold values and country data

3 Countries

Would have passed a total of 9 out of 10 filters

COUNTRY	MCDA SCORE
Israel	9
Rep. Korea	9
Belgium	9

With Israel already being the result of the global Value Creation Funnel (VCF), the MCDA is confirming the attractiveness of this market.

However, if additional markets should be assessed for market entry, the **Rep. of Korea** and **Belgium** could be considered as the most interesting candidates.

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5. Conclusion

This Field Lab (FL) aimed at applying the Value Creation Wheel (VCW) for identifying attractive, new geographical markets to increase the impact of Earth Observation (EO) on urban planning. Based on the FL's presented research, global cities are experiencing significant economic losses due to climate change. Rapid urbanization causes increasing concerns for maintaining an adequate quality of life for the citizens, such as health, quality of infrastructure, and safety. Modern urban planning requires addressing all these challenges. It was found that most cities lack effective methods for monitoring the urban environment and making informed and impactful decisions.

International efforts such as the SDGs, EU Green Deal and the Urban Agenda share the common goal of making the world a better place by steering it into a sustainable direction. To achieve that, all intended targets and measures must support the pillars of the Triple Bottom Line (TBL). With significant financial resources made available to achieve these goals, innovative solutions are needed to close the gap between the two. Therein, truly sustainable innovation creates value for all TBL dimensions at once. This includes financial profit for the organization and customers themselves, but also a positive impact on communities and the environment.

The EO industry represents a source of constant technological and sustainable innovation through enabling meaningful decisions benefiting many stakeholders at once. While EO is commonly used in the Agriculture, Forestry, or infrastructure sector, its application in urban planning is currently not that pronounced.

To increase its contribution, three promising solutions from two different service providers were chosen by the FL team. These included Urban Heat Island and Building Health monitoring by

Latitudo 40 and Impervious Surface monitoring by DHI Gras. All added to the TBL dimensions and were strongly aligned with multiple SDGs and their related targets.

Together with the companies' Key Decision Makers (KDMs), the challenge of identifying new attractive geographical markets was launched. After applying the VCW and its five main phases, the projects were presented to the KDMs. All three received highly positive feedback, with the companies being convinced their service would strongly benefit the proposed city and regions.

The framework enabled the FL team to solve a complex challenge in a high-tech market. Close collaboration with KDMs as well as involvement of other internal and external stakeholders allowed the incorporation of various perspectives and therefore create additional value in the process. The understanding of environmental and social factors that would highlight the potential need for the solution in a particular geographic area was key to achieve a bigger impact. The use of quantitative datasets enabled a structured and unbiased process for identifying the final target markets.

As a result of the individual projects, Petah Tikva subdistrict of Israel, Amsterdam city in the Netherlands, and Kanagawa prefecture in Japan were found to have the highest need for the chosen urban planning solutions. Therefore, entering these geographical markets would have a lasting positive impact on regional urban planning activities and the overall quality of life of citizens. While it remains to be seen what new, innovative solutions our companies will develop for other markets, space-based methods will play an ever-increasing role in the future of urban planning.

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