

A conceptual Six-Dimensional Strategic Analysis Tool for Digital Sustainable Competitive Strategy

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Abstract

Contemporary organizations are transforming their competitive strategies in response to two mega trends i.e., digitalization and sustainability. Both, researchers, and practitioners are demanding novel tools that help in bridging digital and sustainable goals of an organization into new competitive strategies. To fill this demand, our work presents a conceptual six-dimensional strategic analysis tool (6DSAT). The creation of this tool is based on Design Science Research using two sources: a literature review and pilot-testing workshops with enterprises and students with start-up ideas which are from eleven different countries and four different continents on university level. Our results impart six interconnected core dimensions for mapping a long-term digital sustainable competitive advantage. Furthermore, results from workshops show that our conceptual tool helped all start-ups and students in mapping a digital sustainable competitive strategy for their current and future business ideas.

1. Introduction

In the twenty-first century, both mega trends i.e., digitalization and sustainability are transforming every industry and economy across the globe (European commission, 2020; Lang, 2021; The world economic forum, 2022). Such trends are consequences of two fundamental developments: a human caused ecological and climate crisis (Sachs 2015; The royal society, 2012), and the rapid development, growth, and usage in advanced digital technologies such as artificial intelligence (AI), cloud computing, quantum computing, 5G, Internet of Things (IoTs), and 3D printing (kissinger et al., 2022; Sachs, 2020; Curuksu, 2018). On strategic level this transformation is pushing all kinds of organizations towards the need of creating a new competitive strategy around digital and sustainable goals in today's digital age (Schneider et al., 2022; Lang, 2021; Sachs et al., 2019). This is true, since a competitive strategy of an organization (particularly for business organizations) is considered vital for setting an imperative to compete and succeed in various markets by differentiating itself from other competitors through their products and services in long term future (Hutzschenreuter & Israel 2009; Campbell-Hunt, 2000).

Currently, most people on management positions (both in academics and industry) consider bridging digital and sustainable goals an opportunity for creating a new competitive strategy (Hussain et al., 2022; Ogrean & Herciu, 2021). On one hand they want to create new products and services that are fundamentally digitally data-driven in nature, while on another hand, they also want these products and services to be sustainable in identity by keeping planet and people at its core (Hitt et al., 2011; Accenture, 2021; Soule et al., 2015). Therefore, innovation on the strategy level is required by organizations to align digital and sustainable goals to leverage long term competitiveness. However, very recently, this challenging desire of bridging digital and sustainable goals have led scientific community from interdisciplinary fields – data science, informatics, business, and management - in highlighting a new research objective. Which is *to create novel management frameworks or tools, that can help organizations on strategy level in creating a unique integrative digital-sustainable competitive advantage* (Bharadwaj et al., 2013, Lobschat et al., 2021; Wade et al., 2021, Subramaniam, 2022). Such research objective became more prominent when both, academics and practitioners, from all kinds of global organizations, demanded novel solutions on this matter in the World Economic Forum annual meeting in the year 2021 (The world economic forum, 2021).

Contributing to such demand, this paper presents a conceptual 6-dimensional strategic analysis tool (6DSAT) for digital sustainable competitive strategy. These integrative generic six dimensions of the tool are data privacy, data analytics, data security, social, economic, and environmental. We developed 6DSAT in two phases. At first, an exploratory literature review (Durand et al., 2017) was conducted for conceptualizing 6DSAT. We use corporate digital responsibility (CDR) Concept (Lobschat et al., 2021) as a primary reference for developing our conceptual tool. The work of Lobschat et., (2021) is the most recent and relevant guiding framework, that helps in bringing sustainability practices in connection to digital transformation. In second phase, after conceptualizing 6DSAT, we pilot- tested it with three different start-ups in three different workshops (Ørngreen & Levinsen, 2017). Participants from eleven different universities and four different continents participated in these workshops.

In conceptualizing 6DSAT, we make two primary contributions to research. First, we have developed a new management tool that intends to help any kind of organization in bridging their digital and sustainable goals. Our novel tool has highlighted six interconnected and interdependent dimensions that aim to benefit users in mapping a new digital and sustainable competitive strategy. Secondly, through practice, we have found that this tool did not only help and improved original business ideas, but also facilitated start-ups in identifying gap for developing future competitiveness. All participants during workshops agreed, that 6DSAT has

helped them in realizing and creating new form of strategic competitive advantage, considering contemporary mega trends of digitalization and sustainability.

This paper is structure in the following manner. The section of introduction is followed by a description on research method, including details on literature review process in exploratory manner, and on the setup of three workshops. The result part includes findings from both research phases. First, it introduces 6DSAT, including its structure, functionality, and connectivity between its six dimensions. Secondly, it provides practical findings from workshops and shares contributions of this work. Last sections present conclusion, and limitation and outlook for future research.

2. Research design

This research aims to develop a new management tool for helping organizations that are struggling to bridge their digital and sustainable strategic goals. Since, our main focus is on seeking innovative solution towards a real organizational problem i.e., *how to bridge digital and sustainable goals*, therefore, our study implemented the design science research (DSR) (Vom Brocke et al., 2021). Our core artifact is a conceptual 6DSAT for digital sustainable competitive strategy. We followed the DSR methodology (Peppers et al. 2007) in designing our method, which includes six phases: problem identification, definition of design objectives, design and development, demonstration, evaluation, and communication as shown in Table 1 below.

Phases	Description
1. Problem identification	- Organizations are struggling to bridge their digital and sustainable goals. - Lack of novel management tools in digital age that can help organization, particularly on this matter
2. Definition of design objectives	Creating a new management tool derived from existing knowledge on digitalization, sustainability, and strategy ... in an exploratory manner.
3. Design and development	Literature review to develop a conceptual 6DSAT
4. Demonstration	- Three workshops - Fifteen participants
5. Evaluation	- The usage of the tool in practice - Asking participants about the tool's effectiveness in terms of usage and innovation
6. Communication	Scientific publication (conference - Journal)

Table 1: Instantiation of the DSR methodology to design the 6DSAT

We derived the conceptual 6DSAT (i.e., Phase 3 of DSR methodology) by a synthesis of existing literature. As shown in Figure 1 below, this literature review was conducted in an exploratory manner. This is because our research objective (Phase 2) – which is “*new management tools for digital sustainable competitive strategy*” - is nascent, broad, and interdisciplinary in nature. This objective originates in response to contemporary academic and real-world organizational problem (Phase 1), which is “*scarcity of management tools that help in bridging digital and sustainable goals of an organization*” as justified in Section 1 earlier.

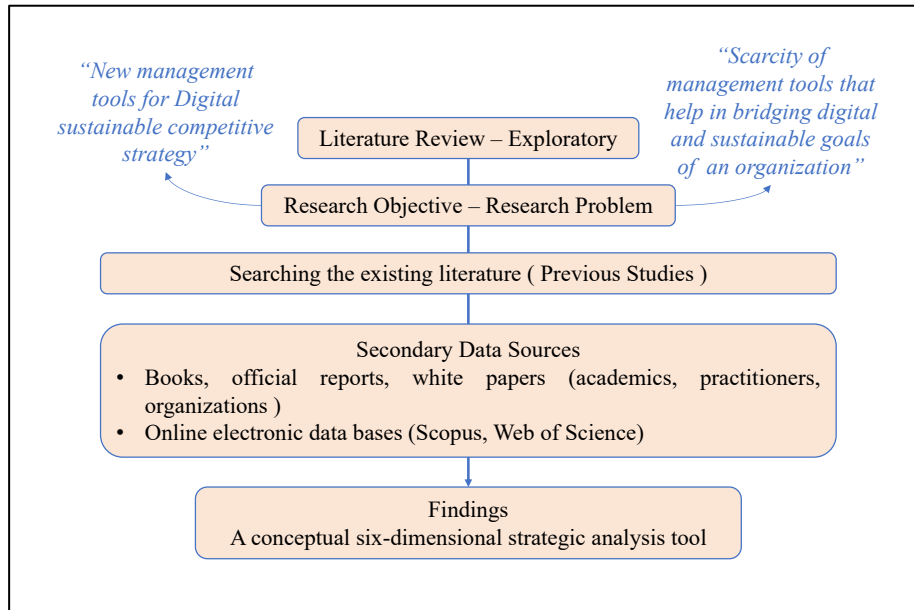


Figure 1: An Approach of our exploratory literature review

We search for different kinds of literature in an exploratory manner, keeping CDR concept developed by Lobschat et al., (2021) as a primary reference. We did synthesis of present literature, following the recommendations of Durand et al., (2017), and Grisold et al., (2022). As mentioned earlier that, specific literature related to our research objective was scarce, therefore we search more broadly using various secondary data sources such as books, white papers, reports, and online electronic databases as shown in Figure 1 above. Concerning online electronic databases, we used Scopus and Web of Science databases for literature search from the year 2010 to 2022. Here we again kept our search broader, where our search strings were formed in combination of topics such as ‘digitalization’, ‘sustainability’, ‘competitive strategy’, ‘data science’ and ‘management tools’ as shown in Table 2 below.

Search string	Search within	Number of non-exclusive results	
		Scopus	Web of Science
digi* AND sustaina*	Title/Article title	1751	1136
"Digital sustainable" OR "digi* and sustaina*"	Topic/article title, Abstract, Keywords	151	92
"Digital sustainable" OR "digi* and sustaina*" AND strategy	Topic/article title, Abstract, Keywords	32	28
"Digital sustainable" OR "digi* and sustaina*" AND tool* OR framework*	Topic/article title, Abstract, Keywords	46	31
"Competitive strategy" AND sustainab* AND digi*	Topic/article title, Abstract, Keywords	22	9
"Competitive strategy" AND sustainab* AND digi* AND tool* OR framework*	Topic/article title, Abstract, Keywords	3	4

"Sustainable data" OR "green data" OR "responsible data"	Topic/article title, Abstract, Keywords	867	619
"Sustainable data" OR "green data" OR "responsible data" AND tool* OR framework* OR concept* AND Strateg* OR competitive*	Topic/article title, Abstract, Keywords	35	32

Table 2: Overview of searching literature using online electronic databases.

At the end, all relevant information to our research objective, extracted from various secondary data sources, was gathered, filtered, and utilized in conceptualizing 6DSAT for digital sustainable competitive strategy.

Once conceptualization of 6DSAT was successfully achieved, then in Phase 4 of *demonstration* as shown in Table 1 above, three workshops (Ørngreen & Levinsen, 2017; Shah et al., 2020) were conducted with the following stakeholders:

- Fifteen participants
- A researcher from the Institute of Interactive systems and Data Science, TU Graz.

we tested this tool in workshops with three different start-ups having different entrepreneurial business ideas. The participants who created these start-ups are from four different continents and are doing their majors in nine different engineering studies as shown in Table 3.

Workshops (With Start-ups)	Code	Study	University	Country	Business Idea
Team 1	Participant 1	Electrical Engineering	Universidade Presbiteriana Mackenzie	Brazil	“AI driven software for marketing consultancy”
	Participant 2	Computer Science	Delft University of Technology (TU Delft)	Netherlands	
	Participant 3	Financial Engineering	Montana State University	USA	
	Participant 4	Software Engineering	Graz University of Technology	Austria	
	Participant 5	Engineering management	Warsaw University of Technology	Poland	
Team 2	Participant 6	Aerospace Engineering	Seoul National University	South Korea	“Providing electromechanical modules for transportation drone”
	Participant 7	Engineering Management	Warsaw University of Technology	Poland	
	Participant 8	Industrial Mechanical engineering	Free University of Bozen-Bolzano (Freie)	Italy	

			Universität Bozen)		
	Participant 9	Control Engineering	Norwegian University of Science and technology	Norway	
	Participant 10	Mechanical Engineering	INSA Lyon	France	
Team 3	Participant 11	Sustainable development engineering	Monterrey Institute of Technology	Mexico	“ Building sustainable blocks for construction industry”
	Participant 12	Industrial Engineering Management	Polytechnic university of Valencia	Spain	
	Participant 13	Biotechnology	Linköping university	Sweden	
	Participant 14	Civil engineering	Monterrey Institute of Technology	Mexico	
	Participant 15	Civil Engineering	Monterrey Institute of Technology	Mexico	

Table 3: An overview of three workshops

Furthermore, all these participants were taking the course of ‘Introduction to International Entrepreneurship’ offered by the Graz University of technology, Austria (2022). One of the main objectives of this course is that participants are grouped in teams to form start-ups, and practice theory of entrepreneurship and strategy (Neck et al., 2016) by creating new products and services for future local and global markets (Jansson, 2020). During this course, all participants had already used classical strategic analysis tools such as SWOT and PESTEL analysis frameworks for mapping a competitive advantage for their respective products and services. So, this remained the precondition of our workshops as it was vital for us to test our 6DSAT tool after participants have already used some famous classical strategic analysis tools. The idea behind such precondition was to experience the practical impact our newly developed tool in comparison to conventional tools.

All workshops were held in the following manner. First, we invited each start-up to a seminar room at the Institute of Interactive System and Data Science at the Graz University of Technology, where all practical activities were carried out. Before each workshop, 6DSAT was printed and hanged on side walls as A0 Size Charts (33.1” by 46.8”) and sticky notes were placed beforehand. The purpose of such sticky notes was to facilitate participants in brainstorming and idea generation activities for mapping a new competitive strategy for their products and services.

Afterwards, each workshop started with a short presentation, where all participants were introduced to structure, functionality and usage of 6DSAT in practice as described in the following Section 3.1. Once everything was cleared to participants, then they were asked to test the tool on their respective products and services. During this practice, constant assistance was provided to each start-up by us.

At the end of each workshop, feedback was collected through a survey regarding the impact of 6DSAT. This was our phase 5 of *evaluation* following DSR methodology. Participants were asked to provide free-text answers to the question: Did this tool helped you in mapping a

competitive advantage by bridging digital and sustainable goals? Here the main goal for us was to know if 6DSAT helps in mapping a new competitive strategy, that is both digital and sustainable in nature. And furthermore, we were also interested to witness if the tool helps in identifying any innovation gap opportunity for start-ups.

All data generated and collected from three workshops was digitalized. Out of which results are extracted and presented in the section 3.2.

3. Results

This section is divided into two parts. In first part, we introduce conceptual 6DSAT for digital sustainable competitive strategy. And in second part, we share results from the workshops, when the conceptual tool was pilot-tested and evaluated in terms of impact with three start-ups.

3.1 A conceptual 6DSAT for digital sustainable competitive strategy

A digital sustainable competitive strategy arises, when an organization and individuals unlock the value of data using modern digital technologies to create sustainable products and services (Subramaniam, 2022; Wade et al., 2021). Figure 2 depicts 6DSAT for digital sustainable competitive strategy. It represents the structure, functionality, and connections of tool's six strategic analysis dimensions. These dimensions are based on two perspectives, i.e., digital, and sustainable. The digital perspective encapsulates data-driven interdependent dimensions such as data privacy, data analytics, and data security. While the sustainability perspective considers the triple bottom line dimensions such as social, economic, and environmental (Brundtland, 1987). There are also interconnections between various dimensions of 6DSAT based on internal and external views of an organization and are depicted by node 1 and node 2 in Figure 2, below.

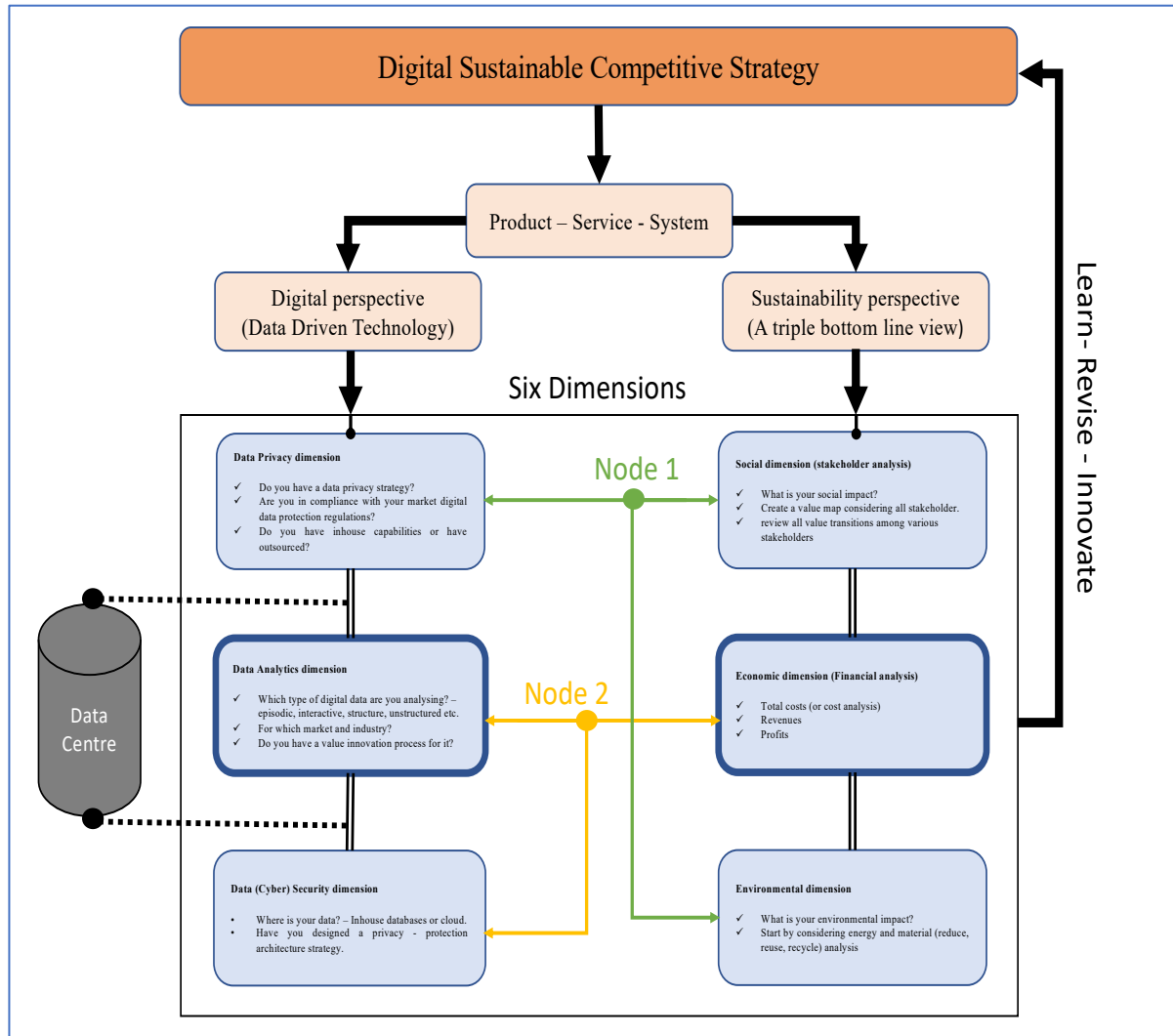


Figure 2: Structure, functionality, and connectivity of 6DSAT

3.1.1 Digital perspectives

Data-driven modern digital technologies such as artificial intelligence (AI), cloud computing, quantum computing, 5G, Internet of Things (IoTs), and 3D printing, are increasingly becoming important to how organizations work, and how we (stakeholders), as citizens, customers, consumers, or suppliers relate to them. This current trend requires new strategies from a digital perspective. Therefore, we attempted to identify critical dimensions from existing literature, that can help organizations in mapping a long-term digital data driven competitive advantage. We successfully identified three fundamental data driven dimensions relevant to map a digital competitive advantage for new products and services. These dimensions are data privacy, data analytics, and data security. Recently, while other researchers (Lobschat et al., 2021; Ritter and Pedersen, 2020; Rene et al., 2019) have similarly conceptualized work on important digital dimensions for responsible governance and long-term growth, our conceptualization is different, as we aim to create a generic competitive advantage perspective on strategy level rather governance, business model or process level. Our main purpose was to filter relevant literature on those digital dimensions, that are considered important for organizations in gaining strategic competitiveness. We explain in detail, how these three dimensions are closely interrelated and vital for strategic analysis.

Digital privacy:

In present-day, the most important questions in strategic domain to map a digital competitive advantage are – Do you have a data privacy strategy? If yes, for which market? - And have you built any capabilities within organization around data privacy, or have outsourced it?

As a starting reference to such questions, we will start with recent disruptive developments in Europe and UK. The introduction of General Data Protection Law (GDPR) by the European Union (EU) on May 25, 2018, and extended to UK, these earlier questions have become essential by every organization to answer. Any organization that carries out activities such as storing, processing, and analyzing digital data of EU and UK residents (Abraham et al., 2019; The Royal Society, 2019) is facing enormous challenges to comply with GDPR. Recent empirical work, documented by big consulting firms, such as Accenture and McKinsey, have highlighted digital privacy compliance as a vital dimension for all organizations to create strategic differentiation and competitiveness for future (Janiszewska-Kiewra et al., 2020; Accenture, 2020; Anant et al., 2020; Accenture, 2018). Most organizations, primarily operating in EU and UK markets, including leading American digital companies (such as Facebook, Amazon, and Google) are still struggling with the challenging issue of data privacy compliance (Wade et al., 2021; The Royal Society, 2019). However, they all consider such challenge as an opportunity to create new competitive advantage (Accenture, 2020; Abraham et al., 2019). Therefore, for every contemporary organization, having a data privacy strategy should be a priority. And should consider it as an inevitable proactive step before data storage, processing, and analytics in the wide spectrum of data governance.

Data Analytics

Since the beginning of the digital era, creating new technologies, strategies, and capabilities, around data analytics (Han et al., 2012) were considered prime objectives by all organizations. Once small startups, now leading digital global companies such as Google, Facebook, and Amazon were first in realizing the importance of data analytics (mainly customer analytics). And are considered pioneers in building core digital technologies and capabilities around data analytics. Due to which, these companies attained a niche competitive advantage. And rapidly became more valuable than legacy firms, that were operating for more than a century (Subramaniam, 2022; Curuksu, 2018)

However, in current times, data analytics is becoming increasingly pervasive. There is an urgent demand to review, revise, and reconstruct new competitive strategies and capabilities on this dimension. This is because of two main external factors. First, the introduction of new and strict data privacy laws on national, regional, and international levels. Second, an increase in societal sensitivity towards the issue of personal data privacy. (Taylor & Purtova, 2019; British Academy & The Royal Society, 2017)

Therefore, data analytics dimension now needs a strategic alignment with the data privacy dimension (Fovino, 2011). An organization that will build capabilities and strategies on such alignment will be able to foresee, grasp, and create new competitive advantages for their products and services. Therefore, we recommend the following questions in an exploratory manner to be answered - Which type of digital data are you analyzing, and for which purpose? - For which market and industry? – Have you developed an agile digital transformational response to minimize the risk of new external forces i.e., new data privacy issues, laws, and regulations for current markets?

Data (Cyber) Security dimension

Data security (like data analytics), which is often termed as ‘cybersecurity’, was always considered a principal strategic dimension for sustaining long-term digital competitiveness. This dimension has comparatively gained more focus, since the rapid expansion of digital transformation across every industry on both, global and local scales (The National Security Commission on Artificial Intelligence, 2021; Federal Chancellery Republic of Austria, 2021). For almost all organizations and governments, data security has become priority number one. They are investing heavily in rebuilding new capabilities and infrastructure around this matter. The main strategic objective of this dimension is facilitating secure functioning of all digital activities in cyber medium (Emer et al., 2021; Daimi & Francia, 2021).

Due to the rapid advancement and popularity in cloud computing technology, many organizations are in a phase of strategic transformation by partnering with cloud computing service providers. And are outsourcing their data storage capabilities and resources. This trend particularly demands new kind of data security strategy, because partnering with external cloud service providers disrupts and divides security responsibilities among users and suppliers in both, business to business (B2B) or business to customer (B2C) contexts. (Marinescu, 2022; Wang et al., 2013)

In the process of mapping long term competitiveness and strategic differentiation on data security dimension we recommend the following questions to be considered in a generic manner - Where is your data stored and retrieved from – inhouse databases or cloud? - Have you designed data security in the following strategic manner i.e., privacy -analytics- protection? Since data security provides fundamental assurance to all digital practices and processes of any organization operating in cyber space, therefore it is vital to map an aligned and interrelated strategic view of data security, data privacy, and data analytics. This will help any organization to enhance digital competitiveness.

3.1.2 Sustainability perspective

In the last decade, the topic of sustainability was made relevant to ongoing digital transformation, and vice versa by both academics and practitioners. Such work created urgency, particularly, when people living on the planet earth demanded sustainable practices, products, services, and mindsets from global leaders and organizations. (Stawicka, 2021: George & Schillebeeckx, 2021: Bican & Brem 2020)

The three sustainable dimensions: social, economic, environmental, depicted in Figure 3.1 are extracted from a triple bottom line perspective of sustainability (Brundtland, 1987; Elkington, 1998; Geissdoerfer et al., 2018). These are social, economic, and environmental dimensions. Wade et al., (2022) also consider these three dimensions essential and fundamental in categorizing CDR into four parts. His work helps in creating relevance of sustainability perspective to digital transformation or digitalization. And provides vital recommendations for practice. Apart from that, two of our sustainability dimensions are also foundational to environmental, social, and governance (ESG) framework (United Nations & Swiss Federal Department of Foreign Affairs, 2004). ESG framework guides organizations in investment strategies for creating impactful value for all stakeholders, primarily on social, environmental, corporate governance dimensions.

Social dimension

This dimension revolves around the question - which kind of value and impact an organization creates in connection to all stakeholders of our society using digital data? By stakeholders, we mean all people and machines (e.g., AI systems) connected in the whole value chain and

ecosystems of your digital products and services directly or indirectly. Data privacy and protection is becoming an important issue and concern for people as explained earlier in section 3.1.1. Therefore, organizations should map a positive social impact value (Bocken et al., 2013) in connection to digital data perspective in mapping a competitive strategy. Such mapping process should include two things. First, a transparent data privacy and protection strategy for all stakeholders. Second, leveraging data analytics capabilities to help society.

Economic dimension

For many organizations the main goal is to be profitable in both short and long term. This goal always required high organizational knowhow and capabilities on financial perspectives (Kane et al., 2017). However, in today's digital age things have changed. For generating and sustaining high profits, now organizations require both, financial and digital data analytics capabilities (Kumar et al., 2022). New digital technologies such as AI, blockchain, and machine learning are rapidly changing the rules of classical ways of financial analytics. Therefore, it is recommended to build an align strategy by closely integrating the economic dimension with digital dimensions of 6DSAT.

Environmental dimension

This dimension concerns with the question - what is your environmental impact? Creating an environmental competitiveness in contemporary digital age has become a fundamental opportunity for contemporary organizations (Schneider et al., 2022). A recent survey conducted by Accenture (2021) showed that more than 80% of consumers put importance to the idea, that companies must design more environmentally sustainable products. Also, The Global Risk Report, issued by the World Economic Forum (2022), identified ten dominate global risks in terms of severity, impact, and likelihood. Five out of ten were environmental risks. These facts are now challenging all organizations locally and globally to rebuilt new environmentally competitive strategies for their products and services. Therefore, we recommend using digital data-driven technologies in creating a positive environmental value. And encourage to start mapping such environmental strategic analysis with topic such as 'energy' and 'materials' related to value chains of products and services.

3.1.3 Integrative internal and external views

We bridged various dimensions of 6DSAT from two different views. These new connections are based on external and internal views of an organization (Grinblatt & Titman, 2002). To facilitate the process of analyzing and mapping a competitive advantage, in Figure 2, we depicted an external view with Node 1 (shown in green), and an internal view with Node 2 (shown in yellow).

From an external view of organization, we bridge social, environmental, and data privacy dimensions. This is true as people in contemporary times demand two things. On one hand, they demand transparent digital data privacy and protection strategies from organizations. While on other hand, they also expect and demand environmentally sustainable practices, products, and services. Therefore, through a node 1, we develop an interrelationship between various digital and sustainability dimensions of 6DSAT. Secondly, from an internal view of an organization, we bridge data analytic, data security, and economic dimensions. This is true, as internally every digital organization wants to build new capabilities, partnerships, and strategies in connection to these three dimensions. Studies from last two decades prove, that the more data analytics (on all levels) capabilities an organization develop, the more chances

are that it will generate high profits and long-term growth. And the more it becomes necessary for organizations to secure all their digital functionalities and activities operating in a cyber space. Therefore, such internal and external views can provide an alternative way on how digital and sustainability dimensions of 6DSAT can be viewed and bridged before mapping a competitive strategy.

3.1.4 Usage of 6DSAT in Practice

In this section we describe an overview on how 6DSAT can be used in practice in the process of mapping a digital sustainable competitive strategy. As shown in Figure 3 below, we assume that an ideal competitive strategy for any organization will be the one that succeeds to create an equal competitiveness on all six dimensions i.e., data privacy, data analytics, data security, social, economic, and environment of our conceptual tool. For illustration, we have compared an ideal competitive strategy metaphorically with a 360° view as of a circle's center point. Where the center point represents an organization's strategy. Such an ideal situation depicts the idea that an organization desires and strategizes to develop an equal view of 60° (i.e., new capabilities) on each of these six dimensions to create a unique competitive advantage. However, it is true that none of organizations will develop such balanced, complete, and absolute competitive advantage in real. Because by nature, our systems are always vulnerable to new threats particularly in digital manner (i.e., cyber space), and markets external forces (that are hard to predict). Therefore, we purposely termed it 'an *ideal* competitive strategy'. In today's era of digital ecosystems, organizations are dependent on making strategic external partnerships in terms of capabilities and resources to achieve an optimal competitiveness (a balanced mix of digital and sustainable value creation). Therefore, the sole purpose of 6DSAT is to guide organizations during their process of developing a competitive advantage that is closer to an ideal or optimal scenario as shown in Figure 3. Furthermore, 6DSAT also intends to help users by highlighting an innovation gap and future opportunities related to their products and service. Such gap and opportunities are highlighted in the following steps.

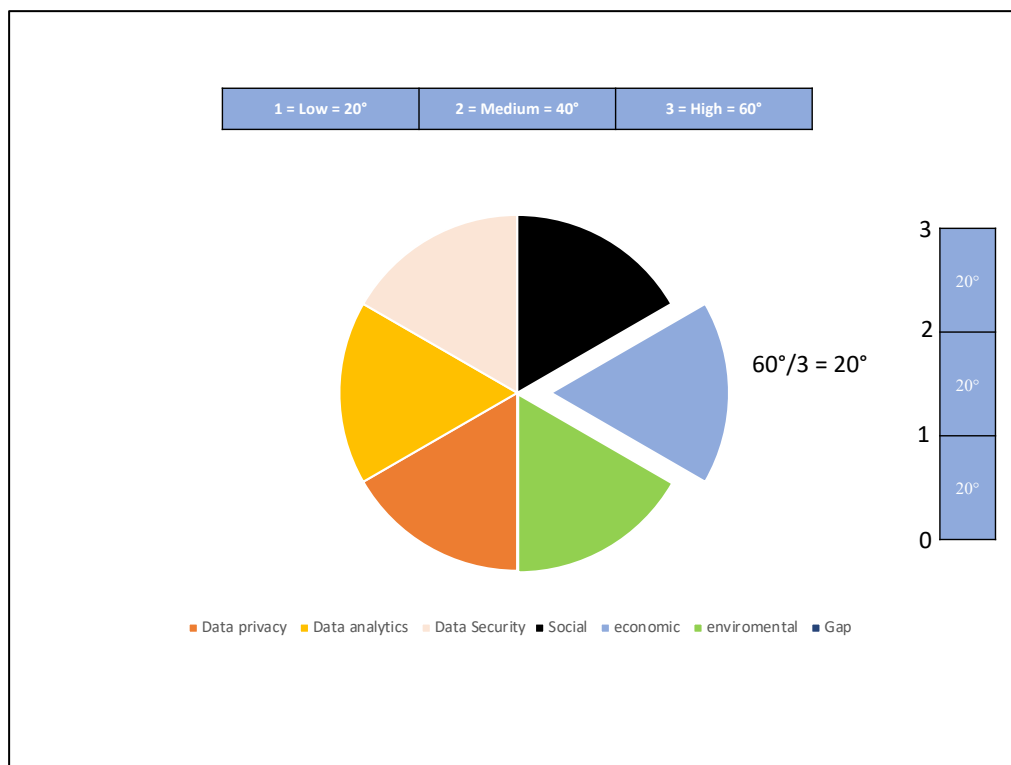


Figure 3: An ideal situation of competitive strategy and usage method of 6DSAT

First users choose their product and service for which they want to map a competitive strategy. After that, they start strategic analysis on these six dimensions. Such process of analysis starts by answering questions describe for each dimension in the section 3.1.1 and section 3.1.2. The two perspectives (i.e., represented as nodes) outlined in the section 3.1.3 also facilitates users in bringing more clarity. Once this process of analysis is finished using 6DSAT, then users based on their practical experience and understandings are asked to score each dimension from 0 to 3 i.e., where 0 being the lowest and 3 being the highest score for recognizing competitiveness. The scoring conversion guide is displayed on the top of Figure 3. Since, for each dimension, our tool depicts an ideal case view as 60° , so if (i.e., 60°) divided by 3, one gets 20° . We took this 20° , and made it an equivalent of 1, which is a low score for competitiveness. In the same manner we took 40° , and made it an equivalent of 2, which is a medium score. lastly, we took 60° , and made it an equivalent of 3, which is a high score. Using this conversion guide, 6DSAT tool tends to help users in highlighting, where their gap for innovation lies. In other words, such innovation gap indirectly informs the users, where the opportunity to focus and develop a new and long-term competitiveness exists. In next section, we present the practical results from three workshops.

3.2 Results from workshops

This section presents the outcomes of three workshops, where 6DSAT was pilot tested with three start-up teams. First, results of Team 1's workshop are presented. Then results from workshop with Team 2 are indicated. And at the end, results from workshop with Team 3 are recorded.

3.2.1 Workshop – Team 1 Results

Team 1 aspired to make an AI software for marketing purposes. They wanted to develop B2B services. The main idea behind their digital (intangible) product was to provide an AI driven marketing solutions to those businesses, that want to outsource capabilities of market research on extending their businesses to new markets. After testing 6DSAT with their product's idea, we got the following results.

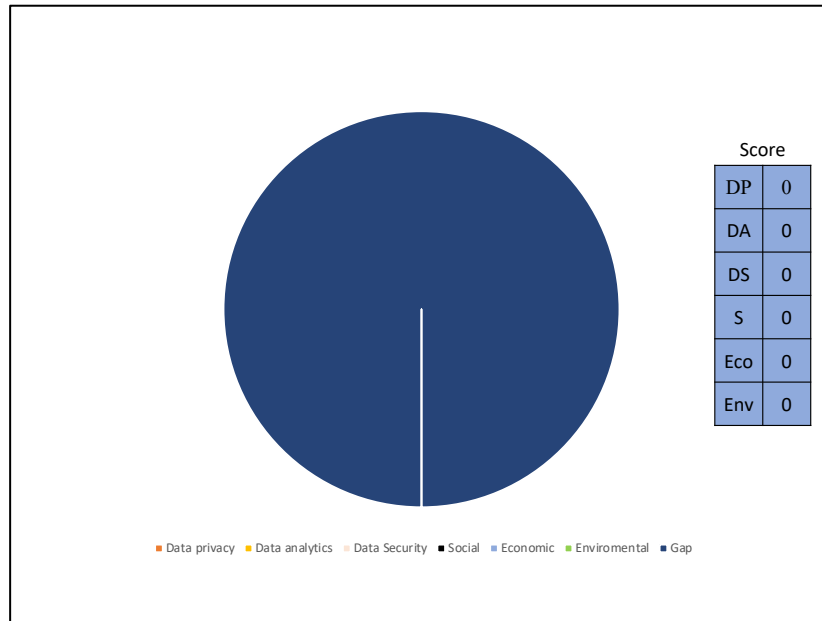


Figure 4: Score of Team 1 using 6DSAT

- As shown in Figure 4, above, Team 1 agreed to allocate 0 score to each dimension, where DP stands for data protection, DA for data analytics, DS for data security, S for society, Eco for economic, and Env for environment dimensions.
- Team 1 was lacking clarity on all fundamental puzzles of digital strategic analysis. They failed to answer questions connected to three digital dimensions of 6DSAT. Participants were not aware of GDPR, yet they wanted to do business in Europe. They had expertise on how to create an AI software, and how the system can learn from data. But were lacking clarity on which type of data will they feed to their AI system. All the proposed options of Team 1 on this matter turned out to be illegal according to GDPR. And normally the kind of data that is considered important for marketing research and consultancy is not an open-source data, and to buy important data from dark web or third-party businesses without customers consensus is a forbidden act. All these doubts and missing alignments among various digital dimensions highlighted by 6DSAT convinced Team 1 to complete withdraw their current idea. And encouraged them to create a new business idea.
- We have noticed that since participants of Team 1 were mostly from informatics background such as participant 1, 2, and 4, therefore, they were focused primarily on creating digital intangible products and services. However, 6DSAT helped them in better understanding, which digital dimensions are fundamental to data driven products and services in contemporary time, and how these dimensions are linked and interdependent with other three sustainability dimensions.
- All participants agreed that 6DSAT have helped them on individual level. And has broaden their perspectives on new challenges and opportunities in terms of digitalization and sustainability. For them it was first time, where they had a practical experience with the process of mapping an integrative digital and sustainable competitive advantage.

3.2.3 Workshop with Team 2

Team 2 desired to build an electromechanical module for transportation drone manufacturers. They plan on providing B2B services. They had a mix of tangible and intangible product. In their product, the physical winch module and its electronics are tangible, while the included software Application Programming Interface (API) was intangible. Team 2 was aiming to offer a sustainable and flexible solution for quick drone deliveries to its customers in comparison to their current competitors. After testing 6DSAT with their product's idea, we got the following results.

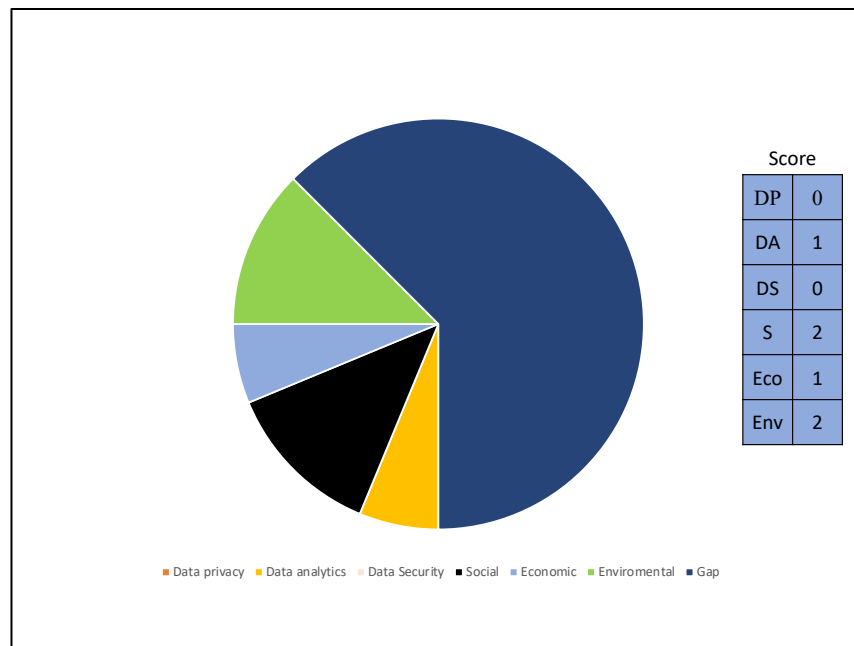


Figure 5: Score of Team 2 using 6DSAT

- As shown in Figure 5, Team 2 gave an average score of 2 on environmental and social dimension. This is because they plan to make their module from materials that are green and recyclable in nature. And also, their main goal is to serve society and people through their products. Particularly in challenging circumstance such as natural disaster, or people in urgent health care need in remote areas across the world. They gave 1 score on economic dimension because they have predicted profits in next two years, since they are in development phase of their product.
- On digital dimensions they gave 0 score on DP and DS dimension, because Team 2 did not make any strategic analysis on such dimensions. However, they gave 1 score on DA dimension since customer analytic were important to their overall business.
- After providing scores on all six dimensions, 6DSAT identified gap on how to develop more competitiveness in future. Team 2 realized that they must focus on aligning their DP, DA, and DS dimensions using digital technologies such as advanced analytics. In future, they decided to make strategy for data analytics in compliance to digital laws for their selected market, and always remain agile to new disruptions. And also planned to outsource their digital data storing capabilities to a cloud service provider. In this case they will minimize the risk of their data security.
- Participants of Team 2 confirmed that 6DSAT helped them in realizing on how a start-up can map a digital sustainable competitive strategy for their product or service.

3.2.2 Workshop with Team 3

Team 3 desired to make sustainable algae bricks. They wanted to develop both B2B and B2C services. The main idea behind their tangible product was to provide an environmentally friendly solutions to all kind of construction businesses, that wants to reduce their carbon emission footprints and are interested in becoming more sustainable in repure. After testing 6DSAT with their product's idea, we got the following results.

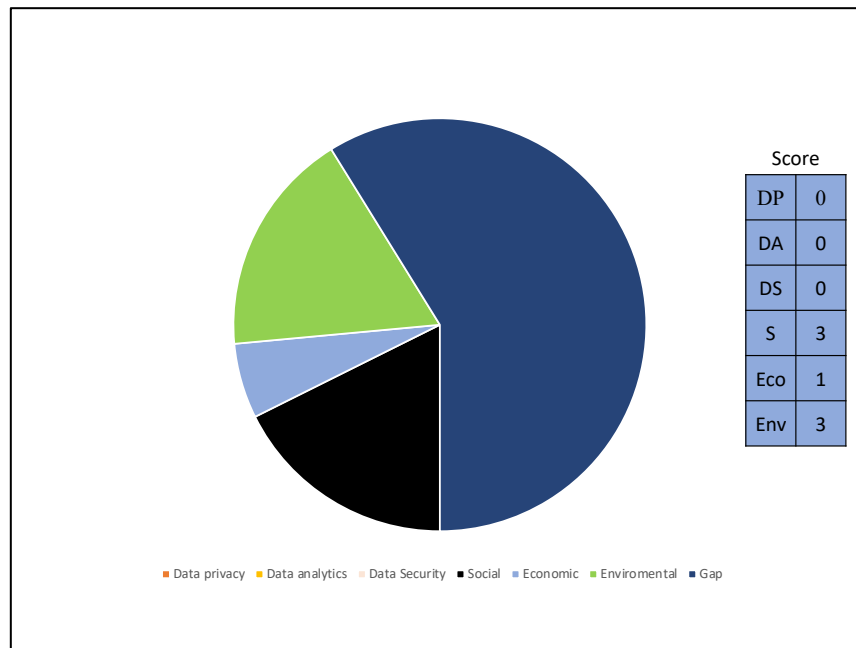


Figure 6: Score of Team 3 using 6DSAT

- As shown in Figure 6, Team 3 gave an average score of 0 to all the digital dimensions such as DP, DA, DS. These is because their product is sustainability focused and not digital driven. In general, when participants in this group was asked about the data privacy dimension of digitalization (i.e., GDPR), only participant 13 was able to contribute to such question, while others did not have any idea. We further asked participant 13 for his or her sources in relationship to awareness and GDPR. We found out that the sources for developing capabilities and skills on such matter was not university academics rather family, where one of the parents of participant 13 was a practicing lawyer in a Scandinavian country.
- Participants of this team gave high score of 3 on social and environmental dimension. However, they gave 1 score to economic dimension, because they thought their product's success in terms profits will not be achieved too early. Since participant 11 had sustainable development engineering background therefore, this team was able to grasp competitiveness on sustainability perspective from early stage.
- After giving scores on all dimensions, 6DSAT helped Team 3 in identifying a gap of innovation for future competitive advantage. The team decided to take advantages of advanced 3D printing technologies for construction industry. And explore new digital opportunities. Because only have a sustainable product will not give them guarantee to sustain long-term competitive advantage.
- Participant 14 and 15 of having civil engineering expertise were particularly confident to build new digital competitiveness related to their existing sustainable product. They

saw potential for providing customized digital solutions (i.e., design and durability) of their bricks in future using 3D printing technologies. And become a consultant firm on for providing digital and sustainable (a mix of tangible and intangible) solutions.

3.3 Contributions

This research findings generates, both theoretical and practical contributions to various streams of current research in considering our findings from section 3.1 and 3.2. Theoretically, we built a new tool for strategic analysis existing knowledge such as the framework of CDR developed by Lobschat et al., (2021) as starting reference. With our work, we also extended the theory of *digital competitive strategy* compiled by Subramaniam (2022) by adding sustainability perspective to it. Practically, we contributed practice-oriented findings to Wade et al., (2021) work on *how to manage digital and sustainable transformations in responsible manner* through our workshops. And at last, we also contributed new knowledge on strategy level to the existing *business action framework* on bridging digital and environmental goals developed by The World Economic Forum (2021). Indeed, the findings of our research aim to provide alternative guidance to various strategists-in-practice stakeholders - namely, managers, policymakers, and researchers - seeking for *How to bridge their organizational digital and sustainable goals, and to develop competitive strategies in the digital age*.

5. Conclusion

Digitalization and sustainability are driving all type of organizations to create new competitive strategies. 6DSAT conceptualized in this paper is intended as a main step on strategic analysis level to help organizations in bridging their digital and sustainable goals. And presents findings of workshops on how this conceptual tool was used and how it helped start-ups by first highlighting an innovation gap on their existing business ideas, and second, to facilitate in mapping a digital sustainable competitiveness for future. The apparent easiness of this tool is that it considers simple six interconnected and interdependent dimensions to help any user in the process of mapping a long-term digital sustainable competitive advantage for their product or service. It is efficient in hovering strategic responsiveness on contemporary challenges of the digital age like data privacy and data security, and how they relate to and can affect and disrupt practices of digital data analytics. This tool is also valid for answering sustainability issues from a triple bottom print perspectives and helps users in leveraging advance digital technologies to create sustainable value (or an impact) for their products and services.

6. Limitation and Outlook

6DSAT does not include perspectives of organizational analysis on governance and business model levels. It is only limited to the phase of strategic analysis particularly in the context of mapping a competitive strategy. Other limitation to our study is that this tool is conceptualized in an exploratory manner and was pilot tested in only three workshops. Therefore, further studies in terms of its pilot-testing will be needed in future with other kind of organizations such as corporates, SMEs, government organizations etc. to further check its impact and usability. In future, we intent to perform multiple case studies with different kinds of organization primarily in Austria. And, to do more workshops with start-ups created by students other than engineering sciences.

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