RESEARCH PROPOSAL

The role of digital technologies in supporting business models for sustainable mobility

By

[Wafa Zainab]

A Masters /PhD Research Proposal
Submitted to the Department of XYZ
XYZ University
Dated: 00-00-0000

1. Description

Digital technologies are revolutionizing the conventional strategic layouts in all service domains. One of the most notable sectors is the transport and mobility system. There's no denying the fact that the mobility of people and goods circulates around transportation mode, infrastructure, networks and traffic flows. Besides aiding service providers in achieving mobility objectives, the transport system inevitably begets unfavorable environmental, social and economic consequences. Keeping in view the structural business model of transportation, the key logistics such as land use planning, policy regulation, behavioral aspects, technology and energy consumption, vehicle operation management oftenly resort to eco-degrading and unsustainable supply chains. As per the findings of the World Bank, by 2030, passenger traffic will exceed 80,000 billion passenger-kilometers—a fifty percent increase—and freight volume will grow by 70 percent globally[1]. Unsustainable service delivery gives rise to material waste, toxic pollutants, lower air quality thus giving way to economic decline. Resultantly, people have to face the dire consequences in the form of financial overhead, social inequity and turmoil. Third world countries are mired in severe economic meltdown and climate catastrophe causing a great deal of environmental crisis.

However, progressing nations such as India, China and Southeast Asia also lack the substance to implement such mobility services which can live up to the expectations of global commitments to mitigate ecological damage. Similarly, China's multi-billion dollar mobility project *One Belt One Road* is termed as an economic game changer but unfortunately the world is doing little to escape the vagaries of environmental degradation caused by the project [2]. This grim scenario paints a gloomy picture of the international state of affairs when it comes to the realization of maintaining an effective transportation system with a strong will of transforming the climate-unfriendly transport business model to a climate-friendly enterprise. Having expounded upon the detriments of unsustainable mobility, it is now crucial to determine how digital technologies can help industries combat the environmental challenges linked with transportation. For instance, Google Maps is a widely-used application which optimizes travel time and distance. Digital technologies can come to rescue in terms of a resilient, green and equitable mobility system promising sustainable development while paying dividends manifold. A sustainable transport model has three dimensions: society, environment and finance.

The overarching importance of ecological conservation calls for charting a technological environmental perspective of the transport process. A green digital technology model paradigm, namely circular economy, can serve the aspiring prospects such as clean energy management, capacity maintenance, climate change adaptation, cost effectiveness, socio-economic recovery, carbon neutrality, infrastructure safety and human development indicators. According to the Environmental Protection Agency (EPA) of USA, circular economy reduces material use, redesigns materials, products, and services to be less resource intensive, and recaptures “waste” as a resource to manufacture new materials and products [3]. This research is mainly oriented to work on specifying the advantages of a digitized transport business model engendering the concept of technological circular economy which entails recycling, reusing, refurbishing and

remanufacturing of the material-based remnants of service cycle. The core purpose of a digitized circular economy is to employ sustainable technology that reinforces eco-friendliness and clean mobility. Hence, transforming the entire mobility system process through digital technologies in order to maximize sustainability is the principal motive.

2. Problem Statement

The ecological footprint of the transport sector due to unsustainable business models is discouraging for the global commitment to curb the threat of climate crisis. Accordingly, this research takes into account the concept of a sustainable business model with a special regard to bringing eco-friendly mobility services. The role of digital technologies in promoting sustainability would be highly promising to prevent mobility industries from contaminating the environment because eco-inefficient business models have majorly contributed to climate change and carbon emissions [4]. Hence, the research would be conducted with a focus on stimulating sustainability in the transportation system with a sprinkle of digitization to overcome the environmental hazards stemming from unsustainable mobility.

3. Expected results

The *World Summit for Sustainable Development (WSSD)* held in Johannesburg in 2002 states that sustainable development is built on three interdependent and mutually reinforcing pillars — economic development, social development and environmental protection [5]. So are the following research objectives.

- ➢ Advancement of sustainability in mobility services lifetime. It would sustain greenhouse gas concentrations between 350 ppm and 400 ppm (A global standard for allowable emissions) and vehicle noise pollution index below maximum safe level of 70 dB(A) (Qing Li, Fengxiang Qiao, and Lei Yu, 2016).
- ➢ Development of sustainable energy security keeping in check the ecological footprint of fuel. It would ensure the usage of renewable energy resources in the mobility sector [6].
- ➢ Determination of a sustainability pledge between public and private mobility service providers to reap maximum benefits of mixed efficient environmental collaboration.
- ➢ Achievement of better quality of life by sustainably optimizing the transport supply chain. Creating a sustainable transport waste management system and improved road safety conditions.

4. The state of the art

The concept of digital technologies in sustainable mobility provides an enabling ground for the transport enterprises to digitally green the service delivery procedures. It would generate unprecedented gains in resource conservation, goods delivery risk reduction, economic growth, employability, innovative market emergence and social inclusion. Keeping this objective in view, many researchers have come up with different solutions. A novel sustainable mobility model called “digital sustainable entrepreneurial mobility” (DSEM) has transpired (Guangping Xu, Guangyuan Hou and Jinshan Zhang, 2022). Directing to put in place a DSEM model oriented on digital capability and digital innovation orientation,it defined how digital capability could be

enhanced to foster digital sustainable entrepreneurship in mobility in order to ascertain the creation of social and environmental effectiveness. However, the model could not comprehensively target the environmental repercussions resulting from unsustainable use of sophisticated technologies. The research limitations were unavoidable, grounded in unacceptable concentration of carbon dioxide and other harmful gases in production houses, making it susceptible to further research questions. In addition, a groundbreaking research solution also came to view named "Alpha Model" which identified the risk factors attached with the DSEM business model (Gianmarco Bressanellia, Federico Adrodegaria, Marco Peronaa and Nicola Saccania, 2019). Given the innovative nature of the Alpha business model, an ample set of tested propositions has been mentioned encompassing how internal and external agents sway the process of sustainable transformation. It has put forward greenhouse gas tracking, monitoring sustainability criteria through digitization and ecological restoration community drive. On the flip side, unprecedented negative impacts of this research solution including financial burden, operational risks, cannibalization and return flow uncertainties emerged. Moreover, Dale Stoel and Muhanna (2009) have shown in their research the association of digital capabilities and mobility efficiency, substantiating that the outer domain has an insight into the sustainable significance of mobility service in respect with technological capability that relies upon the transportation, the specification where all industries are in an array of competitive edge. Nevertheless, the disadvantages of the model under discussion revolve around capital inability, surplus resource deficiency and unsustainable supply chain process in carrying goods and people.

Therefore, the aspiring research model aims at the neglected dimensions of sustainable mobility. The research barriers declared in the literature have set the stage for our research interest. So, this research would overly shed light on sustainability. The focused areas of the proposed business model would be mobility supply chain, eradication of unsustainable designs, green use of digital technology and sustainable maintenance of processed residues. Sustainable technologies such as smart cities and vehicles support car-sharing, ride-hailing, carpooling, predictive maintenance, real-time information systems and optimized roadway utilization. It is crucial for the accomplishment of SDG 7 on energy. Similarly, transportation is consequential to achieving SDG 9 (building resilient infrastructure) and SDG 11 which pertains to building sustainable cities and communities, realized through improvements in road safety and by expanding public transportation (Mahmoud Mohieldin and Nancy Vandycke 2017) [7]. These developments facilitate innovative technologies with a greater adherence to the global promise of collectively achieving a climate-resilient world. We therefore predict:

- ***Hypothesis (H1):*** Sustainable mobility business model based on innovative technologies would be associated with revamping of the transportation system.

  Sustainable Development is often regarded as the criteria for inclusive advancement. However, sophisticated technologies can play a major role in launching such digitally-enhanced solutions which can bring to light the ideals of sustainable mobility.

- ***Hypothesis (H2):*** The proposed solution would comply with the digital perspective of sustainable development.
- ***Hypothesis (H3):*** The devised digital sustainable mobility business model would enhance the value proposition, revenue model and operating capacity of the transportation system.
- ***Hypothesis (H4):*** The proposed research solution would ensure low carbon emissions and toxins.
- ***Hypothesis (H5):*** The stakeholders would professionally be obliged to shun an unsustainable business model.
- ***Hypothesis (H6):*** The particulars of a circular economy integrated with digital technology determine the environmental, socio-economic benefits.

4.1. Research Method

A. *Sample and Data Collection*

We would conduct a cross-sectional test on the theoretical model with a questionnaire interview survey of prominent mobility service providers at the local landscape. A ”mobility service provider” is defined as a transport system, which is administered by a chain of employees including executives, middle management and lower management. Expanding it over, the mobility system also keeps the external agents under check such as regulatory compliance, standardized logistics, peripheral equipment, buffer zones, terminal operation and urban designs. The research would focus on exposing the demerits of traditional activities that lead to production of solid waste and environmentally hazardous material. The abominable challenges in the way of circular economy would also be examined in this phase. Making it a promising measure to better the structural woes as well as economic decline. A qualitative analysis of the questionnaire would be carried out to bring to fore the strengths, weaknesses, opportunities and threats of environmental footprint of the mobility sector.

Afterwards, a case study aiming to address how absence or lack of digital technologies in the transportation gives birth to unsustainable mobility would be analytically established. We would also take into consideration the sampling of those mobility systems which are being deployed with great ease within other countries. This multi-dimensional and cross-cultural analysis would broaden the research sampling. In spotlighting the environment-degrading transport system, a hybrid research model based on the technicalities of both quantitative and qualitative methods would be implemented. The data acquisition in this regard necessitates a structured dataset to construct a study [8]. During sampling, a statistical approach would be determined for identifying the target population and collecting the data. All data would be collected by means of a closed-format interview questionnaire, which would also ground in some open-ended questions.Thus, the interview records would then be assembled prior to comprehensive analysis.

B. *Questionnaire Design*

The questionnaire would briefly comprise five sections: (1) A comprehensive study on sustainable mobility ; (2) A detailed account of activities involved in transportation; (3) Sustainable digital technologies and their usability; (4) sustainability performance; and (5) Rethinking an organizational overhaul based on reducing carbon footprint. These parameters would be essentially considered to capture necessary qualitative constructs while shedding light on the distinctive research variables.

I. Control Variables

The main control variables included in the questionnaire would be following:

- ➢ Most frequently used method of delivering transport service (question: 'What business model does your organization work on?')
- ➢ The environmental impact of the unsustainable mobility sector
- ➢ The worthiness of digital technology in driving a sustainable transport system

II. Independent Variables

The key independent variables in the questionnaire would be:

- ➢ Reliance on digital technologies for the green economy,
- ➢ Application of digital technologies in the firm's business model
- ➢ Digitized eco-friendly business model experimentation.

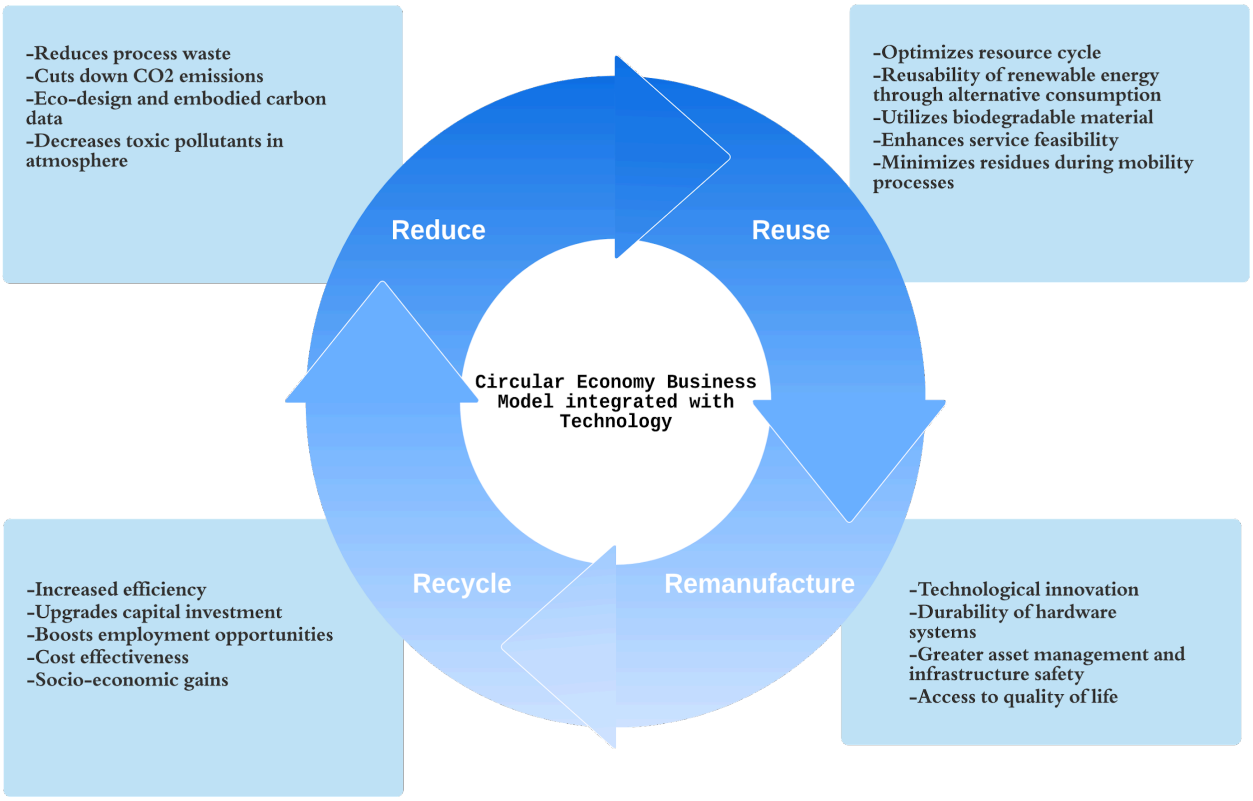
III. Business model experimentation and outcome Variables

We would assess two test cases of performance variables in the study: sustainability performance and digital business model performance. The first test case of outcome variables would measure the sustainability performance and would seek to encapsulate any upshots of firm-level digitalization on sustainable performance in figuring out the better outcomes of a business model driven by sustainability. The second test case of outcome variables would be centered on the digital business model performance and would pursue any consequence of digitalization and business model experimentation for three dimensions of transport sustainability: environmental sustainability, social sustainability, and stakeholder welfare.

5. Articulation and implementation

The concern of tackling the spectre of climate change is gaining momentum worldwide. Global leaders have moved several commitments and pledges in order to cap the scourge of climate catastrophe. Many landmark environmental accords include Paris Agreement, UN Framework Convention on Climate Change (UNFCCC), Kyoto Protocol(Lindsay Maizland, 2022). This research proposal intends to bring state-of-the-art business models to expand the desirable concept of sustainability in mobility services across the world. A Circular Economy Business Model integrated with digital technology would be highly effective in kick-starting a new drive of social and economic change.Firstly, a comprehensive account of the environmental benefits of the said business model incorporates ecological restoration, usage of renewable energy resources and resource use efficiency [9]. Henceforth, social advantage resulting from the proposed research solution would be manifold. Paving the way for improved quality of life through

reduced air and noise pollution, job opportunities, public-private partnerships, surplus private investment into local infrastructure of mobility.



Apart from this, economic welfare coming from the model can not be unnoticed owing to its possible reconstruction of the technological sector as well as minimized wastage of potential natural and artificial assets thus curtailing the cost of the rapid growth of solid and e-waste. This articulation of the research proposal defines how the proposed research solution would not only grapple with the unsustainable mobility sector but would also have positive effects rippling throughout other mandatory sectors such as societal setup, finance and technology [10].

A. Implementation model

Centering on the implementation literature, we would take on a staged implementation timeframe scheme underscoring sustainability in transportation approximately fixing a timeframe of 3 years. We prioritized our outlook on the Active Implementation Framework(AIF) (Blase & Fixsen, 2013; Fixsen, Blase, Naoom, & Duda, 2013) due to its wide-ranging implementability for sustainable solutions and therefore equally integrates digital technology into a circular economy based sustainable transport model [11].

- ***Exploration of sustainable mobility model and its key functional areas:***

  This stage encompasses triggering an environmental protection drive within the mobility sector. The constructive role of media, pressure groups and lobbying can be of immense help in this regard. This broad-visioned awareness campaign would be instrumental in taking the issue to governmental agenda. An additional

but necessary feature of this stage is to accommodate the technological competence that would be integrated in the proposed model. It is going to be as much a telling move to inculcate a sense of ecological responsibility.

- ***Installation of the green ideology of circular economy coupled with digitization:***
  A clearly carved-out business model that emphasizes on the core values of recycling, remanufacturing, refurbishing and reusing of equipment and mobility apparatus. Majorly focusing on operational strategy, manpower, technical training and evaluation criterion. Primary actions involving the key process of implementing digital sustainability in the mobility paradigm.

- ***Initial Implementation:***
  It would be a sort of partial implementation thus the proposed business model would be operationalized. The mobility enterprise would then be able to figure out sustainability, to gather across-the-board feedback to introduce improvements in an effort to overcome limitations, and a professional vow to continuous sustainable betterment.
- ***Full Implementation:***
  This consequential stage takes into consideration the overall implementation of the green mobility model oriented towards digitally sustainable development of transportation. The proposed business model would become the substantial method of functional principle in mobility services whereby professionals and stakeholders would regularly be expected to practice sustainable services.

B. Implementation timeframe

Timespan	Milestone	Description
April 2023-July 2023	Foundational research work	First quadmester details preliminary activities such as concept building and area of interests
	Identification of key concepts	
	Determination of research metrics	
August 2023-Nov 2023	Literature Review	Second quadmester deals with related work and specifying research questions
	Setting Hypothesis	

Dec 2023- Mar 2024	Setting Hypothesis	Third quadmester remains same for hypothesis but overly focuses on methodological perspective of defining population and sample
	Data Collection	
	Sampling	
April 2024-July 2024	Data Collection	Fourth quadmester determines the structure of questionnaire and the nature of variables as a parametric configuration
	Sampling	
	Questionnaire Design	
	Defining key variables	
August 2024-Nov 2024	Conducting Questionnaire	Fifth quadmester relates to holding surveys and drawing conclusions from the surveyed data
	Inferential analysis	
Dec 2024- Mar 2025	Inferential analysis	Besides carrying out the last milestone of fifth quadmester,sixth quadmester takes on the execution of the AIF implementation model
	Implementation of solution	
April 2025-July 2025	Implementation of solution	Seventh quadmester draws on the evaluation of implementation results and information aggregation
	Criteria assessment analysis	
	Compilation of final results	
August 2025-Nov 2025	Research paper writing Proposal defense	Eighth quadmester delineates academic write-up of research and a strong argumentative basis
Dec 2025- Mar 2026	Research paper publication Thesis submission	Ninth quadmester determines research acceptance and submission

6. Outline of the criteria to be used to assess the findings

The following points make up a standard outline for assessing the research findings:

- Assess to which degree the achievement of sustainability in mobility has been made.
- Examine the effectiveness of digital technologies stating how efficiently those technologies have been merged with the sustainable model.

- Analyze the execution of a digitally-enhanced green circular economic paradigm keeping in view usability performance, social viability, ecological conservation, financial efficacy, digital prowess and comparative analysis of the difference between previous business model and the proposed sustainable one.

Sustainable Circular Economy Business Model integrated with Technology		
Assessment Criteria		
Environmental metrics		
Parameter	**Description**	**Score**
1-Sustainability	Has the proposed model achieved sustainability?	
2-Mobility Waste	Has the proposed model ensured sustainable disposal of generated solid waste?	
3-Ecological footprint	Has the proposed model demanded less ecological values?	
4-Carbon emissions	Has the proposed model kept the CO_2 emissions below 400ppm?	
5-Resource utilization	Has the proposed model utilized resources in a sustainable manner?	
Economic metrics		
1-Service cost effectiveness	Has the proposed model provided efficient and cost-effective service ensuring sustainability?	
2-Sustainable business processes	Has the proposed model modeled sustainable production and distribution?	
3-Hybridization of mobility sector	Has the proposed model fostered public-private partnerships facilitating sustainable finance?	
4-Sustainable manufacturing	Has the proposed model executed recycling, remanufacturing and refurbishing to transform unsustainable patterns?	
Social metrics		
1-Reduction in environmental pollution	Has the proposed model reduced ecological pollution to a possibly lower level?	
2-Road safety	Has the proposed model ensured road safety for passengers and workers?	

3-Quality of life	Has the proposed model elevated the quality of life in a sustainable way?	

Note: Score will be available in the particular phase

References

[1] Bai H (2021) Role of Digital Technology in Transforming Organizational Competencies Influencing Green Economy: Moderating Role of Product Knowledge Hiding. Front. Psychol. 12:792550. doi: 10.3389/fpsyg.2021.792550.

[2] Kahrovic, Ernad & Avdović, Atif. (2021). Impact of Digital Technologies on Business Performance in Serbia. Management:Journal of Sustainable Business and Management Solutions in Emerging Economies. 10.7595/management.fon.2021.0039.

[3] Bai, Haoran, Role of Digital Technology in Transforming Organizational Competencies Influencing Green Economy: Moderating Role of Product Knowledge Hiding, Frontiers in Psychology, 12, 2021, https://www.frontiersin.org/articles/10.3389/fpsyg.2021.792550}, DOI 10.3389/fpsyg.2021.792550, ISSN 1664-1078.

[4] Łobejko, S.; Bartczak, K. The Role of Digital Technology Platforms in the Context of Changes in Consumption and Production Patterns. Sustainability 2021, 13, 8294. https://doi.org/10.3390/su13158294.

[5] Klarin, Tomislav. (2018). The Concept of Sustainable Development: From its Beginning to the Contemporary Issues. Zagreb International Review of Economics and Business. 21. 67-94. 10.2478/zireb-2018-0005.

[6] Gregori, Patrick & Holzmann, Patrick. (2020). Digital sustainable entrepreneurship: A business model perspective on embedding digital technologies for social and environmental value creation. Journal of Cleaner Production. 272. 122817. 10.1016/j.jclepro.2020.122817.

[7] Xu, G.; Hou, G.; Zhang, J. Digital Sustainable Entrepreneurship: A Digital Capability Perspective through Digital Innovation Orientation for Social and Environmental Value Creation. Sustainability 2022, 14, 11222. https://doi.org/10.3390/su141811222.

[8] Bressanelli, Gianmarco & Adrodegari, Federico & Perona, Marco & Saccani, Nicola. (2018). The role of digital technologies to overcome Circular Economy challenges in PSS Business Models: an exploratory case study. Procedia CIRP. 73. 216-221. 10.1016/j.procir.2018.03.322.

[9] Dinusha Maduwanthi Rathnayake, Teresa Roca, The Emergence of Technopreneurship for Sustainable and Ethical Economic Growth: Theory, Research and Practice, Integrated Business Models in the Digital Age, 10.1007/978-3-030-97877-8, (467-535), (2022).

[10] Martin-Rios, C.; Hofmann, A.; Mackenzie, N. Sustainability□Oriented Innovations in Food Waste Management Technology. Sustainability 2021, 13, 210. https://doi.org/10.3390/su13010210.

[11] Irwan Trinugroho, Putra Pamungkas, Jamal Wiwoho, Sylviana Maya Damayanti, Teddie Pramono, Adoption of digital technologies for micro and small business in Indonesia, Finance Research Letters, Volume 45, 2022, 102156, ISSN 1544-6123, https://doi.org/10.1016/j.frl.2021.102156.