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PHD STUDENT FORUM: ONGOING DOCTORAL RESEARCH ON DESIGN FOR SUSTAINABILITY

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ABSTRACT

This paper results from a survey carried out within LeNS (Learning Network on Sustainability) to map the ongoing Ph.D. research on Design for Sustainability (DfS). This is a global effort with a collective of doctoral candidates from different regions of the world and includes institutions from South America, Africa, Europe, China, India and Oceania. The aim of the research was to support early career researchers working on DfS by providing them an overview of the main ongoing doctoral research themes in the LeNS-affiliated universities and potential zones to foster future efforts and collaboration towards sustainability at the global level.

KEY WORDS

Design for Sustainability (DfS); Doctoral research; Sustainable design education; Network; Collaboration.

1. INTRODUCTION

Design research plays a crucial role in addressing the societal challenges towards sustainability. It covers different levels of innovation, and it is also mainly characterized by making interdisciplinary collaboration between design and other areas of expertise (CESCHIN and GAZIULUSOY, 2020). Design for Sustainability (DfS) has been significantly developed by research with approaches, methods and tools in the last 30 years and is still evolving. In line with the global agenda managed by the United Nations, it tackles social, environmental and economic issues that have to be managed locally and globally by all nations (BHAMRA and HERNANDEZ, 2021). According to Vezzoli and Ceschin (2011), DfS is a relatively recent field and a key issue for researchers, teachers and students (in industrialized, emerging and low income contexts) is to find the most effective way to access the most updated knowledge and advancements.

From this context, this study was supported by the International Learning Network on Sustainability (LeNS), which since 2015, involves universities from all over the world (Figure 1), aiming at the promotion of a new generation of designers (and design educators) capable of effectively contribute to the transition towards a sustainable society for all. According to LeNS (2021), it is essential for a design research community to enable and activate open knowledge and learning opportunities.



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The **social** dimension of sustainability promotes a society with more social cohesion and equity, ensuring all human rights. Design challenges in this dimension includes topics such as public policies, corporate social responsibility, base of the pyramid initiatives, social business, product+service systems, distributed economy, social innovation, creative communities and new lifestyles (SANTOS *et al.*, 2019).

At last, the **economic** dimension of sustainability deals with new economic paradigms in contrast to conventional models and is guided by values such as solidarity, ethical and fairness. It promotes models based on cooperation and distributed/small scale systems. Typically, economic sustainability is less approached in DfS in relation to social and environmental. Design challenges in this dimension includes topics such as business-economic-political models, consumption culture and organizational culture (SANTOS *et al.*, 2019).

2.2. Design for Sustainability

Based on the framework proposed by Ceschin and Gazioulosoy (2020), DfS main approaches are encapsulate in eleven categories including: from **Green Design**, **Product Ecodesign**, **Biomimicry**, **Cradle-to-cradle Design**, **Product-Service System (PSS) Design**, **Emotionally Durable Design**, **Design for Sustainable Behaviour (DfSB)**, **Design for the base of the pyramid (DfBoP)**, **Design for Social Innovation (DfSI)**, **Systemic Design** and **Design for Sustainability Transitions (DfST)**.

The framework locates the DfS approaches according to distinct innovation levels, implying that design can contribute in different scales of intervention for sustainability challenges. The levels are: **material/component level** - aimed at developing new or replacing materials; **product level** - aimed at improving existing or developing new products by considering the whole life cycle; **product-service system level** - the focus goes beyond individual products towards integrated combinations of products, services, stakeholder value chains and business models; **spatio-social level** - the focus is human settlements and conditions of communities from neighborhoods to cities; **socio-technical system level** - focus on promoting radical changes in how societal needs (such as nutrition and mobility) are fulfilled and thus focus on supporting transitions to new socio-technical systems; **socio-technical-ecological systems level** - an earthcentric focus on ongoing transitions as well as on post-transition contexts, considering not only existing humans but also non-humans and future generations.

3. METHOD AND DEVELOPMENT STRATEGY

A list of contacts of professors and lecturers affiliated with the LeNS Network worldwide was acquired by the authors by the end of May 2021. The contacts, already grouped according to their country and respective continents, were assigned to a particular PhD student in charge of a particular region or continent. For instance, a PhD student in charge of Oceania was responsible for reaching out to the contacts in universities across Australia and New Zealand.

An invitation to participate was sent via email to the contacts. It was explained on the invitation that the study intended to map any ongoing doctoral research around the world which are related to the topic of Design for Sustainability (DfS). It also described that the study was a global initiative and collaboration of PhD students from different parts of the globe under the supervision of the LeNS network. The purpose of the study was elaborated and a link to the survey was included. The expectation was that the contacts would inform the doctoral students they are currently supervising about the survey and then the students could fill the online survey themselves. If the contacts have no current doctoral students researching within the field of Design for Sustainability, they were kindly asked to forward the invitation to any other professor or lecturer in their department or university who might have any students researching a topic related to the DfS field.

The method of data collection was an online survey, using GoogleForms. The data collected in the survey included participant's name, supervisors, department, host institution, stage of research, working or tentative title of doctoral

research, brief description of doctoral research, and keywords of their research. Participants were also asked to choose which Sustainable Development Goals they suspect that their research would have the highest impacts on. Invitations to participate were sent mid-July and the survey was closed at the end of August 2021.

The data was then individually analyzed according to their region or continent by the respective PhD student who identified a number of different statistics from the data collected, such as the country with the most number of DfS research in a particular region and which SDGs are most research addressing. Keywords collected from the data were then used to identify themes and emphasis regionally as well as at a global level. At last, a cross-analysis between the regional results was conducted to identify global emphasis and opportunities, in respect to DfS innovation level, DfS approaches, research topics in evidence and potential impact for SDG.

4. RESULTS AND ANALYSIS

We received responses from 61 doctoral students from 39 universities. Figure 2 shows the global map of contributing respondents.



Figure 2: Map of ongoing doctoral research on Design for Sustainability. SOURCE: the authors.

At the global level, most survey responses came from South America with 31 responses. Responses from South America are distributed among 12 higher education institutions (HEIs) which surpass other regions. In regard to specific countries, responses received from Brazil are distributed among a higher number of universities with 7. In regard to HEIs, most responses came from Indian Institute of Technology Guwahati (IIT Guwahati) and the Federal University of Santa Catarina (UFSC) (IIT Guwahati: 8, UFSC: 7).

Regarding the design intervention focus, a consolidated view of the DfS ongoing doctoral research by region, is shown in Figure 3. The PhD students' researches were classified according to the identified DfS innovation level framework proposed by Ceschin and Gazioulosoy (2020).

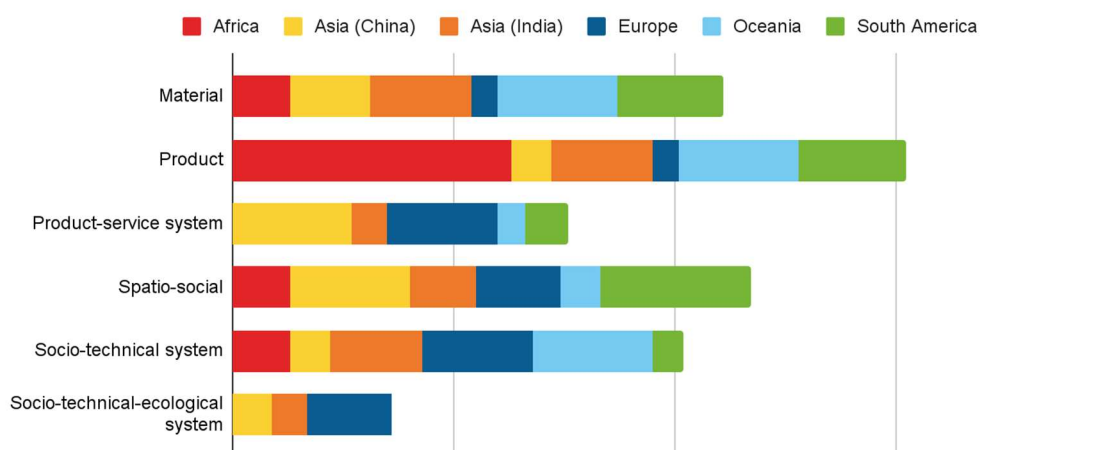


Figure 3: DfS innovation level distribution for ongoing doctoral research by region of LeNS affiliated HEIs respondents.
SOURCE: the authors.

Spatio-social, products, material-components, and socio-technical system levels emerged with the higher numbers from the responses in the analyzed data and also, are approached by all regions participating in this survey. Except for Africa responses that have a research emphasis on product-level, the other regions appear to have a distribution of doctoral research along the different levels. Product-service system level is mostly addressed from Asia-China and Europe responses. Spatio-social level is more present in responses from South America. Although responses from all regions approach the socio-technical system level, Europe, Asia-India and Oceania have most of the responses.

The overall scope of design intervention from the responses ranges from insular to systemic interventions, with the higher number of responses addressing systemic levels for sustainability innovation. The recently non-anthropocentric level, socio-technical-ecological system is the one with the least responses from this survey.

Additionally, a consolidated view of the DfS approaches identified from the ongoing doctoral research by region is shown in Figure 4.

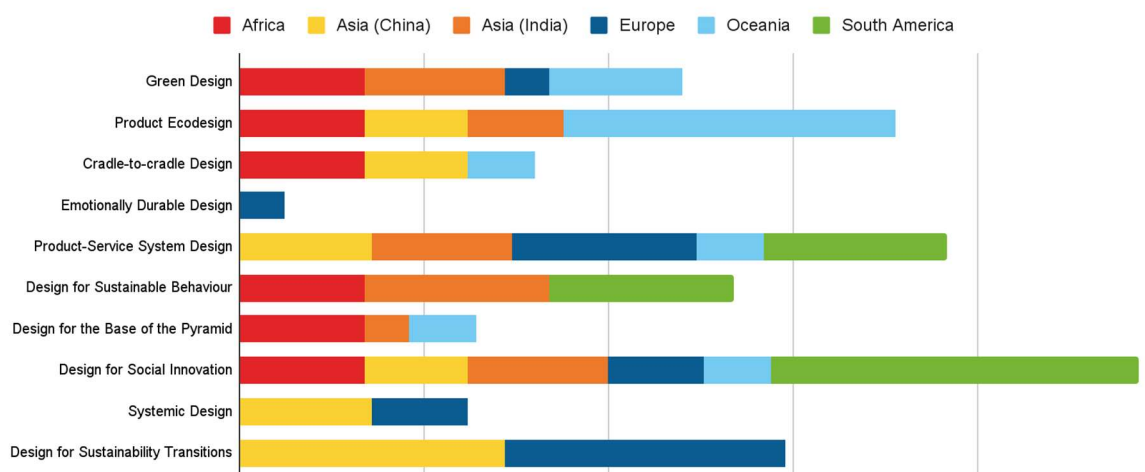


Figure 4: Distribution of DfS approaches employed on doctoral research by region of LeNS affiliated HEIs respondents.
SOURCE: the authors.

The DfS approaches identified are in line with the results for the innovation level, with a higher number of responses addressing systemic Design for Sustainability approaches. Design for Social Innovation emerges as the approach that dialogs with most of the responses from ongoing doctoral research, especially from South America. Product-Service System Design is the second approach with a higher number of responses in total. Next, Design for Sustainability Transitions appears in third place, with responses from only two countries, Asia-China and Europe. Oceania responses are mainly characterized by Product Ecodesign and Green Design, and Africa responses don't emphasize a specific approach. At last, Emotionally Durable Design and Design for the Base of the Pyramid are the approaches with the least number of responses.

Besides a DfS theoretical and practical perspective, from the results emerged main themes being addressed by the doctoral researchers. A classification representing the thematic clusters that emerged from the responses is shown in Figure 5.

Design Field	<i>User-centered Design</i> <i>Participatory Design</i> <i>Creative Process</i>	<i>Eco-Design</i> <i>Regenerative Design</i> <i>Life Cycle Design</i> <i>Data-driven Design</i> <i>Transparency Design</i>	<i>Design Toolkit Development</i> <i>Environment Quality Evaluation Tool</i> <i>Life Cycle Assessment Tool</i>
Communities and Culture	<i>Cultural/behavioral practices</i> <i>Heritage Conservation</i> <i>Artisans and cultural resilience</i>	<i>Regional Collaboration</i> <i>Social Cooperation (community-led sustainability transitions initiatives)</i> <i>Sustainable Livelihoods</i>	<i>Marine Culture Industry</i> <i>Glocal innovation</i> <i>Living Standard Profiling</i>
Fashion Sector	<i>Sustainable Fashion Production</i> <i>Circular Textile value chain</i> <i>Future of work in fashion</i>	<i>Apparel Sustainability</i> <i>Knitwear Manufacturing</i> <i>Textile Design and Production Practices</i>	<i>CAD systems in Fashion Design</i> <i>Sizing and Fit for Fashion Design</i>
Healthcare Sector	<i>Mental health</i> <i>Aging mental healthcare</i>	<i>Safety and health</i> <i>Health and hygiene</i>	<i>Life-enabling healing bio-based materials</i> <i>Smart and life-saving furniture</i>
Waste and Circularity	<i>Waste Management</i> <i>Waste and circular economy</i>	<i>Zero waste City</i> <i>Stakeholder trust-building</i>	<i>Use sharing</i> <i>Make, test and repair</i>
Food Sector	<i>Fresh Food Products</i> <i>Familiar Agriculture</i>	<i>Water-Energy-Food Nexus</i> <i>Food waste</i>	

Figure 5: Classification of main themes being addressed by the ongoing DfS doctoral research. SOURCE: the authors.

The first thematic cluster with a higher number of responses from all regions participating in this survey, is mainly characterized by DfS doctoral research encompassing knowledge or know-how for the Design field, including design processes/practices and tools. Regarding potential synergies on this cluster, Oceania and Europe are exploring Design for Life Cycle, while Asia-India and Europe are both exploring Participatory Design.

The second main thematic cluster is mainly characterized by DfS doctoral research responses encompassing Communities and Cultural issues and practices. Regarding potential synergies on this cluster, Europe and Asia-China are both studying Marine Culture and Collaboration, Asia-India and South America are both studying Cultural Heritage, while South America and Africa are both studying Local Artisan.

The third thematic cluster is mainly characterized by DfS doctoral research responses oriented to the Fashion Sector, with an emphasis on Textile related studies. Regarding potential synergies on this cluster, Oceania and Africa are both studying different Textiles manufacturing, while Africa, Europe and South America are studying the Fashion Chain/Industry.

Next, it is worth highlighting the Healthcare Sector cluster, with potential synergies between Asia-China and South America on Mental Health. The Waste and Circularity cluster, with potential synergies between Asia-China, Oceania and South America on Waste Management and Circular Economy with focus on cities. The Food Sector cluster, with potential synergies between Oceania and South America on Food Production. Cities, Energy, Natural Materials and Design for Sustainability Education are other clusters that emerged from the responses, but with less emphasis and synergies between the analyzed regions.

At last, a consolidated view of the potentially impacted Sustainable Development Goals (SDG) by the responses from the ongoing DfS doctoral research, is shown in Figure 6.

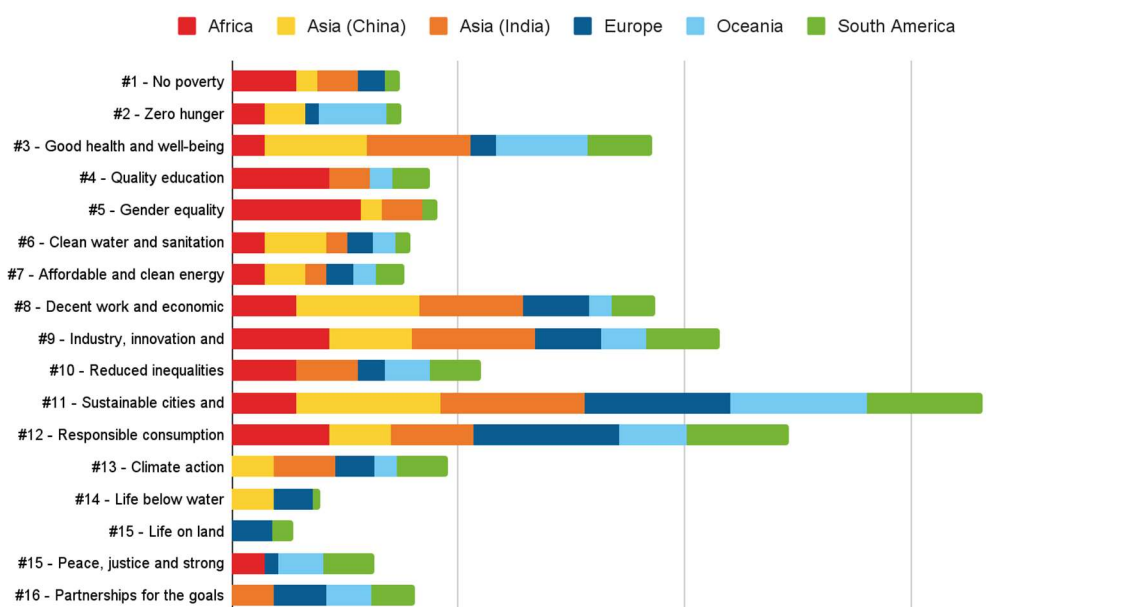


Figure 6: SDG priority from DfS ongoing doctoral research by region by region of LeNS affiliated HEIs. SOURCE: the authors.

'Sustainable cities and communities', followed by 'Responsible consumption and production' are the SDGs with a higher number of responses as potential doctoral research impact on sustainability, especially for South America and Europe. This dialogs with some of the main thematic clusters identified in the survey, regarding SDG11 with 'Communities and Culture', and for SDG12 with the themes 'Fashion Sector', 'Food Sector' and 'Waste and Circularity'. Thus, these ongoing DfS PhD researches have a potential contribution to global challenges in facing unsustainable ways of living and unsustainable use of natural resources impacts on our planet (UN, 2021). Additionally, Industry, innovation and infrastructure also emerged from South America, Asia-india and Africa responses. Good health and well-being for South America, Asia (China and India) and Oceania. Decent work and economic growth for Asia (China and India) and Europe.

Next, a summary of the results for each region is provided:

4.1. Africa

Currently, African universities engaged in PhD research on Design for Sustainability are Kwame Nkrumah University of Science and Technology, Kumasi, Ghana; University of Nairobi and Maseno University both of Kenya; Namibia University of Science and Technology, Namibia; and Stellenbosch University, South Africa. The countries with more research as far as DfS is concerned are Ghana and Kenya with 3 to 2 students respectively. The rest of the universities have 1 student each. The ongoing research is in 3 different stages, reflecting 3 in advanced stage (Ghana, Kenya and South Africa), 2 in developing stage (Ghana and Kenya) and 2 at the beginning stage (Ghana and Namibia). There are no identified dominant topics, however, DfS approaches as mentioned by PhD researchers are Design for Social Innovation in ongoing research in University of Kenya, Nairobi, and Cradle to Cradle (in reference to Circular Economy), in Kwame Nkrumah University of Science and Technology, Ghana. However Green design (Ghana), Product Eco-design (Ghana), and Design for Base of the Pyramid (Namibia), and Design for Social Behaviour (South Africa), were inferred from research descriptions provided by researchers in respective countries. DfS innovation levels identified are Material/Component with 1 research in Ghana, Product level 5; 3 and 2 from Ghana and Kenya respectively, Spatio-social identified in Namibia University of Science and Technology, and Social-technical in Stellenbosch University, South Africa. The dominating SDGs as distributed in ongoing research are Quality Education, Gender equality, Industry, Innovation and Infrastructure, and Responsible Consumption and Production. These are followed by No Poverty, Reduced Inequalities, Sustainable Cities and Communities, and Decent Work and Economic Growth. From the above it could be seen that DfS research in African Universities, as far as the LeNS Network is concerned, are few. However, there are myriad issues in African communities that can be seen through the lens of DfS. There is the need for African Universities to be actively engaged in DfS research as the continent is poised for Industrialization. The responses focuses on impacting the SDG4 - Quality education, SDG5 - Gender equality, SDG9 - Industry, innovation and infrastructure, and SDG12 - Responsible consumption and production.

4.2. Asia

4.2.1. China

In China, different researchers are interested in a wide range of topics. Although the concept of sustainable development has received widespread attention in China, there are not many doctoral students who take sustainability as a research direction. 11 Ph.D. candidates from 4 different universities are working on the fields of sustainability and participated in the survey. The majority of the candidates are from Academy of Arts & Design, Tsinghua University (4) and School of Design, Hunan University (4), which are also the main coordinators of LeNS. Another respondent from Wuhan University of Technology. Another college which does not belong to the LeNS family but has 2 Ph.D. candidates is research on sustainability, they come from Central Academy of Fine Arts (CAFA). We also try to get in touch with the LeNS network in China, which include Tongji University, Jiangnan University, Beijing Institute of Technology and Hong Kong Polytechnic University and so on. But no relevant feedback has been received yet. On the other hand, although many universities in China have design schools or design-related majors, there are still very few schools with design doctoral programs, this is also an important factor that limits the results of the survey.

The promotion and action of the LeNS series of projects in China has made the approach of product service system design widely used as one of the most important and important sustainable design research methods in China. The four Ph.Ds from Hunan University and Tsinghua University used the PSS method to varying degrees in their research; meanwhile, some of the research also involved approaches related to systematic design. In addition, a doctoral study on aging and two doctoral studies related to cultural industries also incorporate some approaches of social innovation design. In the survey, three doctoral students focused their research on products and materials. Their methods also focused on product and ecological design, and to a certain extent applied some methods from cradle-to-cradle design. Finally, we have also observed that with the guidance of China's sustainable transition related policies, many Ph.Ds have

added thoughts and explorations on complex systems and sustainable system transition in their research process. At the same time, the related research of futurology is receiving more and more attention. We believe that there will be doctoral research related to it in the near future. The responses focuses on impacting the SDG11 - Sustainable cities and communities, SDG8 - Decent work and economic growth, and SDG3 - Good health and well-being.

4.2.2. India

In India, there are currently eleven doctoral studies going across three institutes with most of them at a developing and advanced stages. Sustainable Cities and Communities, industry innovation and infrastructure are the SDG's in which most doctoral research in India is related to. The less mentioned SDG's are clean water and sanitation and affordable and clean energy. The research emphasis here is most towards design for sustainable behavior, and emerging to PSS Design, green design and design for social innovation. We can determine a research inclination towards urban context and product development.

4.3. Europe

17 Ph.D. candidates from 5 countries and 8 universities searching about DfS, attended the survey in total. The majority of the candidates are from Italy with different 4 Universities namely Politecnico di Milano which has the highest number of attendees in Italy with 4, University of Florence with 2, Politecnico di Torino with 2 and University of Camerino with 1 candidate. The rest of the countries are represented on the survey with one university for each. Namely, Istanbul Technical University from Turkey with 3, Leuphana University from Germany with 1, Aalto University from Finland with 4, Brunel University from England with 1 candidate. As we can see, among the countries, Italy has the highest number of candidates with a number of 9, however, no more than 2 candidates for each university. Therefore, among the universities in Europe Aalto university, Finland has the highest number of candidates with a number of 4.

As a wide range of different aspects of studies in Europe is seen, it is not easy to mention a distinctive recurring topic. However, material and social cooperation are repeatedly mentioned and can create little clusters, although they are still approached in totally different manners. The DfS innovation level of doctoral research in Europe, it is obvious that product and material level is not the focus and remarkably the smallest number of research with only 2 in total (1 for each) has been conducted on these levels. The rest of the research are on broader levels namely, Product-service system and Spatio-social innovation level with 4 studies each and followed by Socio-technical-ecological system and even the more recently mentioned earth-centric 'Socio-technical-ecological system' level with 3 studies each. Correspondingly, The DfS approaches in Europe, emphasized on 'Design for sustainability transitions' with remarkably the highest number of 6 studies among others followed by 'Product-Service System Design' with 4 studies. The rest of the approaches employed in only 1 or 2 studies each, while some of them have even no example. The responses focuses on impacting the SDG11 - Sustainable cities and communities, SDG12 - Responsible consumption and production, and SDG8 - Decent work and economic growth.

4.4. Oceania

In the Oceanic region, Australia has the most doctoral research in Design for Sustainability with six ongoing studies. However, the University of Canterbury in New Zealand hosts the highest number of research under one university with three. Most DfS research in the Oceanic region is at the developing stage. Sustainable Cities and Communities is an SDG which most doctoral research in Oceania relates to. Packaging, food, and waste are recurring topics observed across Oceania. The DfS innovation level of doctoral research in Oceania is emphasized on the material or component, product, and socio-technical. Most commonly used DfS approach employed in Oceanic research is Product Ecodesign, with five studies, followed by the green design approach which is used in two studies. The responses focuses on impacting the

SDG11 - Sustainable cities and communities, SDG3 - Good health and well-being, and SDG12 - Responsible consumption and production.

4.5. South America

In South America, 31 Ph.D. candidates from 11 different universities are working on the fields of sustainability and participated in the survey. Brazil and Colombia are the countries with the higher number of responses. However, Colombian researchers are more concentrated in conducting their PhD outside Colombia, in Universidad Politecnica Cataluña (Barcelona), Swinburne University of Technology (Melbourne) and Instituto Nacional de Salud Pública (Mexico). Brazilian main universities researching the theme are: Federal University of Santa Catarina (UFSC)(7), Federal University of Paraná (UFPR)(4), and Federal University of Pernambuco (UFPE)(4). Argentina has 2 PhD candidates that participated in the survey from Universidad Nacional de Mar del Plata, and Mexico with 2 PhD candidates from Universidad Autónoma Metropolitana (UAM).

The DfS innovation level of doctoral research in South America is emphasized on: a) material or component level with research exploring topics such as natural materials, building, bamboo, wood; b) spatio-social level with research topics such as sustainable community, disaster scenarios; and cultural heritage; c) product level with research topics such as electronic waste and clothing. Socio-technical system innovation is the level with the least number of studies and socio-technical-ecological systems level with zero. The DfS approaches emphasized in South America are Design for Social Innovation with 6 studies, followed by the Design for Sustainable Behaviour and Sustainable Product-Service Systems with 3 studies each. Doctoral research in South America emphasizes the Sustainable Development Goals: Sustainable cities and communities with 16 studies; Responsible consumption and production with 14; Industry, innovation and infrastructure with 10 studies and Good health and well-being with 9 studies.

5. CONCLUSION

This study presents a closer look of DfS doctoral research being conducted within the LeNS network across the globe. The collected research was consequently classified based on their DfS sustainability level and identified based on the DfS approach employed. By doing so, the study findings help foster better collaboration and synergy within the LeNS network as well as towards sustainability at the global level.

This study may have several limitations. First, the scope of this research is limited to the LeNS-affiliated universities. Moreover, this study was emphasized on the design field. The survey was dispersed only to design-related departments across the global LeNS network. Therefore, there might have been other ongoing research at other departments aside from the design department that focus on areas related Design for Sustainability (e.g., research on sustainable or eco-friendly material in the department of material science). The authors of the present article recognize that the collected data partially reflects the totality of ongoing doctoral research on the field.

This study was initiated by a small number of doctoral students across the globe under the guidance of the LeNS network. The initiative has produced concrete results and demonstrated a positive collaboration among its members. In the future, the PhD forum can be a suitable platform for doctoral students researching on the topic of design for sustainability as it would help bring forth synergy among the LeNS community in the pursuit of sustainability at a larger scope. Thus, we highly recommend the continuation of such a platform because it is paramount to maintain and grow this initiative network of doctoral students within the LeNS community. Quarterly presentations on working titles by early beginners of PhD research can be made to identify synergies and possible collaborations across continents. A repository can also be developed to gather current and subsequent themes to guide the selection of topics and directions. Regular meetings can be organized at the beginning of every term for the PhD candidates to interact, collaborate, feedback, help and also update each other. Ph.D. forum/Lens can be an intermediary to gather candidates

for this purpose. Additionally, a platform on the Slack app dedicated to sustainability researchers (which is a kind of more “official” WhatsApp based on mail addresses instead of mobile phones where people can connect, discuss, share and create different topics and rooms) can be utilized for open discussions at any time.

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ANNEX I - AFRICA

Country	University	Department	Ongoing research
Ghana	Kwame Nkrumah University of Science and Technology	Industrial Art	3
Kenya	University of Nairobi	School of Art and Design	1
	Maseno University	Art and Design	1
Namibia	Namibia University of Science and Technology	n/a	1
South Africa	Stellenbosch University	Visual Arts	1

Scope of African Universities from this study. SOURCE: the authors.

Country	University	Working Title
Ghana	Kwame Nkrumah University of Science and Technology	Sustainability Assessment of Design and Production Practices of Textiles Firms in Ghana.
		Assessment of CAD Systems in Fashion Design Studio in Ghana
		Integration of Sustainable Fashion Production in Ghanaian SMEs Through The Circular Economy Approach
Kenya	University of Nairobi, Nairobi	Social Design Approaches for Sustainable Livelihoods: A Case of Women in Craft in Kenya
	Maseno University, Kisumu	Assessing the Need for Sizing and Fit for Fashion Design Sustainability among the Youth in Kenya
Namibia	Namibia University of Science and Technology, Windhoek	Namibia Rural Communities Living Standard Profiling Using Images Pattern Recognition for Drought Relief Resources Allocation
South Africa	Stellenbosch University	Exploring Critical Citizenship and Decolonization as a Framework for Design Education in South Africa

Ongoing DfS Doctoral Research in Africa by university. SOURCE: the authors

ANNEX II - ASIA : CHINA

City	University	Department	Ongoing research
Beijing	Tsinghua University	Design	4
	Central Academy of Fine Arts	Design	2
Hunan	Hunan University	Design	4
Wuhan	Wuhan University of Technology	Design	1

Scope of China Universities from this study. SOURCE: the authors.

City	University	Themes/Topic
Beijing, China	Tsinghua University	Positive Ageing: A Study of Design Strategies and Approaches to Support Seniors to Realize Personal Values
	Tsinghua University	Sustainable Design from Nature
	Tsinghua University	Research on sustainable design methods and strategies based on circular economy
	Tsinghua University	Distributed System Design Research Towards Sustainability-Case studies of Water system
	CAFA	Sustainable Integrated Design Research
	CAFA	Art and Technology (Biological Art Research)
Hunan, China	Hunan University	Designing Sustainable Product-Service System applied to Distributed Water-Energy-Food Nexus : A scenario-based design
	Hunan University	Sustainable design related to the marine cultural industry
	Hunan University	Sustainable Product-Service System applied to Distributed Water-Energy-Food Nexus
	Hunan University	Research on the Grassland Cultural Ecosystem under the Regional Collaborative Innovation Network
Wuhan, China	Wuhan University of Technology	Sustainable Fashion System Design

Ongoing DfS Doctoral Research in China by university. SOURCE: the authors.

ANNEX III - ASIA : INDIA

City	University	Department	Ongoing research
Bangalore, Karnataka	CMR University	Architecture	1
Tiruchirappalli, Tamilnadu	National Institute of Technology	Architecture	2
Guwahati, Assam	Indian Institute of Technology	Design	8

Scope of Indian Universities from this study. SOURCE: the authors.

City	University	Working Title
Bangalore, Karnataka	CMR University	Foundation program in design education with sustainability perspectives
Tiruchirappalli, Tamilnadu	National Institute of Technology	Knowledge management framework for cultural values in heritage conservation: Tiruchirappalli City, India.
		Place Identity along highways: Location choice and visibility of identity landscape elements
Guwahati, Assam	Indian Institute of Technology	Development of indoor environment quality (IEQ) assessment tool.
		Development of socio-cultural framework focused on sustainable design assessment for the residential sector.
		Furniture Design through bamboo craftsmanship via principles of Eco-Design to complement transient nature of the Millennial generation
		Design strategies for unorganized retailers to compete with emerging markets of smart cities in India
		Crafts as functional and sustainable product generator for the Global market
		Supporting decision-making towards Sustainable Smart City Planning in North East, India
		Ergonomic Design interventions for ensuring OSH of the workers engaged in Floating Solar PV installation and maintenance and its link with sustainable development goals
		Frugal Design for Marginal Contexts: A Structured Approach and Design Toolkit

Ongoing DfS Doctoral Research in India by university. SOURCE: the authors.

ANNEX IV - EUROPE

City	University	Department	Ongoing research
Milano	Politecnico di Milano	Design	3
Torino	Politecnico di Torino	Architecture and Design	2
Macerata	University of Camerino	Architecture and Industrial Design	1
Florence	University of Florence	Architecture and Design	2

Scope of Italian Universities from this study. SOURCE: the authors.

City	University	Working Title
Milano	Politecnico di Milano	Design for sustainable furniture systems The theory and practice of furniture Life Cycle Design and Sustainable furniture Product-Service System design Social innovation; marine culture sustainable Healing Materialities from a Biodesign Perspective
Torino	Politecnico di Torino	Sustainable organizational model for social cooperative enterprise Systemic Design for a circular textile value chain
Macerata	University of Camerino	Sustainable Design of Life-Saving Products for Public and Private Indoor Environments
Florence	University of Florence	Design Together. Design as a strategic tool for the enhancement of cooperation, understood as a complex ecosystem activity of a socio-environmental and interspecies nature

Ongoing DFS Doctoral Research in Italy by university. SOURCE: the authors.

City	University	Department	Ongoing research
Espoo	Aalto University	Design	4

Scope of Finish Universities from this study. SOURCE: the authors.

City	University	Title
Espoo	Aalto University	Design as continuous repair Architect as 'Mediator': Socio-political roles in mediating the urban 'temporary use' of vacant spaces Co-Designing with Nature for Sustainability: A Conceptual and methodological Framework for nature-inclusive Collaborative and Participatory Design Design, learning and change in citizen-led sustainability transitions initiatives: an inquiry into the interactive learning processes and networks

Ongoing DFS Doctoral Research in Finland by university. SOURCE: the authors.

City	University	Department	Ongoing research
Istanbul	Istanbul Technical University	Industrial Design	3

Scope of Turkish Universities from this study. SOURCE: the authors.

City	University	Title
Istanbul	Istanbul Technical University	Multiperspective approach to use sharing systems in Turkey
		Cultural Evolution for Sustainability
		Mediation of design in the circular economy: Biowaste valorization

Ongoing DfS Doctoral Research in Turkey by university. SOURCE: the authors.

City	University	Department	Ongoing research
Lüneburg	Leuphana University	Sustainability Sciences	1

Scope of German Universities from this study. SOURCE: the authors.

City	University	Title
Lüneburg	Leuphana University	Four perspectives for sustainability transition in the lighting industry

Ongoing DfS Doctoral Research in Germany by university. SOURCE: the authors.

City	University	Department	Ongoing research
London	Brunel University London	Design	1

Scope of English Universities from this study. SOURCE: the authors.

City	University	Title
London	Brunel University London	Reduce the single-use plastic packaging

Ongoing DfS Doctoral Research in England by university. SOURCE: the authors.

ANNEX V - OCEANIA

City	University	Department	Ongoing research
Sydney	University of New South Wales	School of Built Environment	1
Melbourne	Royal Melbourne Institute of Technology (RMIT) University	Design	1
		Design and Social Context	1
	Swinburne University of Technology	School of Design	1
Canberra	University of Canberra	Industrial Design	2

Scope of Australian Universities from this study. SOURCE: the authors.

City	University	Working Title
Sydney	University of New South Wales	Implementing next generation indoor vertical farming for fresh food production inside the maximum-security Macquarie Correctional Centre
Melbourne	Royal Melbourne Institute of Technology (RMIT) University	Integrating Decision Support Tools into Organisations for Food Waste Strategies
		Improving Packaging so that Households Reduce Food Waste
	Swinburne University of Technology	Engaging in Sustainability Projects in Complex Systems: An Instrumental case Study in Colombia and the Role of Trust
Canberra	University of Canberra	New Design Standards for the Design of Food Preparation Tools and Artefacts, Appropriate for Older Persons with Arthritis of the Hands
		An Investigation into the Impacts of Product Design from a Social and Environmental Perspective

Ongoing DfS Doctoral Research in Australia by university. SOURCE: the authors.

City	University	Department	Ongoing research
Christchurch	University of Canterbury	School of Product Design	3
Auckland	Auckland University of Technology (AUT)	Design and Creative Technologies	1

Scope of New Zealand Universities from this study. SOURCE: the authors.

City	University	Title
Christchurch	University of Canterbury	Designing a Sustainable Product-Service System to Improve the Health and Hygiene of the Urban Poor in Jakarta Slums Utilizing the Human-Centered Design Methodology
		Sustainable Active Packaging for Fresh Food Products
		No Waste Design
Auckland	Auckland University of Technology (AUT)	Design Tool for Assessing the Environmental Sustainability of Knitted Apparel Products in New Zealand

Ongoing DfS Doctoral Research in New Zealand by university. SOURCE: the authors.

ANNEX VI - SOUTH AMERICA

City	University	Department	Ongoing research
Florianópolis	Federal University of Santa Catarina (UFSC)	Architecture and Urbanism	7
	Santa Catarina State University (UDESC)	Design	2
Curitiba	Federal University of Paraná (UFPR)	Design	4
	Positivo University	Environmental management	1
Recife	Federal University of Pernambuco (UFPE)	Design	4
Belo Horizonte	Federal University of Minas Gerais (UFMG)	Design, Architecture and Urbanism Technology	2
Porto Alegre	Unisinos University	Design	2

Scope of Brazilian Universities from this study. SOURCE: the authors.

City	University	Themes
Florianópolis	Federal University of Santa Catarina (UFSC)	<p>Predictive assessment of thermal comfort in office environments: highly glazed facades</p> <p>Construction with earth</p> <p>Construction with bamboo</p> <p>Construction with wood frames in Brazil</p> <p>Planned camps for humanitarian logistics</p> <p>Multi-criteria decision model for the design of temporary planned camps for disaster disaster scenarios</p> <p>Wall implanted with heat pipes (WIHP): a strategy of passive cooling for humid subtropical climate</p>
	Santa Catarina State University (UDESC)	<p>Semantic references from slow fashion vestuário objects, and aesthetic diretrizes for the designer creative process</p> <p>Design practice methodology regarding work from home considering emotional aspects.</p>
Curitiba	Federal University of Paraná (UFPR)	<p>The future of work in the sustainable fashion sector</p> <p>Data-driven design applied to design of meta-scenarios for sustainable behaviour</p> <p>Heuristic principles for a holistic approach in the creative process of Sustainable Products+Services System (SPSS)</p> <p>Design for transparency in sustainable services: a design toolkit</p>
	Positivo University	Design framework in conservation Units

Recife	Federal University of Pernambuco (UFPE)	<p>Application of Information Design and Educational Design in the formulation of a proposal for the improvement of teaching and learning experiences in the disciplines of Graphic Expression in the basic cycle of Engineering courses</p> <p>Proactive information strategies to support eating for older adults with mild dementia</p> <p>Social Innovation: the role of Strategic Design in the formulation of public policies aimed at non-semi-arid family agriculture in Pernambuco - Brazil.</p> <p>Collaborative design process with a musical community, taking into account its cultural context.</p>
Belo Horizonte	Federal University of Minas Gerais (UFMG)	<p>Empowerment and resilience of groups of artisans, through the knowledge manual: Case study of embroiderers from Barra Longa-MG</p> <p>Decision methods for sustainable design projects</p>
Porto Alegre	Unisinos University	<p>Value creation in social innovation: The power of creative ecosystems from the perspective of strategic design</p> <p>Strategic Design in the FabLabs's spaces</p>

Brazil Ongoing DfS Doctoral Research by university. SOURCE: the authors.

City	University	Department	Ongoing research
Bogotá	Instituto Nacional de Salud Pública	Salud Ambiental	1
	Universidad del Rosario	Law	1

Scope of Colombia Universities from this study. SOURCE: the authors.

City	University	Themes
Bogotá	Instituto Nacional de Salud Pública	Air pollution index proposal for Colombia
	Universidad del Rosario	Legal challenges for rural development integration under the sustainable development goals

Colombia Ongoing DfS Doctoral Research by university. SOURCE: the authors.

City	University	Department	Ongoing research
Barcelona	Universidad Politecnica Cataluña	Mechanical Engineering	1
		Tecnología de la arquitectura	1
Melbourne	Swinburne University of Technology	Design	1

Scope of International Colombian researchers from this study. SOURCE: the authors.

City	University	Themes
Barcelona	Universidad Politecnica Cataluña	Building sustainable communities from the CSR strategy
		High density net-zero: Life cycle analysis and renewable energies applied to collective housing in Colombia
Melbourne	Swinburne University of Technology	Engaging in sustainability projects in complex systems: an instrumental case study in Colombia and the role of trust

International Colombia Ongoing DfS Doctoral Research by university. SOURCE: the authors.

City	University	Department	Ongoing research
Mar del Plata	Universidad Nacional de Mar del Plata	FAUD - Instituto del Hábitat y el Ambiente	1
		FAUD - CIPAD	1

Scope of Argentina universities from this study. SOURCE: the authors.

City	University	Themes
Mar del Plata	Universidad Nacional de Mar del Plata	Valorization of electronic waste in the city of Mar del Plata: contributions for its sustainable management.
		Interdisciplinary methodology for the development of sustainable materials: focus on user experience.

Argentina ongoing DfS doctoral research by university. SOURCE: the authors.

City	University	Department	Ongoing research
Mexico City	Universidad Autónoma Metropolitana (UAM)	Science and Arts for Design	1
		Environment	1

Scope of Mexico universities from this study. SOURCE: the authors.

City	University	Themes
Mexico City	Universidad Autónoma Metropolitana (UAM)	Design of a multipurpose Robotic System: physical rehabilitation therapy.
		Community renewable energy: organization and financing management models for communities with renewable energy.

Mexico ongoing DfS doctoral research by university. SOURCE: the authors.