Ecosystem mapping technology to understand innovation challenges in MSME Sector: An analysis of the handicraft sector in Sri Lanka

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Abstract: **This paper discusses an application of ecosystem mapping technology to visualize the innovation ecosystem in the Micro, Small and Medium Enterprises (MSME) sector. Ideally, actors in the MSME sector should function as a system, exchanging knowledge, information and other resources, to uplift innovation and create economic value to a country or a region. Visualizing this system enables to understand the deficiencies in the exchange of resources among actors; the deficiencies, which makes innovation and growth challenging to MSMEs. Based on this idea, the study presented in this paper focuses on the handicrafts sector in Sri Lanka and attempt to map its ecosystem based on the manually collected publicly available data on social media. The subsequent analysis of the support ecosystem map reveals a major deficit in the exchange of information technology resources, which hinders the digital innovation and transformation of the MSMEs in the handicrafts sector. The paper further discusses the implications and future research directions.**

Keywords: Digital innovation, Ecosystem mapping, Handicrafts sector, Innovation ecosystem, Network visualization

I. INTRODUCTION

It is well accepted that visuals provide better and beautiful insights. In the big data world, visuals must go beyond merely being a conduit for information to offer some novelty: a fresh look at the data or a format that gives readers a spark of excitement and results in a new level of understanding [1]. Ecosystem maps are powerful and complex visual representations of actors in an ecosystem and their connectivity with other actors through the exchange of resources. They provide a novel and fresh view of the ecosystem, letting users excitedly see the unseen.

During the past couple of years, there seems to have an emerging interest among researchers to use ecosystem mapping technology to understand innovation ecosystems. Particularly in the domain of tech startups, some notable publications capture the key actors and their densities in the ecosystem, exploring opportunities for supporting the orchestration of innovation ecosystems [2]. Such studies are mostly supported by socially constructed data and provide system-level insights regarding the co-creation of value by the actors in the ecosystem. Moreover, such studies seem to have an immense potential to support policy-level decisions regarding national and regional innovation strategies.

This study is inspired by the increasing government sponsorship and the interference of various public and private sector institutions to foster innovation in Sri Lanka.

According to [3], the government has assigned high priority to the SME sector to strengthen the SME as the backbone of the economy and have taken steps to form an entrepreneurial development environment by introducing appropriate policy reforms and providing greater incentives for SMEs. Moreover, the country is orienting its economic growth model to be more open, private sector-led, knowledge-intensive, and focused on developing and exporting higher-value goods and services around the world [4].

However, in practice, it is observed a lack of proper coordination among institutions when it comes to innovation and entrepreneurship (I&E) related initiatives and activities. Furthermore, a notable priority is given to tech startups, especially by the software and business process management related institutions as well as academic entities. Moreover, it is not clear whether sufficient initiatives have been taken to empower MSMEs with technology. Especially, the adequacy of the transfer of information and communication technology-related capabilities is unclear despite its potential to digitally transform the MSME sector. According to [4], some of the key innovation and entrepreneurship challenges in Sri Lanka relevant for this study include;

● The SMEs exhibiting weak capabilities to adopt technology and to innovate

● An overall lack of coordination on I&E policies and programs and the low capacity of public agencies and officials to design, finance, implement and monitor such policies and programs

● Though pockets of research excellence exist, the public R&D system is fragmented and misaligned with the needs of enterprises and society and most institutions operate with little collaboration among themselves

Even though the priority given to tech startups is understandable amidst the need for enhancing technology-intensive exports, sustainable economic growth could be secured through the empowerment of MSMEs, which are mostly labor-intensive as of now. However, it is not clear at what level does that empowerment happen.

Ecosystem mapping could be a useful approach under these circumstances, in particular, to understand the lapses, misalignments, and imbalances in coordination, co-creation and resource exchange among ecosystem actors. Especially, the mapping of the innovation and entrepreneurship ecosystem in non-tech industries, in which the rural and

female communities are mostly engaged, is of paramount importance to devise sustainable policies and strategies to ensure competitiveness and economic growth. Therefore, this study mainly focuses on mapping the ecosystem of MSMEs of non-tech industries. This paper presents an initial structure of the ecosystem map of the handicrafts sector and some findings based on that. The subsequent chapters are organized as follows; Section II discusses the background and related work, Section III explains the research methodology, Section III presents the initial version of the innovation ecosystem map built, Section IV discusses the insights from the ecosystem map and Section V provides implications and concluding remarks.

II. BACKGROUND AND RELATED WORK

A. Network mapping and innovation ecosystems

Visualizing innovation networks is not a new idea. Over the years, researchers have used graphic depictions for the exploration and analysis of actors and their interactions with other actors in innovation networks. A notable introduction to the field is provided in [5], with the term 'network map', which is derived from the traditional sociogram and is designed to play a useful role in the portrayal and interpretation of innovation networks. According to [5], the network mapping approach exploits the visual capabilities of human cognition and the graphic proficiency of the personal computer, and hence, has the power to capture the diversity of actors, links and flows involved in the innovation process. [5] also introduces a set of conventions for network mapping and analysis.

Network mapping is a useful tool in the evaluation and timely monitoring of innovation activities. In other words, it provides a means of measuring innovation in an entrepreneurial ecosystem. The analog to the digital transformation taking place around the globe generate seas of socially constructed data, which can reveal previously unseen relationships between actors in innovation ecosystems. Based on this thinking, a novel approach to transform socially constructed data into useful visual indicators by the means of network maps is introduced in [6], which is named 'the process of data-driven innovation ecosystem analytics'. The data-driven innovation ecosystem analytics process guides the conversion of the row, socially constructed and open data into relational data tables, and thereby, the construction of visual structures and views. This approach enables the analysis of innovation ecosystems both qualitatively and quantitatively at different levels.

Extending on [6], [2] has discussed another important element in the study of innovation ecosystems, which is the *time*. The characteristics of innovation ecosystems such as the structural shape, number of actors and the density may change over time. Network mapping provides a powerful method to evaluate the changes over time visually. As quoted in [2], visualizations can reflect the structure of an innovation ecosystem at a single point in time, and they can also show the evolution of an ecosystem's actors and their relationships over time. The data-driven approach can construct visualizations of a particular innovation ecosystem at several points in time, enabling us to see the respective changes visually and more conveniently. Commercial websites such as www.startupblink.com have also taken initiatives to map startup ecosystems across the world enabling the 1) ranking of startup ecosystems around the world, 2) monitoring of their changes over time as well as 3) comparison of ecosystems against each other. As the collection of accurate data is challenging, they try to capture more accurate data through partnerships with local agents in each region of interest.

The adoption of ecosystem (network) mapping in the formulation of innovation and entrepreneurial policies and strategies is discussed in [7]. Most of the government and funding organizations currently have realized the limitations of formulating policies narrowly focusing on funding and training entrepreneurs; hence they focus more on the 'entrepreneurial ecosystems' at the national and regional level and develop broader policies and strategies. According to [7], the mapping ecosystem is an important strategic process in enabling entrepreneurial ecosystems. The other key strategic processes include; 1) favoring incumbents – i.e. currently existing dominant players – less, 2) listen to entrepreneurs, 3) think big, start small, move fast, 4) avoid artificially segmenting the community or strategies and 5) prepare to capitalize on crises.

B. Sri Lanka's innovation and startup ecosystem

A few notable policies and strategic initiatives could be noticed in the recent past with the intention of creating an innovation-friendly entrepreneur ecosystem in Sri Lanka. [4] has identified the key government actors that play important roles in the innovation and entrepreneurial ecosystem of the country. [8] has introduced several strategic initiatives proposed by the Ministry of Science, Technology, and Research in Sri Lanka, to develop science and technology research to make Sri Lanka a world-class knowledge hub in science and technology. However, most of the goals mentioned there have not been achieved [4]. Another policy framework developed by the National Enterprise Development Authority (NEDA) is introduced in [9], which focuses on the growth and sustainability of SMEs through the creation of a conducive environment.

According to [4], A dynamic entrepreneurship ecosystem is emerging in parts of Sri Lanka, most notably in Colombo and Jaffna. This is well depicted by a recent ecosystem support map produced by the International Trade Center (ITC) pertaining to the entrepreneurship ecosystem in Sri Lanka [10]. As depicted by Fig. 1, their ecosystem map depicts the prominent actors in the startup ecosystem in Sri Lanka and their relationships. Even though this ecosystem map has several limitations, it could be considered as one of the pioneering studies reported so far regarding the application of ecosystem mapping in Sri Lanka. Few notable highlights from this ecosystem map includes 1) the dominance of ICT/BPO related actors, 2) bias towards Colombo-based tech startups ecosystem and 3) absence of key MSME related actors from other sectors such as agriculture, spice, and allied products, handicrafts, floriculture, and tourism, which contributes more to rural economies.
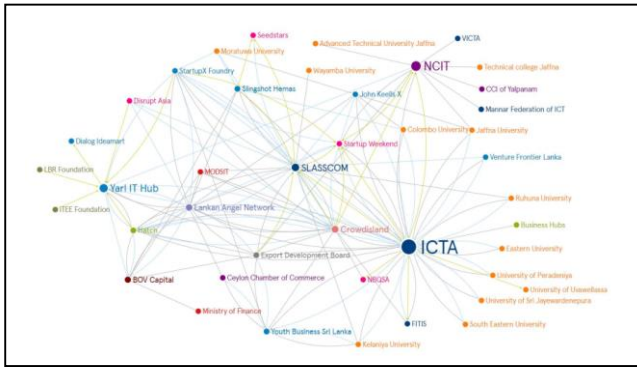
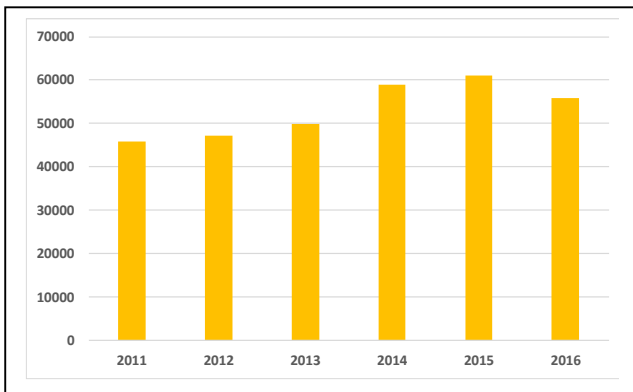Fig. 1. Sri Lankan entrepreneurship support ecosystem map [10]

Fig. 2. Total Exports in the handicraft sector from 2011 – 2016. Figures in USD '000

C. Handicrafts sector in Sri Lanka

The handicraft sector was chosen for this study mainly due to its contribution to the rural economy. According to [11], except for a few key players, most of the enterprises in the handicrafts sector in Sri Lanka are cottage businesses, which are located mostly in rural areas all around the country. Though the investment in the last five years is small, as depicted in Fig. 2, the industry has shown some growth over the last five years with a slight decline in 2016. The production is mainly aimed at the local and niche export market and the cottage businesses are mainly supplying to the prominent players who do the end-sale and export. The key innovation and entrepreneurship support ecosystem actors include; 1) University of Moratuwa, 2) University of the Visual & Performing Arts 3) Academy of Design, 4) The Export Development Board 5) National Craft Council (NCC) and 6) National Design Center (NDC) [11].

III. RESARCH OBJECTIVES AND METHODOLOGY

The key research question in this study is whether ecosystem mapping technology could be used as a tool to understand issues and challenges prevailing in the MSME sector. As the focus of this study is on mapping the innovation and entrepreneurship ecosystem in the handicrafts sector in Sri Lanka, the following research objectives were derived.

1. Identifying the key actors in the innovation and entrepreneurship ecosystem in the handicrafts sector in Sri Lanka

2. Constructing the innovation and entrepreneurship ecosystem map

3. Analyzing the ecosystem map to understand key challenges and issues in the crafts sector

4. Deriving conclusions on the use of ecosystem mapping technology to understand issues and challenges in the MSME sector

5. Determining future research directions for MSME studies with the help of ecosystem mapping technology

One of the biggest challenges in ecosystem mapping is the unavailability of data. The socially constructed data is available but the data is not readily available in the required format. Therefore, the data collection for this study was done manually from the data available on social media.

As the first step, the ecosystem actors were identified from desk research on the MSMEs in the handicrafts sector. There, the National Enterprise Development Authority (NEDA), the Small Enterprise Development (SED) division, the National Crafts Council (NCC), the Export Development Board (EDB), the National Design Centre, the Gem, and Jewellery Research and Training Institute and the Gem and Jewellery Authority were identified as the key actors in the innovation and enterprise ecosystem of the handicrafts sector.

As the second step, the social media posts on their official pages were collected manually for the period of 1-11-2018 to 30-10-2019. The posts were manually read to identify the other actors with whom they have interacted during the past one year. The interactions are classified as interactions for 'platform', 'knowledge', 'funding' or 'policy'. These classifications were purely the judgment of the researcher. A platform interaction is any interaction that creates a platform for some activity. For example, a competition or a workshop organized by the Ministry of Education for school children with the help of the National Crafts Council was considered as a platform interaction between the two entities. A knowledge interaction is a provision of a knowledge service from one entity to another. For example, Sri Lanka Institute of Marketing providing resource personal to a workshop organized by Small Enterprise Development (SED) division was considered as a knowledge interaction. Any interaction that supplied funding for a project was considered as a funding interaction whereas any interaction that supported the formation of a policy was considered as a policy relationship.

As the third step, the ecosystem map was created using the actors and links identified before. The data was fed into the statistical software package R and the ecosystem map was drawn using the *igraph* library. The generated ecosystem map was analyzed to derive conclusions.

IV. RESULTS

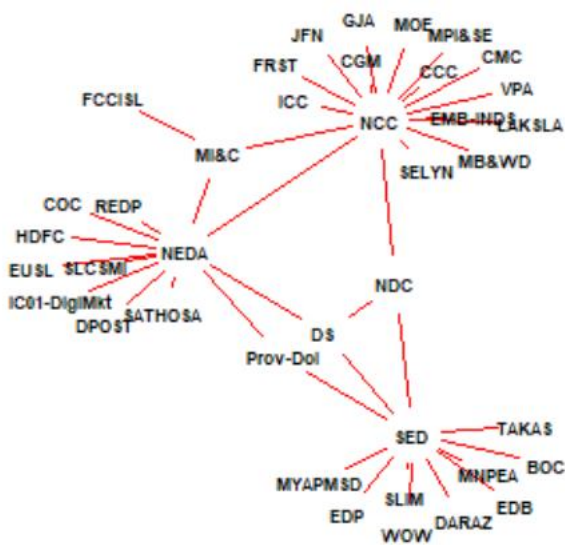Fig. 3. illustrates the aforementioned ecosystem map generated based on the data.

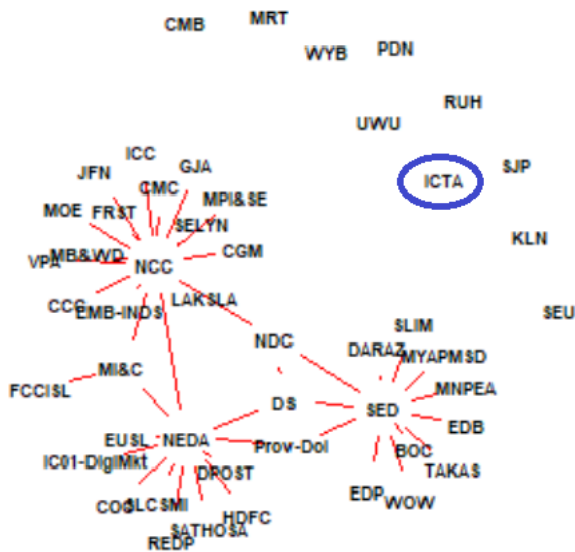Fig. 3. The ecosystem map of the handicraft sector in Sri Lanka

Fig. 4. An extended ecosystem map of the handicraft sector in Sri Lanka with some actors that are not connected, yet, with potential importance

V. DISCUSSION

The Fig. 3. It provides some basic, yet, important information about the handicraft sector. It could be compared with the ecosystem map depicted by Fig. 1. for a better understanding. Some of the important observations from the ecosystem map in Fig. 3 are as follows.

A. *Less coordination among critical actors*

According to Fig. 3., the National Enterprise Development Agency (NEDA), the National Crafts Council (NCC) and the

Small Enterprise Development (SED) division have the highest betweenness in the ecosystem map, which means they are the most prominent actors in the ecosystem. However, it further shows that there are no direct links between NEDA and SED as well as NCC and SED. The Divisional Secretariat (DS) offices and the Provincial Ministries of Industries (Prov-MoI) had been acting as the mediators between NEDA and SED. The two entities, which belong to two different ministries, hence appear to be operating independently on most occasions. The NCC seems to have connected with the SED through the National Design Center (NDC) only. This shows a clear lack of coordination among the important actors in the handicrafts sector.

B. *The less active role of the Export Development Board (EDB)*

Notably, the Export Development Board (EDB) is connected with SED directly, but not with NEDA. Moreover, the betweenness of the EDB in the ecosystem of the handicrafts sector is minimum compared to its significantly higher betweenness in the startup ecosystem depicted by Fig. 1. EDB has listed handicrafts as a key export category on its website, which contradicts this observation. Perhaps, the supply chain structure of the handicrafts sector is arranged in such a way that the EDB is more closely associating with established medium and large scale merchants but not with the micro and small scale enterprises that are served by NEDA and SED. However, this hypothesis needs further investigation.

C. *Lack of ICT support and adoption*

Compared to the startup ecosystem in Fig. 1, the Information and Communication Technology Agency (ICTA) of Sri Lanka are completely out of the picture in the ecosystem of the handicrafts sector. As depicted by Fig. 4, it has no single link with any of the key actors in the ecosystem. Moreover, according to Fig. 3, none of the key actors in the ecosystem of the handicraft sector have had any association with an entity known for ICT expertise during the last one-year period. However, according to [11], digital empowerment is critical in the handicraft sector to develop skills and capacity. The inactiveness of the ICTA depicted in the ecosystem map indicates a digital innovation challenge prevailing in the sector, which may affect the competitiveness of the products of Sri Lanka in the international market. Though understandably, the hand-made products would be more demanded in some instances, less adoption of information technology may hinder the growth of the sector.

D. *Less involvement of the private sector*

Except very few, most of the actors in the ecosystem map of the handicrafts sector are public sector organizations. In contrast, the startup ecosystem depicted by Fig. 1 has a nice mix of public and private sector organizations, which reflects a much higher growth potential. Since the public sector organizations are mostly funded by public money, they have limited financial capacity to support the growth of the sector. Thus, the lack of private sector involvement largely affects the resource accumulation and hence can hold back the innovation and growth of the sector

E. Less involvement of the universities and technical colleges

Universities and technical colleges have a significant potential to transfer critical knowledge for the growth of the MSMEs. As depicted by Fig. 1, the universities and technical colleges are playing an important role in the startup ecosystem in Sri Lanka. In contrast, as depicted by Fig. 4, the ecosystem of the handicrafts sector has shown no connection during the last year with the universities and technical colleges except the University of Jaffna (JFN) and the University of the Visual and Performing Arts (VPA). Partnering with the universities and technical colleges can expedite the growth of the sector through knowledge and technology transfer as well as research and development (R&D). However, the less involvement of universities and technical colleges indicates another innovation challenge in the handicraft sector.

VI. CONCLUSION

The above findings from the handicrafts sector in Sri Lanka strengthen the idea that the ecosystem mapping technology can support having a holistic view of a startup ecosystem to identify its issues and deficiencies in the exchange of resources. Such findings could be used to formulate effective policies and appropriate strategies to enhance innovation and growth in the MSME sector. However, the research presented in this paper has several limitations, which need to be overcome before the use of the findings to formulate or refine national or regional entrepreneurship policies.

A. Limitations of the study

Some of the major limitations of this study are as follows.

● The findings are purely based on a publicly available, manually collected, small sample of data. Hence, there is a chance that the findings are less accurate and incomplete. Lack of high-quality data and the difficulty to locate even the available data is a major limitation of this approach.

● The findings are not validated by experts in the field. Since this is ongoing research, validation of these findings is yet to be done. However, it is expected to interview some representative individuals from the handicraft sector to get these results validated.

● The network map used to model the ecosystem structure could be further improved for better insights. For example, the links between actors are not differentiated in terms of the type of resource being exchanged as well as the frequency of that exchange. Moreover, the nodes can be differentiated based on a criterion such as public or private sector organization.

● The ecosystem map presented in Fig. 3 and Fig. 4 is the ecosystem support map, which contains only the support actors that help the MSMEs in the handicraft sector to function. Though it is challenging, adding the actual MSMEs also into this ecosystem map would reveal much more interesting and useful insights.

B. Future Work

The potential of the findings from this research despite the above limitations indicates numerous avenues for future research. Some of the notable future research directions are as follows.

● The study can be extended to other sectors such as agriculture, healthcare, and tourism, which could reveal unseen inter-sectoral patterns as well as deficiencies in the flow of resources to and among different sectors.

● The ecosystem mapping approach could be used to model large scale innovation and entrepreneurship ecosystems such as national and regional systems of innovation, which would indicate national or regional level innovation and entrepreneurship challenges.

● From a technical perspective, it is vital to develop a method to collect high-quality data to identify actors and their relationships. The manual data collection is cumbersome and error-prone, which needs a replacement with an automated method. However, it is highly challenging to develop such a method.

● Another important observation could be the time-based change of the structure and connectivity in the ecosystem map. As suggested by other researchers as well [2], it would be interesting to observe the change of the ecosystem map annually to understand growth (or decline)

● It is also possible to revisit the national innovation and entrepreneurship policies taking this approach with necessary improvements.

Based on the above limitations and the possible future work, further research will be carried out to improve this data-driven approach, for that to be a useful decision support tool for investors and policymakers.

REFERENCES

[1] N. Iliinsky, "On Beauty" in Beautiful Visualization: Looking at Data Through the Eyes of Experts, J. Steele and N. Iliinsky, Eds. O'Reilly Media Inc., 2010, pp. 1–13.

[2] K. Still, H. Jukka, M. G. Russell, and N. Rubens. *"Insights for orchestrating innovation ecosystems: The case of EIT ICT Labs and data-driven network visualizations."* International Journal of Technology Management, 2014.

[3] J.P.D.R Jayasekara and A. Thilakarathna, *"Government Policy and Strategy for SME Development",* The Fourth IMF-Japan High-Level Tax Conference for Asian Countries, 2013.

[4] "Innovation and Entrepreneurship Strategy of Sri Lanka 2018 – 2022", Ministry of Development Strategies and International Trade, Sri Lanka.

[5] S. Conway and S. Fred, *"Mapping innovation networks"*, International Journal of Innovation Management, Vol 2.02, 1998, pp. 223-254.

[6] K. Still, H. Jukka, M. G. Russell, and N. Rubens, *"Paradigm shift in innovation indicators-from analog to digital"*, ISPIM Innovation Symposium, The International Society for Professional Innovation Management (ISPIM), 2012.

[7] P. E. Auerswald, "Enabling entrepreneurial ecosystems: Insights from ecology to inform effective entrepreneurship policy." Kauffman Foundation Research Series on city, metro, and regional entrepreneurship, 2015.

[8] "Science, Technology and Innovation Strategy for Sri Lanka: 2011-2015", Ministry of Science, Technology, and Research, Sri Lanka.

[9] "National Policy Framework for Small Medium Enterprise (SME) Development", Ministry of Industry and Commerce, Sri Lanka, 2016

[10] "Mapping Sri Lanka's entrepreneurship ecosystem", International Trade Center, 2018

[11] A. Chatterjee, A. Tiwari, P. Mohan Misra, and S. G. Dhande, *"Designing Handicrafts using Information Communication Technology",* Indian Journal of Exports, Vol. 12.1, 2008