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## **Social innovation system (SIS): Using design thinking, product service systems and applied business analytics to improve SIS design**

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### **Abstract**

Social innovation means different things to people, depending on their needs and intended usage. At its most basic level, social innovation is seen as a driver for the actualization of a sustainable society. Through the adoption of novel methods, social innovation satisfies unmet human needs. This paper proposes a novel Social Innovation Systems Architecture based on the human-centered and systemic approach of Design Thinking. The article leverages an applied business analytics approach to assess the inherent needs and outline a solution as a Product Service System (PSS). As it appears in this paper, the architecture of the proposed system is based on the Service Engineering Methodology (SEEM), which provides a holistic method for process ideation, validation, and implementation. Applied Business Analytics has been layered on top of the SEEM Model because it provides insights on possible needs/opportunities through data analysis from various use cases. At the same time, design thinking is leveraged in the creation of a PSS to provide sustainable and efficient user-centric solutions.

**Keywords:** Design Thinking, Product Service System, Social Innovation, Business Analytics, Applied Analytics, Needs

### **Introduction**

(Alex et al., 2015) assert that social innovation isn't net new. Yet, it appears to be entering a new phase by offering solutions to localized problems and systemic and structural issues. Thus, social innovations are new ideas that address unmet social needs. Humans are social beings, and their very existence is extrinsically and intrinsically linked to their social nature. Thus, it is understandable that human social needs are diverse, numerous and ever-changing. Based on this interpretation, it can be argued that many unmet social needs exist.

(Bock, 2015) argues that Social Innovation Systems are an outcome of ongoing debate currently happening around material, technology, knowledge, and economic rationale in innovation studies. Social innovation systems must thus be a defined methodology of new social practices that meet social needs such as working conditions, education, health, and community development in ways better than existing solutions. This understanding of social innovation can be actualized through the social processes of innovation and social purpose innovations such as activism, distance education, community development etc.

Current studies in academia, research institutions, and industries are all trying to develop models that help build constructive, fair, and social-conscious societies. Hence, an implementation of social innovation systems necessitates mental creativity from a diversity of disciplines (Geoff, 2012). The core differences in social innovation theory are based on three dimensions: innovations are new combinations or hybrids of

existing elements, innovations cut across diverse disciplines and innovations translate into effective new relationships between previously separate individuals and groups. Thus, (Geoff, 2012) outlined a straightforward method of implementing a Social Innovation System. Understanding and satisfying social needs are critical to successfully implementing a Social Innovation System. Thus, a Product Service System (PSS) design based on design thinking is an ideal approach to understanding the unmet social needs of society.

(Fabiana et al., 2016) argue that existing approaches to design thinking don't always position human needs systematically at the center of solution design and problem solving. As such, the scholars argue that design thinking is an applied and consciously systematic approach where humans are positioned front and center of the design process. Design thinking is unique because it aims to genuinely and authentically understand human needs and human emotions and empathize with humans to elicit requirements that result in the architecture of meaningful, mindful and high-impact products, services and solutions that emanate from the grass-roots needs of communities and societies (Wyatt, 2010). The Product Service System Methodology sees every solution to a need as a product service, thus ensuring the maximum impact of the product would hinge primarily on the proper definition, identification, and scope assessment of the user's need. This holistic analysis of requirements can be achieved only through design thinking as it considers the factors relating to an identified need and how requirements could vary from individual to individual.

Data is everywhere. The primary driver in the twenty-first century is data from quantitative and qualitative methods, enabling the possibility of gleaning insights and conducting impact analysis on models, processes, systems, and policies. Applied Business Analytics profiles, consolidates, wrangles, synthesizes, and cleanses raw data to make sense for business applications. Most analytical solutions consist of predictive, diagnostic, or prescriptive analytic approaches. Applied Business Analytics also includes forecasting, optimization, and data visualization. Data Science is complementary to business analytics, and it leverages machine learning, artificial intelligence, and statistical methods to problem-solve tough business problems. Applied Business Analytics if done correctly helps organizations solve challenging problems and realize business value such as efficiency, cost-savings, productivity, revenue, and organizational alignment. In sum, applied business analytics provides practical and actionable tools for harnessing the intelligence available in the data.

The onset of social media and the proliferation of technology in every facet of human existence has dramatically simplified the process of data gathering. Whether data is being aggregated from online surveys, user information extracted from e-commerce sites or general statistics relating to everyday life, it is imperative to acknowledge how knowledge and wisdom about unmet needs can be gleaned from the mass of structured and unstructured data available in repositories and data sources. The United Nations Development Program (UNDP) defines social innovation as the ability to leverage innovation in the service of public interest. UNDP argues that social innovation is less theoretical, and more practice based. Moreover, it suggests that Design Thinking and Social Innovation can be combined to bring together actors and sectors from a plethora of disciplines. It argues that Social Innovation is more than just inventing solutions, rather it is more focused on sustainability, viability, scalability, and impact of the innovative solutions to meet ongoing society's social needs as per the United Nations Sustainable Development Goals - SDGs (UNDP, 2014).

### **Related Work**

#### **Social Innovation Systems**

(Paul et al., 2014), argued that social innovation is currently seen as a quasi-concept and thus needs thorough academic attention. In their studies, the researchers discuss how social innovation systems leverage

impactful ideas from disruptive innovation, innovation systems, institutional innovation, and technical transition. The researchers argue that the mélange of these approaches result in controlled, time-boxed, and right-sized social experiments culminating in innovative solutions to some of society's most pressing problems. The authors argue that this creative combination of ideas highlights no matter how small, social experiments can ultimately lead to innovative solutions to some very difficult problems. (Geoff, 2012) argues that the results of social innovation and new ideas that meet society's unmet needs are all around us – albeit most visible amongst non-profit organizations.

Social innovation can be driven by both the non-profit sector and governments and politics. (Fulgenico & Lefever, 2016) argue that social innovation systems as a concept develop, utilize, and strategize to address societal issues and unmet human needs. The author's study identified four themes of social innovation systems: institutional, organizational, social, and quality of life.



**Fig 1: The Social Innovation Triad**  
Source: (Alex et al., 2015)

(UNDP, 2014), established social innovation for institutional and organizational needs in the public service. The United Nations Development Program argues that social innovation aims to test, validate, and adapt methods that help assess the effectiveness of public service. Through ongoing trial, error and learnings, citizens, civil society, and government can acquire insights on what social policies work and what policies fail. The UNDP report goes on to suggest that participatory and evidence-based social innovation system design leveraging engagement and design thinking results in powerful results.

(Alex et al., 2015) argue that the critical focus on social intervention is driven by numerous global challenges such as climate change, rising healthcare costs, average life expectancy and other related social breakdowns. (Jane et al., 2018) doubt the effectiveness of social innovation systems. The researcher's data leveraged qualitative and quantitative data points to articulate the growth, development, sustainability, and diffusion of social innovation systems (SIS) unlocked by design thinking within the context of a SIS cycle. The research also asserts that design thinking is a way of working and a collection of hands-on methods that incorporate cyclical process such as discover, interpret, create, experiment, and evolve to provide valuable and innovative social outcomes for society.

## Design Thinking

According to (Dam & Teo, 2020), Design thinking aims to prototype and test solutions from the get-go and identify what works and what does not work through practical testing and experimentation.

The design thinking approach really emphasizes empiricism and applied learning and testing as a barometer to measure effectiveness of social innovation processes. (Liedtka, 2018) in her review of design thinking

and its application in health, business and social services discovered that Design Thinking has immense power in aligning people and groups, enabling creativity, and generating commitment and self-empowerment of participants in improving process and solution outcomes.

(Baylé, 2018), argues that design thinking helps solve society's most difficult problems. By empathizing with people's problems, focusing on social outcomes, collaborating with multi-disciplinary teams, and leveraging restless innovation, design thinking helps bring a refreshing and engaged approach to social innovation systems. This way of solutioning and problem solving unlocks innovation, fosters creative recombination, and enables mindsets and processes that unlock democratic and consultative decisions.

(Francesca et al., 2017) discussed the interaction between design thinking, public sector innovation and social innovation from a two-fold perspective. Firstly, as an emergent trajectory of innovation. Secondly, as a framework to design processes of change in public organizations.

### **Business Analytics**

(Soraya & Salim, 2018) opined that big data analytics has immense potential for addressing societal challenges. Their research showed how social enterprises can harness the potential of big data and how analytics can help them find creative solutions to various societal concerns. The author's study described the process of knowledge elicitation as an actionable insight, discovery (problem definition, data collection, and data management), modelling and analysis and interpretation.

(Smith et al., 2014) enumerated various steps that needed to be taken to implement big data in social innovation systems. Firstly, society must aggregate datasets and build data banks in the form of open data initiatives on diseases, equality, population dynamics, citizen engagement and critical SDG (sustainable development goals) issues. To build these databanks, engaged citizens, civil society participation is a pre-requisite. Additionally, organizations must ensure quality data governance through designation of data stewards, data owners, data curators and data custodians to ensure accurate and clean data for business analytics modeling and experimentation.

Business Analytics can be done with all sorts of data, whether small, medium, or big. Still, amongst all the possible data sources, big data comprises a larger pool of historical information relating to a phenomenon or a series of phenomena. Thus, good data would likely generate more accurate insights into the unmet needs a social innovation system will seek to solve.

(George et al., 2018) argued that decisions, actions and even existence in the digital world generate data, which offers tremendous opportunities for revising current business methods and practices. The researchers proposed a Digital Transformation and Sustainability (DTS) model. This model bolstered the role of data actors, data capacities and availability, and adoption of leadership and management levels. The research also yielded that data-driven Sustainable Development is a crucial driver for implementing business analytics in social innovation.

### **Product Service System**

The Product Service System (PSS) approach recognizes the need for individualized solutions to specific problems as enumerated in (Cagri, Hakan, & Duygu, 2013). The PSS study developed a valid and reliable social innovation instrument at an individual level.

(Fabrizio, n.d.) argued that Product-Service System (PSS) is really a unique innovation as it emphasizes servicization of products and productization of services. This dual dynamics in PSS disrupts the current approach by engaging cultural, corporate, and regulative forces with civil society and social forces to collaborate towards a common goal.

(Konrad et al., 2016) posits that Product-Service Systems (PSS) are not an island by themselves, they are customer-focused, outcome driven and solution oriented. These systems or models are reinforced and enhanced through agile frameworks and methods and design thinking practices of prototyping, testing, and iterating to learn and improve. The researchers present extensive literature on active customer integration acquired through empirical proof of concept testing approaches tied into PSS design processes.

### **Proposed Social Innovation System and Methods**

(Alex et al., 2015) described the levels and dimensions of social innovation: incremental, disruptive, and institutional levels, individual, organizational, network movement, and system dimensions. Incremental social innovation focuses on products, institutional focuses on markets, while disruptive focuses on politics. The dimensions are related to social processes such as co-production, wiki-production, open-source technology, and microfinance.

(Fabiana et al., 2016) presented a PSS design utilizing design thinking, the model would be adopted in this study to provide solutions to the user, where the general population is regarded as the customer, and the solution provider (business, governments, NGOs) is viewed as the company. An efficient social innovation system must consider the unmet needs of customers. (Magnus et al., 2014) argued that while design thinking emphasizes a deep understanding of the identified unmet needs, the PSS must consider the perspectives of the customers and the company/provider. PSS models should utilize business analytics at the ideation phase because that is critical to idea generation (ideation). However, the ideas generated in a typical PSS would be the identified unmet needs in an SIS system.

### **Methods and Materials**

The proposed model is based on a PSS model but heavily customized with design thinking methodologies and applied business analytics (big data) in its ideation phase. To illustrate benefits to a customer/user, it is paramount that value is articulated early on. The unarticulated needs are the primary focus of a social innovation system. The developed model was validated with similar approaches in related literature on the benefits of SIS. (Pezotta, 2014) SEEM model was adopted for the Development of the PSS-based SIS model. As detailed in (Pezotta, 2014; Fabiana 2016), the SEEM model proposes a balance between the customer and company perspectives. This exact approach was leveraged, as mentioned in the article. Besides the SEEM model, the suggested method allows users to insert an innovation focus covering the value addition for customers and the company.

The proposed model (figure 2) has five (5) parts: Environment, business analytics, Design thinking, PSS solutions model and knowledge database. The adopted model presents and includes the significant players critical to implementing a social innovation system: government, for-profit institutions, not-for-profit institutions, higher education institutions and the general society. These players act as data sources for the ideation phase of the model.

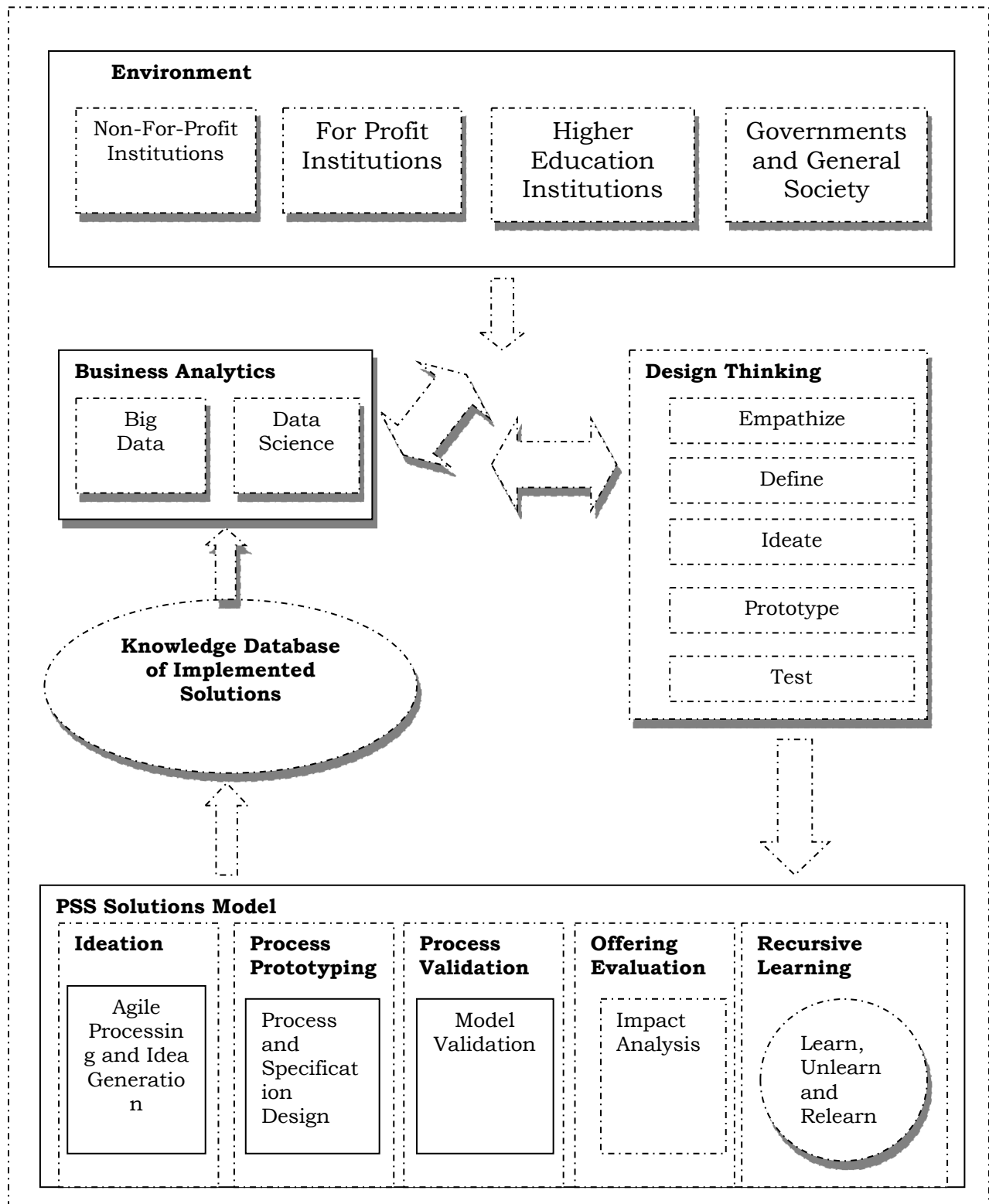


Figure 2: Proposed Social Innovation System Architecture based on BA, DT and PSS

## Discussion

### Environment

The environment consists of players contributing collaboratively or non-collaboratively to the entire concept of social innovation (Howaldt & Schröder, 2016). The unmet needs could be interrelated or intra-related to each of the environment's players. Thus, data generated from the environment could be in the form of government policies, population statistics, university research output, sales records, questionnaires, inflation rates, consumer indices etc. It's important to emphasize that these raw unclassified data are a rich source for business analytics method to generate knowledge related to unmet needs of either the direct environmental players or third parties

### Business Analytics

Big data analytics and data science form the most efficient method for knowledge elicitation from raw unclassified data, which could be generated from diverse environmental sources. Techniques such as:

- a) A/B Testing – A Quality Assurance and Testing approach that splits the sample into Control and Treatment groups and thereafter offers an intervention to discern whether an intervention has an effect or no effect on the outcome. (Manyika, 2011).
- b) Data Fusion and Integration - Data wrangling and enrichment techniques that aggregate, cleanse, and combine data from various sources and databases to provide a more comprehensive and well-defined view of a business problem with multiplicative insights acquired from multiple datasets versus a single data set.
- c) Data Mining - The capability to profile and sift through big datasets leveraging pattern recognition, artificial intelligence, statistics and machine learning tools to mine and extract the most relevant information from an ocean of data (Reavie, 2018).
- d) Natural Language Processing - A domain of Artificial intelligence that leverages speech recognition, text recognition, translation, and sentiment analysis to analyze human spoken or typed/written record of the language. (Manyika, 2011).
- e) Statistics - This technique collects, organizes, and interprets data within surveys and experiments.
- f) Data science techniques – clustering, Naïve Bayes, Neural Networks, Convolutional neural networks (CNN), Monte-Carlo simulations, support vector machines, KNN etc. (Granville, 2016).

The output of this phase would be recommendations about possible areas of unmet needs, either existing presently or not being forecasted to exist sometime in the future.

### Design Thinking

This phase would be fed with the recommendations of the business analytics phase; thus, there will be a lot of requests needing solutions. Therefore, the design thinking phase is tasked with applying a methodology that ultimately defines the unmet needs (ideation) to ensure possible answers can be gauged through appropriate metrics that genuinely add value to humans or other beneficiaries.

(Dam & Teo, 2020) emphasize the need to implement the empathize phase properly. If done correctly, this phase will aid in a better understanding of the unmet needs. At the same time, the define phase considers diverse recommendations to define a general problem (unmet need).

The ideation phase generates ideas about the situation, such as the why, how, when, where and while. After that, a prototype and test phases attempt to recreate the identified problem through experimentation, surveys or other qualitative and quantitative methods. The deliverables of this phase are well-defined problems /unmet needs that have been appropriately classified and localized to where they occur, as well as to whom possible solutions could offer value. This information will serve as input to the PSS solutions model.

### **PSS Solutions Model**

(Fabiana et al., 2016) defines the ideation phase of a PSS solutions model as a task that comprises the generation of new ideas based on understanding the problem. Ideas generation is the process of generating, developing and testing hypotheses, identifying patterns, defining opportunities and creating solutions.

Tools used are brainstorming, design concept, napkin pitches, etc. Agile methodology at this stage allows for further creativity through experimentation, feedback and improvement exercises, such as solution storyboards. The prototype phase defines the specification of the solution, where such specification ensures the scope of the solution meets the problem already identified and defined.

Following the SEEM methodology, this process validation phase must assess the previously developed delivery process and its related performance and determine the appropriate resource configuration. The offering evaluation and recursive learning phases are critical in evaluating the structure and resources necessary for the PSS offering and its impact on solving the problem. Recursive learning provides a means to learn, unlearn and relearn from the offering evaluation exercise. This type of learning aids the optimization of the entire process for the best solution for any problem.

### **Knowledge Database**

(Hayes-Roth, 1983) argued that a knowledge-based system has a knowledge management component and a central repository with facts, figures, and insights. Usually, an engine or model can make sense of the data in a knowledge database while leveraging business rules to derive new facts, solve existing problems or illustrate inaccuracies or gaps in the database. The knowledge database, in this case, is a database of solutions implemented by the PSS. These databases serve as a ready pool of information for the business analytics phase to ensure proper data classification and learning. Thus, the knowledge database of solutions provides that the social innovation systems model is recursive in the application and optimized to self-learn and produce a better solution after each iteration.

## **Conclusion and further Development**

Driven by the need to ensure a sustainable environment and economy, where equity and human sustenance are at the forefront, governments, institutions, and economies are looking to social innovation to provide a framework for delivering world-class equitable solutions for the world's ever-changing needs. This paper discusses the impact of social innovation and the efficacy of design thinking in providing a methodology for impactful problem handling.



The article also enumerated the Product Service System as a critical method for providing individualized, targeted solutions to numerous problems. This study emphasized the role business analytics tools and techniques, such as big data, could play in an ever-changing, data-driven world. The application of design thinking and business analytics in the model enables a deeper understanding of unmet needs, to which the PSS model-based SIS system attempts to provide iterative solutions to holistically.

The model was validated by comparison with results from related studies (Fabiana et al., 2016; Bayle, 2018, Geoff, 2012) will come back from the room. Despite the success of the researchers, in-depth studies are still recommended. The model's applicability in handling other data structures and sources besides those enumerated have not been fully explored and is recommended for future work.

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