Social innovation, research and community engagement: Managing interdisciplinary projects for societal change

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Abstract - **A transformative research paradigm is rooted in knowledge mobilization processes involving close collaboration between researchers and the community. A formalized approach to managing multi-stakeholder participation and community engagement in a science and technology research environment is presented. Design science research methodology is applied with a systems thinking approach to implement an integrated research, development and project management network at a tertiary education institution. The network is presented as a Research and Projects Office that enables a projects-based approach to facilitate interdisciplinary and community-driven research for social change through technology development.**

Keywords – **Project management, social innovation, higher education**

I. INTRODUCTION

The challenges faced by developing societies are profound and complex. At the heart of these challenges lie basic needs such as energy, food and water, housing, mobility, health and access to information. These challenges will intensify as the world population continues to grow and exceeds nine billion people [1]. Access to energy, energy security, poverty eradication and sustainable development are interlinked problems and require new thinking if we are to address them. Within this context, universities need a new understanding of how to respond to societal challenges, changing technological capabilities and the skills requirements of society.

The social arena is changing rapidly, driven by an agenda for sustainable economic development and stable democracies. Scientists and engineers play a key role in innovation-driven economic development, particularly on the African continent. Nelson and Winter [2] pioneered the argument that productive transformation is central to economic development. Contrary to traditional linear models of technological development, they argue that innovation is non-linear and non-sequential. They emphasise that technical growth depends on both social innovation and technological advancement. Consequently, higher education, particularly engineering, should equip graduates to apply knowledge and technology to address societal challenges.

A core function of a developmental state should be to support learning processes to develop dynamic technological capabilities at all levels [3]. If we hope to be competitive—academically, economically and technologically—we need to re-evaluate our educational system, rethink our approach to learning, and reinvigorate our commitment to learning [4]. Disruptive innovation is therefore required in higher education, together with a framework to enable these changes.

The number of traditional non-profits or community-benefit organisations has increased significantly and social enterprise has become a field of study at major universities across the globe. There has also been a marked shift in the traditional business world from green-washing to the rise of authentic socially-minded businesses [5]. The concept of 'social entrepreneurship' has been rapidly emerging since the late 1990s as an innovative approach for dealing with complex social needs [6, 7]. Social entrepreneurship emphasizes creative problem-solving related to human behaviour, social impact and innovation. It recognizes and pursues opportunities to create social value by crafting innovative approaches to address critical social needs [7]. Furthermore, participating in research and education programmes that support social innovation creates a learning environment seated in the reality of social challenges. Social innovation, however, does not fit comfortably in traditional academic institutions, even less so in environments where science, engineering and technology are the main research foci.

Consequently, it is incumbent on universities to refocus their capabilities and figure out how to capture this tacit knowledge more effectively. This would require a stronger focus on organizational learning through integrating new mechanisms within the university. The research presents the response from an engineering faculty in a South African University to establish a mechanism for driving co-created research and societal change aligned with the United Nations Sustainable Development Goals [8]. The following section discusses the research methodology of the study, including its environment and practice; theory on design science research; and the knowledge base of systems engineering and thinking. Section III focuses on the relevance and rigour of the study, whilst Sections IV and V close the paper with an in-depth discussion and conclusion respectively.

II. METHODOLOGY

A Design Science Research methodology was followed: a systems thinking approach was applied as a framework to manage the integration of social innovation

into the engineering faculty at a South African University, linking research to the curriculum through community engagement. The Design Science Research approach is about potentiality, the identification of new opportunities to improve practice. The methodology originated in the fields of architecture, engineering and information systems; and is motivated by the desire to improve the environment with the introduction of new and innovative artefacts and processes [9]. Fig. 1 illustrates the framework to support a projects-based approach to community driven research.

The study employs systems thinking and systems theory as the foundation to evaluate the engineering education and research system. The internal design science cycle evaluates the implementation of a Research and Projects (R&P) Office, testing its relevance to the community of practice in the landscape identified. Systems thinking and social systems theory were applied as an internal design science cycle (adapted from Hevner [9]) to develop a framework by which social innovation can be implemented at institutions of higher education. By applying a Design Science Research methodology, the research attempts to create a system that serves societal needs and specifically enables social impact through technology innovation and implementation.

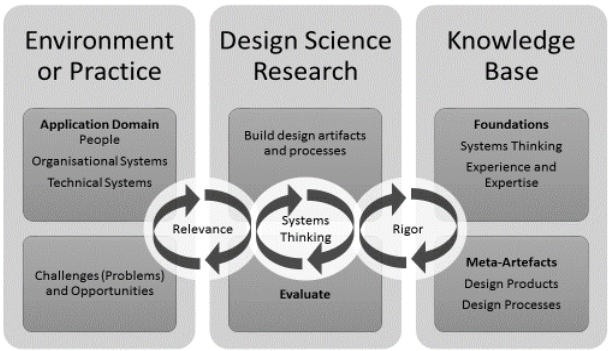

Fig. 1. Design Science Research

Furthermore, the research aims to create value for stakeholders and can be viewed as an alternative research approach to solve practical problems within communities of practice. Applying these methodologies, the practices, knowledge-base and research are defined as follows:

A. Environment and Practice

With its foundation in a learning environment, the R&P Office aims to integrate community-driven research with the curriculum to effect social change. The goal being to create an environment where the participants in the community of practice can eventually fully participate through the available artefacts and the management of information and resources within this landscape.

A community of practice was defined including researchers and academics participating in community engagement activities. This network was established to streamline shared activities and to maximize the value it offers to the institution. An analysis of the landscapes of practice was conducted to identify stakeholders internal and external to the faculty; establishing the application domain and facilitating multi-stakeholder participation by identifying people, organizational systems and technical systems. The analysis is illustrated in Fig. 2.

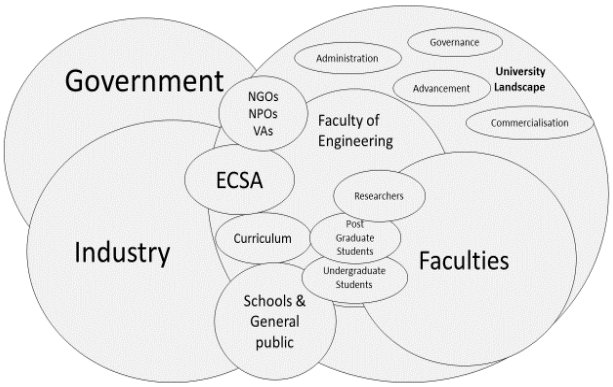

Fig. 2. Landscape of practice

The system requirements identify the teaching landscape, the research landscape, and the operational and project management requirements as determined by the projects. The R&P Office also engages with other entities in the university, such as the Division for Academic Advancement which includes strategic partnerships, internationalization, marketing and public relations, and also supporting functioning bodies such as Corporate Governance, the Technology Transfer Office, and other faculties. The actors in the community of practice are represented by researchers and academics, post-graduate and undergraduate students, administrative and support staff, the Engineering Council of South Africa (ECSA), schools and the general public, industry, local and national government, voluntary associations (VAs), not-for-profit organizations (NPOs) and non-governmental organizations (NGOs). The system input requirements and three functional areas are illustrated in Fig. 3.

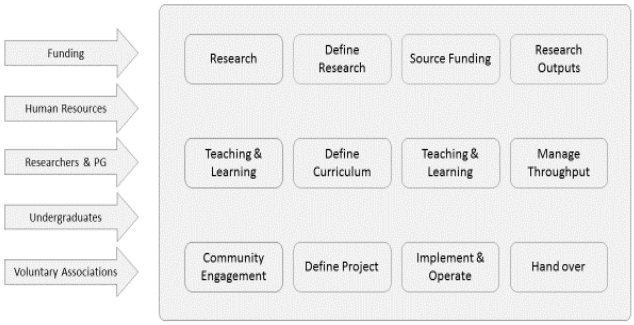

Fig. 3. Communities of practice: research, teaching and community engagement

B. Design Science Research

The system architecture was developed by evaluating existing projects and case studies to define the purpose and objectives of the R&P Office. An iterative approach was applied by evaluating case studies against a base model and updating the model to meet the requirements of the system.

C. Knowledge base

The foundation and theory of the research rely on systems thinking: connecting systems theory and social systems theory to social innovation, impact and human-centered design. A systems thinking approach is fundamentally different from that of traditional analysis. Traditional analysis focusses on separating the individual pieces of what is being studied. The word analysis implies "to break into constituent parts". Systems thinking, in contrast, focusses on the interaction of constituents of the system. This mind-set may facilitate the understanding of systems and events as emerging from a dynamic array of interrelated factors, which may have unexpected and unintended consequences [10]. The purpose of applying systems thinking in this context is to learn and understand how systems can facilitate or hinder the project objectives. The aim is to develop a framework that facilitates co-created solutions connected to the curriculum and the community as illustrated in Fig. 4. The meta-artefacts are the systems architecture and processes developed to facilitate the function of the R&P Office.

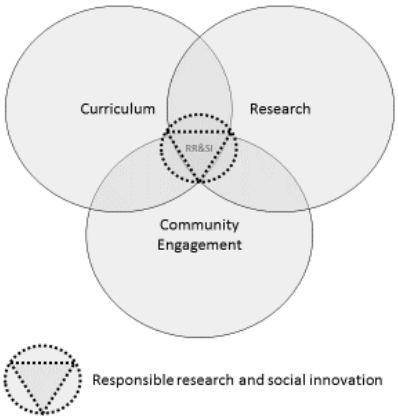

Fig. 4. Responsible research and social innovation

III. RELEVANCE AND RIGOUR

A key to the development and implementation of community-based projects was the establishment of the R&P Office in the engineering faculty to manage community-driven research projects. Following a Design Science Research approach, the current iteration of the R&P Office system architecture is presented.

Focused on supporting innovation-driven economic development in Africa, the R&P Office encourages an interdisciplinary, project-based approach to research and the promotion of community-driven social entrepreneurship through technology innovation, digital enablement and commercialization. The R&P Office has taken a projects-based approach to build on the resources available in and to the University to achieve this. Social and commercial projects which connect community-driven, interdisciplinary research across departments in various faculties are selected to enhance students' learning and to benefit local communities beyond the University's gates. The broad themes supported by the projects are food resilience, and access to clean water and sustainable energy, with the ultimate purpose of the development of a smart city.

An integrated solution for research and social innovation requires a human-centered design approach and inevitably starts by identifying the community and the stakeholders involved, as illustrated in Fig. 5. The project is then defined based on the needs of the community and framed by the broad themes previously identified. The project is essentially a community engagement initiative with the research and development project defined for support. For a project to be considered, it should be aligned with the institution's strategic objectives, add value to all its stakeholders, and deliver measurable impact though ethical practices. Projects are externally funded and comply with requisite internal and external governance structures. During project initiation, the objectives and key performance indicators are identified and aligned with those of the institution and its employees. Research and development, teaching and learning, and operational requirements must be met for each project, as indicated in Fig. 5.

Defining a research project to support the community engagement initiative allows for investigation beyond the engineering discipline and requires interdisciplinary collaboration across faculties. Based on the applied nature of the research and technology, commercialization opportunities are continuously evaluated. Key performance indicators (KPIs) include post-graduate student throughput, publications, funding applications, patents, and start-ups and spin-off companies formed in collaboration with the community. The theme of the community engagement initiative is integrated with the curriculum, and KPIs include student throughput, learning experiences, meeting module exit level outcomes and education research outputs.

The R&P Office is also responsible for the operational requirements of the project and ensures that project deliverables are met to specification and within budget. Functions falling beyond the scope of the academic environment are outsourced to independent contractors and managed by a project steering committee. The R&P Office is responsible for project management, project integration into the University research network and managing the research output. Also, the R&P Office ensures that researchers and students participate on the projects.

Completed projects are then either handed back to the community or scaled for impact. The project KPIs are defined by the initiative, by corporate social responsibility and industry partnerships, and by the marketing and the public relation (PR) value of the project.

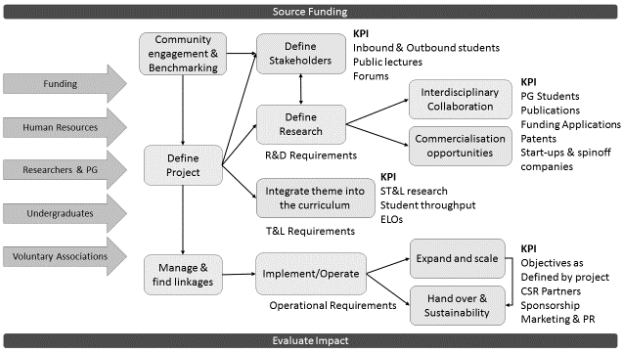

Fig. 5. Research and projects system

This approach has enhanced research and teaching opportunities to achieve the goals identified in the National Development Plan [11]. By identifying the interdisciplinary research potential of social and commercial projects, the R&P Office unlocks new opportunities for collaboration across faculties, with industry, business partners and civil society, and also generates a third stream income, as illustrated in Fig. 6.

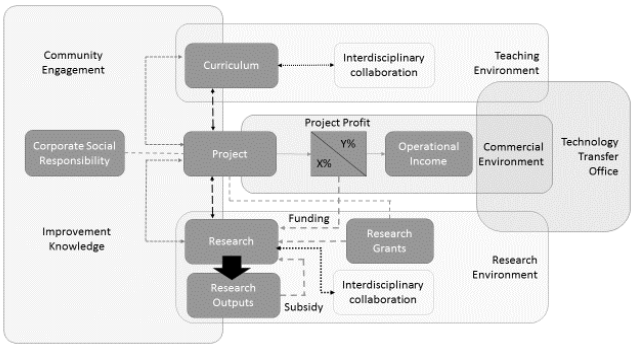

Fig. 6. Project-based research approach

IV. DISCUSSION

The risks and benefits, opportunities and challenges of the R&P Office are presented in this section. The literature clearly states that social and technical skills are important in the repertoire of skills that graduates should develop to be considered industry-ready [12]. A marked shift has occurred in the pedagogy of service-learning and community engagement within engineering as evidence points to how these experiences prepare students for careers in the private, public and non-profit sectors. There is also growing evidence that community engagement can be a powerful tool in the efforts to eliminate under-representation within the engineering profession [13, 14, 15]. Engineers are expected to function in a highly competitive environment, which demands that projects are developed in increasingly efficient and cost-effective ways; across various disciplines; and in environments characterized by rapid change. The literature reveals that engineering students "must learn how to merge the physical, life, and information sciences at the nano, micro, meso and macro scales; embrace professional ethics and social responsibility, be creative and innovative, and write and communicate well. Our students should be prepared to live and work as global citizens, [and] understand how engineers contribute to society" [12]. The same goals are embodied in the Exit Level Outcomes (ELOs) that ECSA defines for all engineering graduates and diplomats in the country. Through the implementation of real world projects, students are afforded the opportunity to conceptualize, design, implement and operate projects in an authentic learning environment.

We are teaching and learning in times of overwhelming change in the way we know, the way we teach and in what is expected of us as educators and learners. Engineering programmes need to improve at teaching personal and interpersonal skills, as well as the skills to produce technologies, processes and systems that are aligned with sustainable development goals. There is a global urgency to eradicate poverty and inequality and to drive sustainable development, with an emphasis on the link between social capital and quality of life. The solutions call for significant collaboration and co-created solutions through participatory design. It will require empathy, awareness and a human-centered approach to reframe the problem and to come up with innovative solutions. Arguably, design thinking and entrepreneurial skills would be appreciated in this climate of change. Design thinking has found its way into business schools as a way of driving innovative decision-making in organizational change. The relevance of entrepreneurship to economic development is well established [16] and it is well-recognized that education and training opportunities play a key role in cultivating future entrepreneurs. However, entrepreneurial skills development is often not included in the undergraduate curriculum, particularly not in technology and science faculties. The R&P Office architecture will enable students to be exposed to entrepreneurial practices and principles.

At South African universities design in the engineering curriculum is often taught as a paper exercise, which only focus on the conceptualization phase of the product. Design thinking is an iterative, collaborative, human-centered approach used to redefine and frame a design problem with the end-user involved and integrated in the successful implementation of real projects. In the same way, implementing new teaching philosophies will have to be inspired through co-created solutions. Adapting and redesigning the engineering curriculum will require cultural change in an organization notoriously slow to transform. Buy-in from multiple stakeholders will be crucial, with compliance to the ELOs set by ECSA included in the success criteria. To successfully implement interventions in the undergraduate engineering curriculum will require a three-pronged approach to align, equip and

sustain. Firstly, aligning students, academics and management towards a new direction. Secondly, equipping the organization and its people with the required capabilities and skills to implement a strategy that supports social innovation in the curriculum; and finally, institutional change – sustaining the change through formal shifts in measurements and rewards.

Unlocking the resources and potential in Universities by applying social challenges as learning opportunities is not a novel concept. The salient benefits of integrating community-driven research activities into the curriculum are known. Organized voluntary associations are seeing more students volunteering their time and skills for extracurricular activities that promote social change. The educational benefits of cooperative learning, working in multidisciplinary teams and implementing project-based learning have long been established, but it is not yet the norm in higher education. The opportunity to drive social change and develop change agents through the tertiary education system are not commonly implemented nor established practice, particularly not in South African Universities. Changing perceptions and research culture are key facets that will require facilitation through broad participation.

V. CONCLUSION

The reasons for the seemingly slow uptake of social innovation in the engineering curriculum in South Africa could be attributed to several factors, including the perceived academic risk for students, an overloaded curriculum, additional burden on financial and human resources, a performance management system that promotes institutional ranking and individual performance, difficult-to-assess learning outcomes, and resistance to change. The R&P Office represents an engineering faculty's response to these changes in the pursuit of creating a transformative knowledge partnership with the communities which universities aim to support and serve.

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