WIP: A Delphi Study on Identifying Competencies for Entrepreneurial Opportunity Recognition and Social Impact Measurement of Engineers

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Abstract

Technology plays a key role in tackling major social challenges in the present time, such as clean water and healthcare accessibility. This fact opens new doors for engineers, who are interested in creating social value based on their technical expertise by creating their own technology social ventures. To pursue such a career, engineers need to develop various competencies beyond their core technical expertise, while it remains fundamental. Among the various competencies, a few noteworthy involves opportunity recognition (OR) and social impact measurement (SIM). Engineer-entrepreneurs who want to create social value with technology need to be able to recognize entrepreneurial opportunities for the social value creation, and once the venture is established, they need to be able to assess whether their venture is making the intended social impact. However, there is limited knowledge in specific sub-competencies needed for OR and SIM, which makes it difficult for educational institutions and professional organizations to design structured training programs that effectively prepare engineers for this role.

This work-in-progress study, therefore, introduces our ongoing efforts to build expert consensus on the essential sub-competencies for engineers who launch and manage their own technology social ventures. Our central research questions are: (1) What sub-competencies are required for engineers to identify opportunities for launching their own technology social ventures? and (2) What sub-competencies are required for engineers to effectively measure the social impact that their ventures are making? To answer these questions, we are employing the Delphi study method with three rounds of survey data collection and analysis. The anticipated outcome of this research is a detailed competency framework, validated through expert input. The outcome of this study will provide the basis for new curriculum development or refinement in engineering education, with the emphasis on technology entrepreneurship for social impact.

Introduction

Technology social ventures are organizations focused on addressing social issues using innovative technologies in a way that is financially sustainable and market-oriented [1], [20]. Technology-based social entrepreneurship has emerged as one of the critical pathways for addressing persistent global challenges such as access to clean water, healthcare, and climate change [2]. As technological solutions increasingly underpin efforts to create social value, engineers are uniquely positioned to contribute to these ventures by leveraging their technical expertise in socially impactful ways.

However, success in technology-based social entrepreneurship requires more than technical problem-solving skills alone [3], [21]. Engineers who pursue socially oriented entrepreneurial pathways must be able to recognize viable entrepreneurial opportunities that generate social value and assess whether their ventures are producing the intended social impact [4]. These competencies, commonly referred to as opportunity recognition (OR) and social impact measurement (SIM), are increasingly viewed as essential for engineer-entrepreneurs engaged in technology-based social entrepreneurship [4]. Despite growing interest in this domain, the literature offers limited clarity regarding the specific sub-competences that underpin effective OR and SIM for engineers, creating challenges for both research and educational practice [4].

Engineers traditionally focus on problem-solving and technical skills, which are foundational to their professional education and practice [5]. However, performing effectively within the realm of social entrepreneurship requires a multifaceted skill set that includes an understanding of social contexts, stakeholder engagement, and the capability to measure social outcomes [6]. The lack of clearly identified sub-competencies for OR and SIM may present a barrier for educational institutions and professional organizations seeking to design structured education programs that prepare engineers for technology-based social entrepreneurship. As engineering education continues to respond to evolving societal and workforce demands, there is a need to identify and validate these sub-competencies through systematic and expert-informed approaches.

This work-in-progress study addresses this gap by seeking expert consensus on the essential sub-competencies required for engineers engaged in technology social entrepreneurship, with a specific focus on opportunity recognition and social impact measurement. Using a Delphi study design involving multiple rounds of expert surveys, we examine two guiding research questions: (1) What sub-competencies are required for engineers to identify opportunities for launching their own technology social ventures? and (2) What sub-competencies are required for engineers to effectively measure the social impact that their ventures are making? A panel of experienced technology social entrepreneurs will be engaged to iteratively share, refine, and converge their expert judgments on the critical knowledge, skills, and attitudes associated with OR and SIM. The Delphi method is particularly well-suited for this inquiry, as it enables consensus building in areas where empirical evidence is limited and expert insight is central.

The anticipated outcome of this study is a validated competency framework that articulates the sub-competencies necessary for engineers pursuing technology-based social entrepreneurship. This framework is expected to inform curriculum development, professional training, and future research aimed at strengthening engineers' capacity to create and assess social impact through technological innovation.

Literature Review

Opportunity Recognition

The term opportunity recognition (OR) is generally viewed as one of the main competencies associated with entrepreneurial activity needed for both venture creation and performance. Prior research identifies opportunity-related competencies alongside relational, conceptual, and strategic competencies as central to entrepreneurial success and as predictors of entrepreneurial behavior [7]. OR is generally considered an intentional process that includes environmental scanning, information processing, and turning ideas into viable opportunities rather than being a mere spontaneous insight [8], [9].

Research indicates that opportunity recognition is strongly influenced by prior knowledge, entrepreneurial awareness, and motivation; thus, OR is grounded in cognitive and behavioral sub-competencies that can be developed through education [10]. In solving social problems, OR consists of identifying unmet social needs and imagining solutions that can bring about considerable social value [11]. Additionally, social capital and access to diverse networks not only facilitate the recognition of opportunities but also make it easier to get information on stakeholders' requirements concerning technologies and markets [9], [12]. In engineering and STEM education, the incorporation of the entrepreneurship frameworks considers opportunity recognition as a major learning outcome, which in turn reaffirms its position as a structured competency set rather than a single skill [13], [14].

Despite this collection of studies, there is a limited consensus on the exact sub-competencies that enable engineers to identify the opportunities in technology-based social ventures. Researchers have come up with general attributes like creativity, alertness, and networking, but still have not specifically explained how these competencies manifest in engineering contexts that integrate technical innovation with social value. This lack of clarity highlights the need for expert consensus to delineate engineer-specific opportunity recognition sub-competencies.

Social Impact Measurement

Social impact measurement (SIM) has become an increasingly important area within social entrepreneurship research. Previous studies indicate that funders, policymakers, and investors demand more evidence of social impact, while there is a limited consensus on definitions and measurement procedures for measuring social impact [15]. Different social ventures have been practicing SIM, but reviewing their works shows that there is a wide gap in defining, measuring, and operationalizing social impact [16].

At the same time, Social Return on Investment (SROI) and Impact Reporting and Investment Standards (IRIS) provide a series of structured methods for impact evaluation, but often they need to be adapted and provided with resources, especially for early-stage firms [15], [17]. Recent research promotes hybrid and participatory approaches that combine standardized metrics with context-specific, stakeholder-informed indicators to better reveal intricate social transformation [17]. SIM is closely linked to organizational learning, legitimacy, and strategic decision-making; however, it is found that a lot of social enterprises have difficulties in fitting their measurement practices to their mission and capabilities [16].

Despite the growing emphasis on SIM, there remains a considerable ambiguity regarding the specific sub-competencies engineers need to measure social impact effectively in technology-based social entrepreneurship. The lack of agreement among the stakeholders further solidifies the necessity of expert-driven initiatives to delineate and rank the skill sets for impact measurement that are pertinent to existing practice.

Methodology

Research Design

This work-in-progress study employs a Delphi study design [18] to build consensus among experts regarding the sub-competencies needed for technology-based social entrepreneurship to recognize opportunities and measure social impact. The Delphi method is well-suited for this research, as it supports structured synthesis of expert judgment in areas where empirical evidence is limited [19]. The study is engaging practitioners with hands-on experience in venture creation and impact evaluation, thus iteratively refining specific competency sub-constructs through feedback. Through multiple rounds of structured surveys, the method will enable iterative refinement of expert judgments.

Delphi Instrument Development

The initial instrument for this study was developed by the research team based on an extensive review of the literature on technology social entrepreneurship, opportunity recognition, social impact measurement, and engineering entrepreneurship education. Sources informing the initial pool of competencies included prior conceptual and empirical studies on entrepreneurial opportunity recognition, social value creation, and impact assessment frameworks. An initial list of competencies was generated to capture the knowledge, skills, and attitudes associated with OR and SIM in the context of engineers managing their own technology social ventures. The research team reviewed this list to identify overlapping, redundant, or conceptually similar items. Duplicative statements were removed, and closely related competencies were consolidated to improve clarity. This process resulted in a preliminary instrument intended for use in Round I of the Delphi study.

The Round 1 instrument employs multiple response formats aligned with the study's research questions on opportunity recognition (OR) and social impact measurement (SIM). The survey first began with open-ended questions to ask participants to describe how effective technology social entrepreneurs recognize or create opportunities and measure social impact. Panelists are then asked to rate the importance of predefined competencies using a five-point Likert-type scale ranging from 1 = Not Important at All to 5 = Extremely Important for capturing expert judgments regarding the relevance of each competency. To assess relative priority, panelists also complete forced-ranking tasks in which competencies within each domain are ranked from most important to least important, with no ties permitted. In addition, the instrument includes open-ended questions that invite panelists to identify additional competencies not represented in the initial lists, allowing for the incorporation of experiential insights and the refinement of the competency set in subsequent Delphi rounds. The complete Delphi Round 1 survey tool can be found below.

Delphi Round 1 Questions. The purpose of this study is to identify and build consensus around key competencies (knowledge, skills, and attitudes) in two domains: opportunity recognition/creation (OR) and social impact measurement (SIM) in technology-based social entrepreneurship. In Round 1, we ask you to evaluate the importance of competencies identified in the literature and suggest additional competencies that you believe are essential.

Section 1. Opportunity Recognition/Creation

Q1.1. [Open-ended question] Please describe in detail (200–250 words or longer) how a good social entrepreneur identifies or creates new opportunities for technology-based social entrepreneurship. You may reflect on your own experience or concrete examples you observed or heard. What processes, skills, or mindsets do you think they can rely on when recognizing opportunities?

Q1.2. The following list shows some prominent competencies that scholarly literature discusses as factors that play inevitable roles in entrepreneurial opportunity recognition/creation. Please rate the importance of each competency on a scale from 1 (Not Important at All) to 5 (Extremely Important), based on your experience:

1. **Leveraging Prior Knowledge and Experience:** Being able to draw from prior knowledge and entrepreneurial experiences.
2. **Social Capital Building:** Being able to develop and maintain networks that provide support, information, and access to resources.
3. **Creativity:** Being able to generate novel, useful, and valuable ideas that may lead to opportunities.
4. **Analyzing Environmental Conditions:** Being able to analyze environmental conditions (e.g., market changes, competition, or regulatory shifts) that impact entrepreneurial activities.
5. **Entrepreneurial Alertness:** Being able to notice opportunities overlooked by others.
6. **Systematic Search:** Being able to intentionally gather and analyze information relevant to potential new opportunities.

Q1.3. [Ranking question – separate page from Q1.2] Now, we would like you to **rank** the opportunity recognition competencies you rated just before in order of their importance. Please rank the six competencies from most important (1) to least important (6) based on how critical you believe each one is for successful opportunity recognition/creation. **No ties are allowed (each rank 1 through 6 should be used exactly once)**:

1. **Leveraging Prior Knowledge and Experience:** Being able to draw from prior knowledge and entrepreneurial experiences.
2. **Social Capital Building:** Being able to develop and maintain networks that provide support, information, and access to resources.
3. **Creativity:** Being able to generate novel, useful, and valuable ideas that may lead to opportunities.
4. **Analyzing Environmental Conditions:** Being able to analyze environmental conditions (e.g., market changes, competition, or regulatory shifts) that impact entrepreneurial activities.
5. **Entrepreneurial Alertness:** Being able to notice opportunities overlooked by others.
7. **Systematic Search:** Being able to intentionally gather and analyze information relevant to potential new opportunities.

Q1.4. [open-ended question] What other opportunity recognition competencies that were not listed above do you consider important? Please describe each additional competency and why you find it essential, providing examples from your experience if possible.

Section 2. Social Impact Measurement

Q2.1. [Open-ended question] Please describe in detail (200–250 words or longer) how a good social entrepreneur can evaluate the social impact of their work. You may reflect on your own experience or concrete examples you observed or heard. In your response, you may wish to address:

- What specific outcomes or changes a social entrepreneur looks for (e.g., community, economic, environmental).
- What methods or tools they use (e.g., surveys, interviews).
- How they decide whether an initiative was successful.
  You may also share a brief example of a project or initiative where measuring impact was successful.

Q2.2. The following list shows some competencies that scholarly literature discusses as helpful in social impact measurement. Please rate the importance of each competency on a scale from 1 (Not Important at All) to 5 (Extremely Important), based on your experience:

1. **Applying Social Impact Assessment Methodologies:** Being able to use established approaches (e.g., SROI, logic models, cost–benefit analysis) to evaluate social impact.
2. **Data Collection & Analysis Skills:** Being able to design and use both qualitative and quantitative tools to gather evidence of impact.
3. **Outcome/Indicator Development Skills:** Being able to define measurable outcomes and indicators aligned with mission and stakeholder needs.
4. **Engaging Community in the Evaluation Process:** Being able to deliberately seek communities' involvement in the evaluation of the planned interventions
5. **Coordinating Multiple Stakeholders**: Being able to facilitate discussion, collaboration, and negotiation among different stakeholders involved in the planned interventions.

Q2.3. [Ranking question – separate page from Q2.2] Now, we would like you to **rank** the social impact measurement competencies you rated just before in order of their importance. For each competency, assign ranks, with 1 = most important and 5 = least important, in terms of their criticality to successful social impact measurement. **No ties are allowed (each rank 1 through 6 should be used exactly once)**:

Q2.4. [open-ended question] What other competencies that weren't listed above are needed for effective social impact measurement? Please describe each additional competency and why you find it essential, providing examples from your experience if possible.

Expert Panel Selection

The Delphi panel is made up of around 10-20 experts from two different groups that are complementary to each other. The first group consists of people who have experience in launching their own technology-based social ventures with an engineering background (at least one degree in engineering or computer science, BS degree or higher), which allows them to have direct experience with opportunity recognition in the socio-technical context. The second group consists of professionals working in social impact measurement and impact investment, thus providing expertise in evaluating social outcomes across different ventures and identifying good venture opportunities.

The panelists were chosen because they had been directly involved in the opportunity recognition and/or social impact assessment that were related to social ventures. Previous Delphi studies indicate that involving 15-30 experts in two to three rounds is sufficient to reach a stable consensus while minimizing participant fatigue [18], [19], but for highly specialized and selected groups of participants smaller number of experts may be sufficient. The combination of the two expert groups allows for the triangulation of the perspectives coming from both the venture creation and impact evaluation, which in turn strengthens the relevance and applicability of the final competency framework.

Delphi Procedure

The research implements a three-round Delphi procedure. The first round invites participation from experts as open-ended answers, importance ratings, and ranking tasks related to opportunity recognition and social impact measurement competencies to gather their expert views. The second round will show a list of competencies that have been refined based on the results of the first round and will also provide anonymized summary feedback that will allow experts to reconsider their positions. The third round will aim to get confirmation and stabilization of expert consensus on the final sub-competencies set. This iterative design endorses the unfolding of the source of shared priorities, and at the same time, it curtails the effect of the most dominant person in the group.

Planned Data Analysis and Consensus Criteria

Data analysis procedures are being designed to align with the mixed-format structure of the Delphi Round 1 instrument, which includes open-ended questions, Likert-type importance ratings, and forced-ranking tasks across the two focal domains: opportunity recognition/creation (OR) and social impact measurement (SIM). Responses to the open-ended questions (Q1.1, Q1.4, Q2.1, and Q2.4) will be analyzed using an inductive thematic analysis approach. An initial round of open coding will be conducted to identify recurring concepts, processes, skills, and mindsets referenced by panelists. Codes will then be refined and grouped into higher- order categories corresponding to knowledge, skills, and attitudes relevant to OR and SIM. Attention will be paid to competencies that appear across multiple expert responses, as these reflect convergence of expert judgment beyond the predefined items. New competencies suggested by panelists will be compared against the existing competency list to identify overlaps, extensions, or conceptually distinct additions. Competencies that are clearly redundant with existing items will be integrated into broader constructs, while those representing novel or insufficiently captured dimensions will be retained for consideration in subsequent Delphi rounds.

Responses to the Likert-type rating questions (Q1.2 and Q2.2) will be analyzed using descriptive statistics. Each response option will be converted to a numerical value ranging from 1 (Not Important at All) to 5 (Extremely Important). For each competency, median and interquartile range (IQR) scores will be calculated to assess the central tendency and dispersion of expert judgments. A priori criterion for consensus will be applied such that a competency will be considered to have reached preliminary consensus if the interquartile range (IQR) is equal to or less than 1, indicating reasonable convergence of expert opinion. In addition, competencies will be retained for further consideration only if they achieve a median score of 3.5 or higher, reflecting agreement above the neutral midpoint. Competencies failing to meet one or both criteria will be flagged for re-evaluation in subsequent Delphi rounds.

Responses to the ranking questions (Q1.3 and Q2.3) will be analyzed to capture the relative priority experts assign to competencies within each domain. Because ranking tasks require respondents to make explicit trade-offs, they provide complementary insights to the Likert-scale ratings. For each competency, mean rank scores will be calculated across panelists, with lower mean ranks indicating higher perceived importance. Rank distributions will be examined to assess consistency in prioritization among experts. Competencies with consistently high rankings across panelists will be interpreted as core competencies within the OR or SIM domains, while those with wide variation in rank will be identified as candidates for further discussion or refinement in later Delphi rounds.

Expected Contributions, Implications, and Conclusion

The expected result of this study is a framework of sub-competencies of opportunity recognition and social impact measurement tailored specifically for engineers engaged in technology-based social entrepreneurship. This framework will inform the design of engineering entrepreneurship curricula, co-curricular activities, and professional training programs aimed at entrepreneurship for social impact. For researchers, the study brings conceptual clarity to OR and SIM in engineering contexts and opens the way for future empirical validation and assessment development. Practitioners and professional organizations will find this framework useful for identifying the capabilities needed for the engineers to recognize socially impactful opportunities and assess venture outcomes in the study.

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