ABSTRACT

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Characterizing Enabling Innovations and Enabling Thinking.
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The pursuit of innovation is engrained throughout society whether in business via the introduction of offerings, non-profits in their mission-driven initiatives, universities and agencies in their drive for discoveries and inventions, or governments in their desire to improve the quality of life of their citizens. Yet, despite these pursuits, innovations with long-lasting, significant impact represent an infrequent outcome in most domains. The seemingly random nature of these results stems, in part, from the definitions of innovation and the models based on such definitions. Although there is debate on this topic, a comprehensive and pragmatic perspective developed in this work defines innovation as the introduction of a *novel* or *different* idea into practice that has a positive *impact* on society. To date, models of innovation have focused on, for example, *new* technological advances, *new* approaches to connectivity in systems, *new* conceptual frameworks, or even *new* dimensions of performance – all effectively building on the first half of the definition of innovation and encouraging its pursuit based on the novelty of ideas. However, as explored herein, achieving profound results by innovating on demand might require a perspective that focuses on the *impact* of an innovation. In this view, innovation does not only entail doing new things, but consciously driving them towards achieving impact through proactive design behaviors. Explicit consideration of the impact dimension in innovation models has been missing, even though it may arguably be the most important since it represents the *outcome* of innovation.

With this in mind, this qualitative study focuses on creating a comprehensive impact-based perspective of innovation that: 1) classifies innovations by their impact and creates

a model trajectory of innovations and their impact over time, and 2) develops an end-to-end design framework informed by the impact-based innovation model. To achieve this impact-based perspective, the study engaged in a multifaceted approach with two separate yet interrelated research streams.

The first research stream focused on characterizing what is herein termed the *enabling innovation* model. Classifying innovations by their impact and understanding the development of impact over time inherently requires a definition of innovation impact. A scholarship of integration study was employed to synthesize disparate impact perspectives throughout the policy, science, and business innovation literature into a transdisciplinary perspective of the impact of innovations. As a result, in this study, impact is defined as the degree to which an innovation alters the way individuals, groups, and societies live and act, and can be decomposed into the fundamental dimensions of *reach*, *significance*, and *paradigm change*. To create an impact-based classification and model trajectory of innovation, a set of nine strategically selected historical innovation cases were examined, using secondary historical research sources as data, to extract themes regarding common impact characteristics, development trajectories, and possible screening mechanisms. Based on these cases and impact dimensions, the model contrasts what are herein termed *enabling* innovations with *progressive* innovations. Enabling innovations exploit a new paradigm that alters worldviews, have broad reach across individuals, groups, and societies, and significant impact across measures of economics, environment, health, and culture. These innovations generate an impact cascade that affects many application spaces, take many architectural forms, and address multiple families of problems. At the other end of the spectrum, progressive innovations build on a working paradigm, have limited reach and drive focused changes across select measures of economics, environment, health, and culture. Both forms of innovation are complementary and fundamental to societal advance, and this enabling-progressive model suggests that a few innovations drive the majority of value creation in society. The research also investigated the development of enabling innovations, highlighting three

key stages: *the stage of breakthroughs, the enabling window,* and *the progressive cascade.* Each of these stages has considerable variations in impact. Study of historical cases using the model as a guide highlight patterns that can be applied to identify, screen and pursue concepts with enabling potential, especially with regard to early decisions in the enabling window that can shape the future impact of an innovation.

The second research stream focused on creating a framework of patterns of thought and action that can guide the pursuit of enabling innovations. Successful capture of enabling innovations, particularly while in the enabling window, requires new behaviors to proactively envision, shape, and pursue enabling concepts. This research investigated these behaviors and, in particular, the differences with behaviors typically employed to drive progressive innovation activity. This framework of patterns and behaviors – herein termed the enabling thinking framework – was developed through a multifaceted approach, integrating evidence from: 1) a scholarship of integration study on design, innovation, entrepreneurism, and learning behaviors, 2) thematic analysis of the actions of stakeholders that participated in the history of the cases analyzed to build the enabling innovation model, and 3) thematic verbal protocol analysis of 28 performance tasks with a broad population of innovation consultants, corporate innovation leaders, and faculty and students recognized as innovative in their institution. The framework is anchored in the design process and consists of a set of design patterns and behaviors that are tailored to the challenges of achieving enabling innovations.

The combination of the enabling innovation model and enabling thinking framework makes this research study unique, because it frames the types of innovations to be pursued for high-impact and simultaneously outlines the competencies and key philosophies to achieve this type and scale of goal. Beyond defining enabling innovation, this work aims to open up a field of study that goes from simply "designing" to "designing for models of innovation" in which innovation archetypes can guide innovation pursuits throughout society – and facilitate intentional innovation.