



The importance of the technologically able social innovators and entrepreneurs: A US national laboratory perspective



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ABSTRACT

A country's National Innovation Policies (NIP) often center on military, energy or other national security missions. Yet many countries' NIPs have resulted in tremendous societal benefit through both planned and unplanned action not associated with these goals. Socially important technology product platforms often are developed at facilities that are part of National Innovation Systems. Yet the policies that govern Social Entrepreneurial Action (SEA) at these facilities are unclear. If there is not a place for SEA in these facilities for technology transfer practice then there is cause for concern.

Here we add to the growing literature on SEA by utilizing the case study method to investigate how SEA has been utilized by the US National Innovation Systems (NIS) for the benefit of society. We do this by investigating two cases which emphasize internal (corporate) and external SEA in a research facility within the US NIS. We demonstrate how a US national laboratory's external engagement of SEA led to one of the most important innovations of the last half of the 20th century – the Laminar Flow Clean Room. We also show how internal SEA led to the emergence of the National Institute for Nanotechnology Engineering (NINE). The “NINE program” created a pathway enabling the emergence of nascent policy makers, technologists and entrepreneurial professionals. We then provide a model for SEA at US national laboratories through technology able social innovators and identify a new type of internal and external social entrepreneur – the Technologically Able Social Entrepreneur (TASE).

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1. Introduction

Our investigation is initiated with a short discussion of Social Entrepreneurship (SE) (Ulhøi, 2005) and Social Innovation (SI) (Cajaiba-Santana, 2014). Here we define our use of these terms in our study. Moreover, we discuss the importance of a technologically able social innovator (within management of technology innovation principles (Berg et al., 2015)) as agents that translate technology developed in the U. S. National Laboratories into societal value (Toole and Czarnitzki, 2007).

We next review National Innovation Policy (NIP) (Niinikoski and Moisander, 2014) and how NIP together with entrepreneurial action helps to shape a country's National Innovation System (NIS) (Lo et al., 2013). NIP is initiated in nearly all countries, including the United States (US), to meet the security needs of a nation (Samara et al., 2012). The U.S. NIS was born during the post-World War II cold war era. Post WWII NIP expenditures in the U.S. dwarfed all previous

investments giving rise to the systemization of Pre WWII practice creating the structure of its modern NIS (Arrow, 1962; Freeman, 1987; Mowery and Rosenberg, 1993; Nelson, 1993; Roessner, 1988). During the cold war the US spent as much as 80% of its research and development budget on military needs (U.S. Office of Management and Budget, 1995). Much has been made of turning “spears into plows” in NIP or the transformation of military, defense or other national mission efforts for other societal benefits to meet these changing roles (Said et al., 2012). Moreover, we briefly describe how regional centers of innovation (Haak et al., 2014; Hajek et al., 2014) are part of NIS and how those entities embrace social capital (Rutten and Boekema, 2007; Yoon et al., 2015). Finally, we use the competence perspective of a firm (Prahalad and Hamel, 1990; Walsh and Linton, 2001, 2002, 2011) to frame our effort.

We used our literature review of NIS, NIP, Social Entrepreneurship, Social innovation, technology innovation, and technology strategy to form the basis of our model development and case study review. We choose our cases in accordance with case study research practice which emphasizes longitudinal research methods (Yin 1994; Yin, 2009). We selected exemplar cases that reflected characteristics and problems identified in our conceptual framework and which are

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consistent with case study research practice (Eisenhardt and Graebner, 2007; Seawright and Gerring, 2008 and Yin, 2009).

Our first case was initiated in 1958 by US Gauge's request for assistance from a US national Laboratory. This occurred during the formation of the US NIS policy. The US system of national laboratories is a part of US NIS and they have been called "Cradles of Invention" in the US NIS (Tierney et al., 2012). Sandia National Laboratories (SNL) social innovators utilized external SE to enable the commercialization of the Laminar Flow Clean Room in the early 1960's (Beakley et al., 1966; Whitfield, 1962). This activity focused on one of the world's grand challenges -healthcare. We follow this early case study with another one to view how the use of SEA in US NIS matured over time. This second NIS case was focused on another of one of the grand challenges facing the 21st century world – education (Diamandis and Kotler, 2012).

We find that the use of SEA has increased and become more accepted in NIS systems over time. The mission of SNL includes "innovating and discovering new technologies to strengthen the nation's technological infrastructure" (SNL, 2014). SNL's internal SEA contributed to the establishment of the National Institute for Nanotechnology Engineering (NINE) program in the first decade of the 21st century.

We describe the concepts of the Technology Able Social Innovator (TASI) and the Technologically Able Social Entrepreneur (TASE). We find these to be critical components of SEA in the US NIS. Finally, we find that TASE and TASI have provided exceptional value to society in terms of quality of life, longevity, regional economic growth, job creation, and wealth creation (Walsh and Kirchoff, 2002) for over 50 years.

2. Literature review

Our literature review has four segments. The first is focused on SE and how we operationalized the concept in our technology intensive setting. The second focuses on SI and how we differentiate the concept from SE and operationalize it. The third focuses on the drivers that integrate SI and SE into NIS and NIP. The fourth provides a discussion of competency theory as the theoretical base for the inclusion of technology management into the concept of social entrepreneurship.

2.1. Operationalizing Social Entrepreneurship (SE)

SE brings value to society (Steyaert and Katz, 2004). It is a form of entrepreneurial action that addresses social problems by focusing resources on them (Dacin et al., 2010). The SE concept has greatly broadened and in that process become more ambiguous (Turró et al., 2014). Zahra and Harms (Harms et al., 2014; Zahra et al., 2009) emphasize individual motivations in defining SE.

Moreover SEA can be realized in 'for profit' enterprises like the micro lending efforts initiated by Grameen Bank (Conan, 2010; Grameen Bank, 2014); corporate social responsibility (Hmieleski and Baron, 2009; Young, 2001); and some suggest that for-profit SE are more sustainable especially in "Bottom of the Pyramid" community (Prahalad, 2006). Yet others feel uncomfortable with for-profit SEA organizations (Peredo and McLean, 2006) referring to the role of for profit organizations like Non-Governmental Organizations (NGO) (Ostrander, 2007). Still others suggest that SE includes: outcomes of organized philanthropy (Reis and Clohesy, 1999; Van Slyke and Newman, 2006; Thompson, 2002a,b; Jack, 2005); variety in the sources of social innovation (SI) (Bornstein, 2004), and sustainable ventures that generate social and economic value (Emerson and Twersky, 1996; Robinson, 2006). Finally, some researchers state that SE includes government action (Austin et al., 2006). Even though SE emphasizes social goals it must become sustainable and therefore must emphasize the simultaneous pursuit of economic and social goals often through innovation (Seelos and Mair, 2004).

For example, the founder of the Grameen bank, Muhammad Yunus, was awarded the Nobel Prize, for what he and others discussed as the "double bottom line" inherent in SEA. The "double bottom line" is a

concept that academic researchers and others use to denote that profit as well as societal benefits are considered when reviewing the success parameters of a firm. More recently (Fairfax, 2004) added the effects on the environment forming a triple bottom line (Elkington, 1998) approach and this was then furthered with the addition of cultural issues in order to develop a quadruple bottom line (Mahoney and Potter, 2004). This encompassing SE term incorporates for profit activities like positive social change from entrepreneurial action in both large firms and small firms through innovation (Tracery and Phillips, 2007; Young, 2001). Yet the insights provided by these researchers do not stress the technological elements which are critical for the use of SEA in NIS settings.

Finally, some have suggested typologies for the activities of social entrepreneurs – "social bricoleurs," social constructionist, and social engineer (Dacin et al., 2010; Zahra et al. (2009)). We extract six common factors from SE literature to operationalize SE in our effort. They are: (1) the characteristics of individual social entrepreneurs; (2) social entrepreneur's operating sector; (3) the processes and resources used by social entrepreneurs; (4) their primary mission, activities and outcomes associated with them; (5) social entrepreneurs motivation and (6) the ability and desire to exploit (launch) social entrepreneurial activities.

2.2. Operationalizing the Social Innovation (SI) literature

We have chosen to differentiate Social Innovation (SI) (Kanter, 1998) from Social Entrepreneurship (SE) in a technology intensive arena. In order to do so we incorporate the technology based innovation literature into the SI literature. This helps to define a Technology Able Social Innovator (TASI) and provides the basis to differentiate them from Technologically Able Social Entrepreneurs (TASE).

Innovation in the management of technology literature is accomplished by an innovator only after their technology change is used by some type of a consumer (Yanez et al., 2010). If the technology change is not used by someone it may well be an invention but it is not an innovation (Marquis, 1969). A TASI is then someone who creates a technology based change that is used for the good of society.

Here we use a similar argument to that of Marquis (1969) to differentiate the TASI from the TASE. We demonstrate that TASIs and TASEs are different aspects of technology based social entrepreneurial action. We describe how a TASI does not always become TASE (Phills et al., 2008). The distinction between a TASE and and TASI (Pol and Ville, 2009) is critical in understanding how the social entrepreneurial action vector works in national innovation systems. We initiate this distinction with a discussion of SI and SE below.

The term SI (Cajaiba-Santana, 2014) incorporates a similar but fewer set of factors than SE. Social innovators do not have to take the final entrepreneurial act and therefore SI is a wider more inclusive term than that of SE (Adjebeng-Asem, 1990). Indeed, SI (Bornstein, 2004) can be expressed in many actions including; corporate responsibility (Silvestre and Silva, 2013; Turró et al., 2014), and sustainability action (Mair and Marti, 2006). The first inclusion of Technology into the SI literature by McElroy (2002) suggests that technology based SI can include IP based social capital.

Technology able social innovators invent or create new expressions of their work that are then used by someone else making their work innovations and themselves innovators (Marquis, 1969; Yanez et al., 2010). However, they many times they do not take the next step by becoming risk taking entrepreneurs as (Cantillon, 1979, 1952) and therefore are not social entrepreneurs. In order to create value for the society they must take the entrepreneurial step themselves or engage internal or external social entrepreneurs.

Many SNL technologists create innovations which benefit society and in the process become social innovators. Many of them see other applications for their innovations that could be serve society. Often, however, these innovators have no interest in becoming an

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