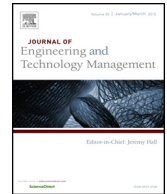




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# Technology management as a profession and the challenges ahead

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### ABSTRACT

This paper is aimed at current and future managers in the field of technology management (TM), and those who train and educate them. After briefly describing TM as a management discipline, the potential challenges likely to rise in the field are introduced according to three processes given in the TM framework: innovation, operation and strategy. Then, a set of propositions are developed regarding the potential impact of those challenges on TM professionals. Concentrating on a long term perspective provides TM professionals with the opportunity to consider their existing knowledge and skill base so that they can prepare for the challenges they will face in the future. The paper ends with implications for professionals and educators.

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## 1. Introduction

This paper aims to understand the challenges facing managers who are pursuing a career in the field of technology management (TM). The discipline of TM dates back to the mid 1950s (Allen, 2004), becoming an established discipline in the late 1980s (Cetindamar et al., 2009). In the 21st century, TM has become a 'traditional business subject', according to the International Association to Advance Collegiate Schools of Business (AACSB, 2009).

The literature describes the intellectual development of TM as a field, and the trends in influential journals that publish papers on TM (Linton and Thongpapanl, 2004; Thongpapanl, 2012; Cetindamar et al., 2009; Duan, 2011). The core focus of TM has changed significantly over the past decades; from research and development (R&D) to strategic management, and ultimately to innovation management (Drejer, 1997; Horwitch and Stohr, 2012).

However, the literature is rather limited when it comes to publications about the profession itself and the people who are responsible for the management of technology. A review of 10 TM-oriented journals (Thongpapanl, 2012) that are published since 2000 shows the limited coverage of the TM profession and education. As shown in Appendix A, these TM journals altogether have published about 40 publications on the topics of TM 'education', 'career', 'profession', 'manager', and 'Chief Technology Officer' (CTO). Perhaps not surprisingly, the practitioner-oriented Research-Technology Management journal is prominent, with nine publications related to these topics. In fact, this journal devoted a special issue to the topic of the CTO (May–June 2011). The remaining journals have published one or two individual papers on general TM education and managerial issues.

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In recent years, a few papers on TM education have been published (Badawy, 2009; Berg et al., 2015; Horwitch and Stohr, 2012; Labini and Zinovyeva, 2011; Van Wyk and Gaynor, 2014; Yanez et al., 2010) and CTO/technology managers (Deevi, 2011; Smith, 2003, 2007, 2011; Chipulu et al., 2013; Van der Hoven et al., 2012). The general management literature does not offer much help, either (Herstatt et al., 2007). However, there are few exceptions. For example, the Academy of Management Learning & Education journal published a special issue in 2009 on 'educating professionals for careers in innovation', where several papers discussed TM education specifically (Clarysse et al., 2009; Austin et al., 2009). There are also a few other journals such as Management Science that published works directly related to TM professions. However, this paper limits its focus to those studies published in academic journals in the field of TM alone due to our focus on understanding the TM profession from the TM discipline.

The gap in literature on the TM profession inspired the research described in this paper, to explore the challenges facing managers pursuing a career in the field of TM. In fact, this problem also applies to the business profession in general, despite it being based on a well-established and broad management discipline as discussed by Schoemaker (2008). Recently, a similar study has been undertaken to identify changing competence needs of engineers in New Zealand without particular emphasis on education (Pons, 2015). Another paper relates to project managers (Chipulu et al., 2013) and one to supply chain professionals (Prajogo and Sohal, 2013). So, we propose that the TM field should start considering the professional concerns as a theme for research. This is necessary in order to develop as a unifying professional identity as Schoemaker (2008) clearly highlights. As a humble start, this paper addresses the gap in two steps. Firstly, TM as a management discipline as it stands today will be introduced, in terms of the field and the profession. Secondly, and more importantly, the future challenges for the field and its professionals are identified. By doing so, we hope TM professionals could consider their existing knowledge and skill base and make plans to prepare for the challenges they might face in the near future. Similarly, academicians and educators should begin revising the educational programs designed for TM professions. The paper concludes with few suggestions for TM professionals and educators.

## 2. Technology management as a profession

### 2.1. Technology management

Due to the complex nature of firms and industries, it is difficult to describe where exactly firms exercise TM activities. Thus, TM framework of Phaal et al. (2004) considers technology as a resource and it emphasizes the dynamic nature of the knowledge flows that must occur between the commercial and technological functions in a firm. In the TM framework, all TM activities are typically linked to or embedded within the three core business processes: innovation, operational processes, and strategy (Phaal et al., 2004).

Considering TM as a dynamic capability (Teece et al., 1997), TM consists of planning, directing, controlling and coordinating the development and implementation of technological capabilities in order to shape and accomplish the strategic and operational objectives of an organization (Cetindamar et al., 2009). Technological capabilities are a collection of routines/activities in order to improve or develop products, processes and existing technology, as well as generating new knowledge and skills (Jin and Zedtwitz, 2008).

Even though TM is a distinct management discipline concerned with developing and exploiting technological capabilities that are changing continually, the general area of innovation management and the more specific issues associated with the management of technology and R&D are often confused (Zabala-Iturriagoitia, 2014). A close examination of the changes in the TM discipline during the period of 1996–2008 shows that innovation has become the leading topic in TM (Cetindamar et al., 2009). For example, a study that examined papers published in the journal of Technovation identified two major themes (Nambisan and Wilemon, 2003): technological innovation and TM. The former theme covers 84% of the journal's articles and deals with issues related to the technology innovation process and policies. The second theme, TM, takes the form of organizational structures intended to facilitate innovation. However, the dominance of one topic starts to misrepresent the TM field, resulting in confusion about the boundaries between innovation and TM. In order to understand what technology managers actually do, it is necessary to resolve this confusion.

Innovation management covers all managerial tasks related to all sorts of innovations. TM, on the other hand, is interested in technology innovations in addition to other technology-related managerial concerns that have little to do with innovation (Cetindamar et al., 2016). Thus, a solution that clarifies the boundaries between TM and innovation management is to use the following rule-of-thumb: TM and innovation management overlap only when an innovation is based on technology. For example, the development of a new television (TV) display technology involves a technology-based product innovation, so there is an overlap, while the development of a new sales channel for a TV is a marketing innovation, whereas the acquisition of a process technology to produce the TV display is related to TM. When it comes to services, the same rule applies. For example, Walk-in clinics accept patients on an ad-hoc basis and with no appointment required. They are innovative health care providers, but their innovation is not based on a technology. Some services are available only through technological innovations. For example, the banking sector offers Automatic Teller Machine (ATM) services that use technological hardware and specific software applications, and are thus an example of a technological innovation.

In addition, a specific innovation might fall into more than one innovation type, making TM and innovation management overlap. For example, the Airbnb Company offers a technology based innovation in the hospitality business, but it includes innovations in marketing, organization, processes and products. Established in 2008, Airbnb became one of the world's

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