



Research Forecasting for Health Information Technology (HIT), using technology intelligence

Nima A. Behkami ^{a,b}, Tugrul U. Daim ^{a,*}

^a Dept. of Engineering and Technology Management, Maseeh College of Engineering and Computer Science, Portland State University, Portland, OR, USA

^b Department of Medical Informatics and Clinical Epidemiology, Oregon Health & Science University, Portland, OR, USA

ARTICLE INFO

Article history:

Received 10 May 2010
Received in revised form 6 July 2011
Accepted 13 August 2011
Available online 15 September 2011

Keywords:

Health Information Technology
Technology adoption
Research Forecasting
Technology intelligence
Technology Forecasting
Healthcare

ABSTRACT

Due to the rapid pace of change in technology and its impact on society, there is an increasing demand for use of Technology Forecasting methods to improve policy planning and implementation. One such area is the field of Health Care and the impact of Health Information Technology (HIT) on this field. Using HIT has shown to be associated with reduced cost, improved quality, and better patient experience; yet HIT adoption has been slow. Therefore, there is a need to better understand the HIT adoption processes in order to meet the evolving requirements for health care delivery.

We propose collecting Technology Intelligence for use in Research Forecasting as part of the larger HIT Technology Forecasting efforts. In this study, we systematically probed for HIT-related technology intelligence in the fields of Information Systems, Engineering Management, and Medical Informatics. Results of our analysis show that all three fields are active in Health IT research, but could benefit from further collaboration. We were also able to identify instances of emerging journals and emerging topics in Health IT research. We conclude that it is indeed plausible and meaningful to collect technology intelligence on HIT adoption, to support the overall goal of improving healthcare delivery.

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1. Problem introduction

Due to the rapid rate of technological and societal changes, there is a growing demand for Technology Forecasting (TF). Public and private sector entities are applying TF from regional to global levels to gain competitive advantage, create social change, implement regulations, and more. Therefore, we propose gathering technology intelligence for forecasting and impact assessment in the field of Health Information Technology; this has not been previously done using the methods in the Technology Forecasting domain. We show how to establish technology intelligence, and how to probe this intelligence to support Health IT adoption. Our methodology may also be useful to other fields considering studying Technology Adoption.

Some of the methods popular for analyzing future technologies include: Technology Intelligence, Forecasting, Road Mapping, Foresight and Impact Assessment [1,2]. Some have even proposed integrating these different methods under a unified field of study: Technology Futures Analysis (TFA) [1]. There is an expectation that renewed focus on innovation and sciences, along with political and social factors, will be major drivers for more effective and efficient Technology Forecasting. In these times of change, the field of TF more so than ever is utilizing interdisciplinary concepts and integrating fields such as political science, computer science, and scientometrics to resolve the complex problems that effect society [2].

Using technology intelligence is a key to successfully forecasting technology and understanding its social impact. The exponential growth of internet and electronic communication has led to an increasing number of data sources that can be useful for gathering technology intelligence. Having the proper Information Technology tools to collect, analyze, and act on this data is of critical

* Corresponding author at: Dept. of Engineering and Technology Management, Maseeh College of Engineering and Computer Science, Portland State University, P.O. Box 751, Portland, OR 97207-0751, USA. Tel.: +1 503 725 4660, +1 800 547 8887x4660 (Toll-free); fax: +1 503 725 4667.

E-mail addresses: nima@pdx.edu (N.A. Behkami), tugrul@etm.pdx.edu (T. U. Daim).

importance to users of technology intelligence. For example, researchers have shown that through technology, intelligence organizations can link knowledge and ideas originating outside of their organization with internal competencies, to create new innovations and gain a competitive advantage in their marketplace [3].

2. Health IT and technology intelligence

In terms of annual spending, the healthcare industry in United States, is the largest delivery system in the world. However, this system is facing monumental challenges. For example, patients suffering from chronic illnesses account for approximately 75% of the nation's healthcare related expenditures. It is generally accepted that the use of Health Information Technology (HIT) can assist in solving the problem by reducing cost and increasing quality of patient care.

Even though the potential benefits of using HIT have been widely accepted, to date, adoption has been slow; for example, currently only about 20% of physician practices and 25% of hospitals use an Electronic Medical Record (EMR) [4]. Previous reviews have shown that broad use of health IT may improve health care quality, prevent medical errors, reduce health care costs, increase administrative efficiencies, decrease paperwork, and expand access to affordable care [5]. Additionally, interoperable health IT may improve individual patient care, and it may also bring many public health benefits including: early detection of infectious disease outbreaks around the country, improved tracking of chronic disease management, and evaluation of health care based on value enabled by the collection of de-identified price and quality information that can be compared [6].

To be able to accelerate the rate of HIT adoption, there is a need to better understand the organizational science that enables future planning and social change. Therefore, we intend to gather technology intelligence from existing research literature to partially support this goal. To that end, we identified four research questions:

- 1) Within the Management Science knowledge areas, which ones are actively investigating HIT adoption? (areas: *Technology Acquisition, Technology Adoption, Technology Assessment, Technology Diffusion, Technology Transfer*)
- 2) What are the research streams evaluating or forecasting HIT adoption issues? (streams: *Information Systems, Engineering and Technology Management, Medical Informatics*)
- 3) What are the current themes in Health IT adoption research?
- 4) How collaborative are the research networks investigating Health IT adoption?

To identify publications of interest, a comprehensive search was performed across Medical Informatics, Engineering Management and Business databases from 1940 to 2008. Medical Informatics publications are mainly housed in PubMed, which is a service of the U.S. National Library of Medicine that includes over 18 million citations from MEDLINE and other life science journals for biomedical articles. Articles related to Business & Economics were queried through major databases including Business Source Premier. In the Engineering and Information Science domain, Compendex, IEEE and other databases were queried. Science databases such as Web of Science were reviewed for Life Science and Social Science publications addressing Health IT adoption.

3. Advances in Technology Forecasting

Bibliometrics, text mining, clustering, database tomography, factor analysis, and taxonomies are among some of the most widely used tools for gathering technology intelligence. Daim et al. have used bibliometrics, patent analysis, and systems dynamics to forecast emerging technologies in fuel cell, food safety, and optical storage industries [7]. Database Tomography (DT) has been used to extract technical intelligence from a range of text-based data sources; for example, Science Citation Index (SCI). Kostoff has used DT for phrase frequency analysis, proximity analysis, and bibliometrics. Phrase frequency analysis provides the prevalent technical themes in literature, and Proximity analysis provides the relationships among the prevalent themes. Bibliometrics provides the following: recent most prevalent topical area authors; the journal that contains topical area papers; the institution that produces topical area papers; most frequent keywords used by topical area authors; authors' work sited most in topical area papers; and journals most sited in topical area papers [8].

Science and technology infrastructure at the national level has also been evaluated using TF methods. Clustering and bibliometrics have been used to identify structure of technical literature for Thin Films industry in Mexico [9]. Using a similar method, Indian's research literature has been examined using the following TF tools: 1) article clustering; 2) bibliometrics to identify value of collaborative research; 3) network mapping to identify networks of organizations publishing together, networks of organizations with common technical interests, and organizations with common interest that are not co-publishing together; and 4) trend analysis for placing results into historical context [10]. Bibliometrics, clustering, and thematic trends have also been used to identify and analyze science and technology core competencies in China [11]. The analysis, based on a two year window, showed that China's research article output has increased significantly over the last decade. And those Chinese publications concentrated on physical and engineering sciences, in contrast to the U.S. publications that concentrated more on medical, social and psychological sciences [12–14].

Another tool used in TF is applying term (keyword) frequency analysis as a way to identify important research and technology trends from journal articles. Of particular interest is the relationship between publication patterns and underlying technological developments. Using bibliometrics, one study extracted the commercialization gap between science and technology. Citation networks were used to link scientific publications with patents. The case report in solar cell showed that scientific research was more concerned with basic fundamentals, such as cell design itself, where patents were concerned more with applied use of technology in solar cell modules [15]. The results concluded that while for some instances scientific activity existed, there were no corresponding

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