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Management policies and the diffusion of data warehouse: a case study using system dynamics-based decision support system

Mohammed Quaddus [a,*], Arunee Intrapairot [b]

[a] *Graduate School of Business, Curtin University of Technology, GPO Box U 1987, Perth, WA 6845, Australia*
[b] *Rajamangala Institute of Technology, Northern Campus, Huay Kaew Road, Chiang Mai 50300, Thailand*

Abstract

This paper studies the impact of management policies on the diffusion of data warehouse (DW) in a large commercial bank in Thailand. A system dynamics (SD)-based decision support system (DSS) is developed and analysed for this purpose. System dynamics was used as the modelling tool because of its rigorous approach in capturing interrelationships among variables and in handling dynamic aspects of the system behaviour. A qualitative model is first formulated to understand the present state of the DW diffusion. The quantitative model is then formulated to simulate seven management policies. Findings unearth two dominant policies of 'increase level of training' and 'decrease training delay' that will speed up the diffusion significantly. None of the policies, however, achieve the bank's target diffusion level within a specified time period. Sensitivity analyses reveal various combinations of the dominant policies that the management can adopt. The analyses act as an eye-opener for the bank executives as they understand what can be feasibly achieved given a number of constraints. With easy interfaces and supportive tools, bank executives can use the DSS to test various scenarios, which will enhance their learning process and improve their decision making.

Keywords: Data warehouse; System dynamics; Banking; Case study

1. Introduction

Intense competition in the global market impels executives in organisations to make swift and appropriate decisions. Since good decisions need accurate and timely information, many organisations are inclined to invest in data warehousing technology in order to use information to support decision-making processes. The usage of data warehouses (DWs) is growing significantly, especially in the fields of financial services. Worldwide expenditure on DWs has climbed from $3.5 billion in 1997 to an expected $5.4 billion in 1999 [39].

A DW is a central source of data that is extracted, standardised and integrated from various operational and management databases of an organisation [38]. It typically provides clean information (reconciling differences in semantics, transaction dates, currencies, etc.) of sufficient breadth (integrating data from several sources) and depth (consolidating data to higher levels while still supporting queries down to the detailed level) [54]. Given these properties, successful DWs provide accurate and timely information, support more effective decision making, help organisations avoid costs before they occur, capitalise on

* Corresponding author.
E-mail addresses: quaddusm@gsb.curtin.edu.au (M. Quaddus), aruneei@hotmail.com (A. Intrapairot).

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previously unrecognised business opportunities, and provide mass customisation of products and services to fit customers' requirements [7,8,25,28].

Despite the above, the current potential benefits from DWs are still considered low, intangible and inconclusive, and projects take longer than expected. Consultants and vendors estimate optimistically that a DW can furnish the investment within 6 months to 3 years, with paybacks ranging from 100% to 700%. However, actual investors, particularly banks, rarely confirm benefits from investment [40]. Furthermore, quite a few DW projects end in failure even before full implementation owing to lack of immediate substantial economic returns on massive investment [24,25,67].

A careful analysis of the above problems reveals that a DW, like any other technology, requires in-depth planning and ultimately large scale diffusion to all potential users. It must be emphasised that benefits from a DW come, in fact, from the intensity of its usage. That is, the benefits cannot be obtained from the mere provision of the actual physical technology. Therefore, once a DW is adopted, enterprise-wide diffusion is a must. Appropriate policies are therefore needed to achieve sustained enterprise-wide diffusion of a DW.

1.1. Research objectives and questions

The primary research objectives of this paper are twofold: (i) to develop a system dynamics (SD)-based decision support system (DSS) to study the diffusion process of data warehousing technology, and (ii) to calibrate the DSS and apply it to study the impact of management policies on the diffusion of DW in a large commercial bank in Thailand. Thus, the following two research questions guide our research.

(i) What is a requisite model of diffusion of a DW for the bank?
(ii) What are the impacts of management policies on the diffusion of DW in the bank?

The paper is organised as follows. Section 2 presents the brief background information on the adoption/diffusion process of information technologies (IT) in general and banking technologies in particular, and on SD-based modelling of IT adoption/diffusion. Section 3 introduces the banking case with current information on the perception of the users towards technology usage. The qualitative diffusion model is developed in Section 4, while the transformation to quantitative model is presented in Section 5. Section 6 shows how the DSS is used for strategic policy analysis. Section 7 presents implications of the policy analyses for management of the bank. Conclusions are presented in Section 8.

2. Background

2.1. Adoption and diffusion of information technologies

Adoption is the process of selecting an innovation (technology, idea, process, etc.) for organizational use [32,50]. The need for adoption may come from internal or external forces. Internally, the organization may feel a need for a technology, and externally various agents (vendors, etc.) may persuade the organization to adopt a technology. On the other hand, diffusion is the process during which an innovation is communicated among members of a social system via certain channels over time. According to Rogers [50] a diffusion process consists of four main elements: an innovation, communication channels, time and a social system. It has been observed that diffusion of technology over time can be modelled by a logistic or S-shaped curve. The literature suggests that new technology is not adopted all at once. Some early adopters adopt new technology. If they are successful a bandwagon effect takes place and the potential adopters then imitate [33,50]. However, there is much variation in the slope of the S-shape curve. If the technology diffuses relatively rapidly, the S-shaped curve becomes quite steep. On the other hand, some technology may have a slower rate of diffusion resulting in a relatively flat S-shaped curve [50].

Information and communications technology (ICT), at present, is the main technology acquired in most countries, with more than 50% of the acquired