

E-commerce system simulation for construction and demolition waste exchange

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Abstract

This article introduces a quantitative approach to e-commerce system evaluation based on the theory of process simulation. The general concept of e-commerce system simulation is presented based on the considerations of some limitations in e-commerce system development such as the huge amount of initial investments of time and money, and the long period from business planning to system development, then to system test and operation, and finally to exact return; in other words, currently used system analysis and development method cannot tell investors about some keen attentions such as how good their e-commerce system could be, how many investment repayments they could have, and which area they should improve regarding the initial business plan. In order to exam the value and its potential effects of an e-commerce business plan, it is necessary to use a quantitative evaluation approach and the authors of this article believe that process simulation is an appropriate option. The overall objective of this article is to apply the theory of process simulation to e-commerce system evaluation, and the authors will achieve this though an experimental study on a business plan for online construction and demolition waste exchange. The methodologies adopted in this article include literature review, system analysis and development, simulation modelling and analysis, and case study. The results from this article include the concept of e-commerce system simulation, a comprehensive review of simulation methods adopted in e-commerce system evaluation, and a real case study of applying simulation to e-commerce system evaluation. Furthermore, the authors hope that the adoption and implementation of the process simulation approach can effectively support business decision-making, and improve the efficiency of e-commerce systems.

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1. Introduction

As a modern way to conduct business in the global economic environment, e-commerce is becoming an essential component integrated with traditional business processes in enterprises. In order to reduce risks and increase profits in e-commerce investments and provide the best services to their customers, enterprises have to find appropriate approaches to analysis their e-commerce strategies at business planning stage. Strategic management tools are designed for enterprises to evaluate their business strategies and can be used to evaluate e-commerce business plan. For example, the SWOT (strengths, weaknesses, opportunities, and threats) analysis is regarded as a popular way to conduct e-commerce business plan evaluation with business environmental scanning based on internal environmental factors (strengths and weaknesses) and external environmental factors

(opportunities and threats) [45]. In order to facilitate the application of the strategic management tools, different forms of applications are adopted such as checklist [36], rating system [46] and expert system [37], etc. Among these strategic management tools, computer driven business simulation tools enable participants to run with virtual business processes, experiment with different strategies, and compete with other companies or plans in a virtual business environment. As an example, the Marketplace [24,25] is a business simulator for integrative business courses, which provides decision content includes marketing, product development, sales force management, financial analysis, accounting, manufacturing and quality management. Regarding the application of computer simulation in e-commerce, the Marketplace strategic e-commerce simulation is designed specifically for the e-commerce courses, and it illustrates the business concepts of the e-commerce environment [25]. For an e-commerce system simulation, Griss and Letsinger [22] conducted their research into flexible, agent-based e-commerce systems with an experimental multi-player shopping

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game, in which agents represent buyers, sellers, brokers and services of various kinds, for demonstration and educational value, for experimenting with alternative individual and group economic strategies, and for evaluating the effectiveness of agent-based systems for e-commerce. Both academic and professional practice have proven that using computer driven simulation is an effective, efficient and economical way for e-commerce business plan evaluation.

However, it is hard to conduct simulation based on the detail flowchart of business processes within current e-commerce simulations environment as mentioned above. This actually makes a limit for applying e-commerce simulation. In fact, computer simulation has been applied to tackle a range of business problems leading to improvements in efficiency, reduced costs and increased profitability since the 1950s [40]. During this period simulation software tools are on the increase in various application areas [21] and process oriented simulation has been becoming popular in business management [43]. The authors believe that a process oriented simulation for e-commerce system evaluation is more directly perceived through the human sense, and their interest is to conduct a quantitative approach to e-commerce system evaluation based on the theory of process simulation.

The e-commerce system simulation is an integrative procedure to run a business process oriented simulation programme based on both internal and external business environmental factors to demonstrate the actual results of implementing an e-commerce business model by using computer driven software toolkits. The e-commerce system simulation is an effective, efficient and economical approach, and can be used to experiment e-commerce business models and to evaluate different e-commerce business plans, in which quantitative analysis is required by decision makers. The adoption of e-commerce system simulation can overcome some limitations in e-commerce system development such as the huge amount of initial investments of time and money, and the long period from business planning to system development, then to system test and operation, and finally to exact return; in other words, the proposed process oriented e-commerce system simulation can help currently used system analysis and development method to tell investors in a very detailed way about some keen attentions such as how good their e-commerce system could be, how many investment repayments they could have, and which area they should improve from initial business plans.

The definition of the proposed process oriented e-commerce system simulation normalizes its procedure to apply a process simulation to experiment an e-commerce model. In this regard, this article will focus on the adaptation of an e-commerce model into a process simulation environment. And the authors will achieve this through experimental case studies with an e-commerce business plan, called Webfill, for online construction and demolition (C & D) waste exchange in Hong Kong. The methodologies adopted in this article include literature review, system analysis and development, simulation modelling and analysis, and case study. Results from this article include the conception of e-commerce system simulation, a comprehensive review of simulation methods adopted in e-commerce system

evaluation, and a real case study of applying simulation to e-commerce system evaluation. Furthermore, the authors hope that the adoption and implementation of process simulation can effectively support business decision-making, and improve the efficiency of e-commerce systems.

2. Background

Generally speaking, C & D waste can be reduced by using innovative construction techniques and management methods, such as adopting prefabrication and installation technologies, recycling C & D debris, reducing the possibility of waste generation in architecture and structure design, and improving site-based materials management, etc. [2]. Although these approaches are proved to be effective to some extent, most of them are still in a stage of research, and contractors usually do not like to invest in high-cost techniques and approaches if they were not forced to do so. For example, surveys show that local constructors in Hong Kong feel it is expensive to use new machinery and automation technology [23]; most (68~85%) local constructors agree to adopt alternative low-waste but high-cost techniques only when they are demanded by the designers, the specifications, or the clients [38,39]. As a result, C & D wastes are normally not controlled effectively on construction and demolition sites in Hong Kong. According to statistical data, C & D debris frequently makes up 10~30% of the waste received at many landfill sites around the world [20], but this figure is over 40% in Hong Kong (refer to Table 1).

On the contrast to the percentage in other advanced countries, for example, C & D debris makes up only 12% of the total waste received at Metro Park East Sanitary Landfill of Iowa State in the United States [30], the quantity of C & D waste in Hong Kong is about three to four times higher. So there is an urgent need to deal with the problem and to find a practical solution for C & D waste reduction in Hong Kong.

One of the most important C & D waste control regulations in Hong Kong is the trip-ticket system (TTS) for disposing waste from work sites to disposal facilities and landfills, which was originally recommended in the *Waste Disposal Ordinance and Waste Disposal (Chemical Waste) (General) Regulation* in Hong Kong in 1998, and was formally adopted in the HK construction industry on July 1, 1999 [18,19]. The aim is to control the illegal dumping and proper disposal of C & D waste at public filling facilities or landfills. The TTS is a recording system for orderly

Table 1
An analysis of C & D waste disposal in Hong Kong [10–19]

Year	Amount of waste disposal at landfills (ton/day)		Percentage of C & D waste (%)
	C & D waste	Total waste	
1998	7030	16,738	42
1999	7890	17,932	44
2000	7470	17,786	42
2001	6410	16,686	38
2002	10,202	21,158	48
2003	6728	17,757	38
Average	7621	18,010	42

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