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Cost-Benefit Factors of Gamification Systems

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Abstract: Gamification means applying the fun of the game, the mechanics and rules included in the game to the non-game areas. The purpose of this study is to present a method for analyzing the effectiveness of gamification systems for business executives. To this end, this study reviews previous work on economic justification of IT investment and gamification systems in various fields. In conclusion, we discuss cost-benefit factors of gamification systems.

Key words: Gamification, economics, cost-benefit analysis, return on investment, IT, field

INTRODUCTION

Gamification systems have shown positive effects in various application fields. However, some studies raise the concern of the negative and side effects of gamification systems. Business executives are not convinced of the development and operation of gamification systems because there are not enough studies and examples in the cost-benefit analysis of gamification systems.

MATERIALS AND METHODS

Previous research: Most gamification systems usually use IT infrastructure as a platform that operates the gamification mechanics and rules and the studies on IT investments have a longer history than that of gamification systems. Firstly, this study reviews previous work on economics of IT investment. Then, the results of the studies published within the last ten years on both positive and negative effects of gamification systems are summarized.

Economics of IT investment: Previous research on the relationship between investment in IT and organizational performance or productivity have reported both positive and significant effects of investment (Alpar and Kim, 1990; Barua *et al*., 1991; Brynjolfsson and Hitt, 1996; Kim and Leem, 2005a, b; Mahmood and Mann, 1993; Mitra and Chaya, 1996; Rai *et al*., 1997). Several studies on the evaluation of investment in information systems have been undertaken. For example, Renkema and Berghout (1997) considered four basic approaches, namely, the financial approach, multi-criteria approach, ratio approach and portfolio approach. Furthermore, Remenyi *et al*. (2000) classified evaluation approaches into the following four categories: economic appraisal techniques, strategic approaches, analytical appraisal techniques and integrated approaches. In addition, Bacon (1992) found that the criteria of the support of explicit business objectives and response to competitive systems are important in deciding about investment on information systems. The cost of doing business and the protection of corporate assets justify an IT security investment (Scott, 1998).

An investment includes an initial purchase cost, renewal cost, administrative expense and so on. A change in revenue means how an investment in security might increase revenue. Adding security functions will allow doing things that would have been too risky to do otherwise. Cost saving that is really about in a security context is loss avoidance. Witty *et al*. (2001) proposed "The Information Security TCO chart" that has accounts categorized into the following five major sections: hardware, people, software, external services and physical security. Furthermore, Harris (2001) suggested the cost factors that should be evaluated in order to calculate the entire cost of a countermeasure. Moel includes the product cost, design/planning costs, implementation costs, environment modifications, compatibility with other countermeasures, maintenance requirements, testing requirements, repair/replace/upgrade costs, operating/support costs and effects on productivity. In addition, Roper (1999) suggested the cost factors of IT security investments including a purchase price, life cycle maintenance costs (installation, preventive maintenance, repair, warranty and replacement), life expectancy and salaries for staff/contractors to implement, price, life cycle m ainteance costs (installation, preventive maintenance, repair, warranty and replacement), life expectancy and salaries for staff/contractors to implement, maintain, monitor or train others to use countermeasure. Kim (2006) classified the cost factors of IT security investments into nine dimensions with two axes of the lifecycle and type of IT security systems.

Table 1: Previous research on the economics of gamification systems

Application field	Research	Approaches/Analysis methods	Results
Education	Mayo (2009), Gee (2014), Plass *et al.* (2009) and Rosas *et al.* (2003)	Gamified learning/statistical analysis	Increase in motivation to learn; improvement of self-efficacy and self-esteem
Education	Kim (2013)	Gamified tool/questionnaire	Improvement of communication and understanding skills; reduction of learning stress
Education	Kim (2014)	Board game/questionnaire	Understanding the basic rules of economics
Education	Kim (2015a, b)	Gamified team building/questionnaire	Enhancing the intrinsic responsibility of the students
Traffic	Merugu	Gamified traffic control system/statistical analysis	Decrease of the congestion ratio by 50% in rush hour
Marketing	Lane	Gamified tutorial for customers/statistical analysis	Increase in trial usage by 54%; increase in channel revenue per trial by 29%
Marketing	Lauer and Veale	Gaming marketing strategy/statistical analysis	Reduction of call center's average call time by 15%; improvement of sales by ca. 10%
Welfare	Vasudevan and Stark (2012)	Gamified workplace management/ quantitative analysis	Improvement of motivation and team-work; Increase in employee's productivity
Training	Bowers (2012)	Gamified e-Learning systems/statistical analysis	Increase in the number of users who return; to the site daily by 46.6%; increase in the number of users who return to the site daily by 36.3%
Relationship	Korolv (2012)	Gamified company's SNS/quantitative analysis	Increase in conversation and posting by 57% in company's social network
Sales	Marsh	Gamified sales events/quantitative analysis	increase in the participation in their sales; event by 10% as compared to pre-events
Sales	Davis	Gaming platform/quantitative analysis	Increase in sales revenue by 30% in the US

Economics of gamification: Gamification systems have shown positive effects in various application fields. In educational fields, gamification systems have demonstrated not only educational benefits but also increases in motivation to learn and improvements in self-efficacy and self-esteem (Mayo, 2009; Gee, 2014; Plass *et al*., 2009; Rosas *et al*., 2003). Specifically, Kim (2013) showed that gamification can be effectively used as a new tool to motivate the learning desire to improve the level of communication and understanding and to reduce the stress of learning in engineering education. Furthermore, Kim (2014) demonstrated that the Acquire board game is effective in teaching four basic rules of economics, namely: a founder of a start-up company lacking funds will have the advantage if s/he sells the business to a large company so that to raise funds for a new business; a large company will have the advantage, if it takes over a start-up company that has a new technology or business model and raises a business with its own capital strength, distribution network and marketing capability; a private investor who prefers high-risk and high-return investment should invest in early start-up companies and a private investor who prefers low-risk and low-return investment should invest in large companies that have their market dominating power. Kim (2015) proposed a team-building method that applies an action game theory to the team building process. Kim (2015a) validated that the proposed salary auction game is an effective and entertaining tool that motivates students learning.

In traffic control fields, the INSTANT project conducted in India showed that the gamified control system for traffic congestion management cut down the congestion ratio by half. The INSTANT project demonstrated that the number of commuters arriving before 8 a.m. increased from 1,000-2,000. Another relevant project is the speed camera lottery designed to reward people obeying the speed limits on the road. The speed camera lottery system took a picture of all passing cars. A portion of the fines from the speeders was used to provide a lottery ticket to the law-obeying car owners. A demo in Stockholm resulted in considerable drop of the average speed from 32-25 km/h. Previous research on the economics of gamification systems are summarized in Table 1. However, some studies raised the concern about the negative effects of gamification systems. For instance, Groh (2012) pointed out that gamified education systems can weaken student's internal motivation. In education environments, students have internal and external motivation factors and the internal motivation factors are more important because those are more long-lasting than external motivation factors. Groh (2012) indicated that a gamified system can have a negative effect on student's self-fulfillment and weaken their internal motivation. Furthermore, Hiltbrand and Burke (2011), Kim (2015b) highlighted that if education contents or business processes and gamified components are not appropriately integrated, users could over-focus on gaining experience points or obtaining the badges in gamified systems, forgetting the primary objective of education or business system.

RESULTS AND DISCUSSION

Cost-benefit factors of gamification systems: This study provides cost factors of gamification systems considering the previous research on the economics of IT investment and gamification systems (Table 2).

Table 2: Cost factors of gamification systems

Administrative	Logical	Physical
Planning		
Loss of working	Computing	Space
Staffing	Equipment	Supporting
Consulting (game and system design)	Network	Utility
Awareness	System downtime	
Training and education		
Implementation		
Loss of working	S/W and H/W	Space
Staffing	Equipment	Supporting
Outsourcing (game and system development)	Contents	Utility
Play testing	Network	Physical facilities and components
Awareness training, education	System downtime	
Operation		
Insurance	Upgrading and maintenance	Space
Staffing (administrator, game operator, helpdesk)	Warranty	Supporting utility
Awareness training,education		Upgrading and maintenance
Rewards		

Table 3: Operational benefit factorsof gamification systems

Measurement factor	Characteristic
Individual benefit	
Motivation to learn	Qualitative
Motivation to work	Qualitative
Motivation to buy	Qualitative
Motivation to participate	Qualitative
Reduction of stress	Qualitative
Increase in self-efficacy	Qualitative
Increase in self-esteem	Qualitative
Organizational benefit	
Increase in collaboration	Qualitative
Increase in communication	Qualitative
Decrease in conflict	Qualitative

Table 4: Strategic benefit factorsof gamification systems

Measurement factor	Characteristic
Individual benefit	
Improvement of learning outcome	Qualitative
Increase in productivity	Numerical
Increase in sales revenue	Economic
Increase in the number of users	Numerical
Improvement of challenge spirit	Qualitative
Organizational benefit	
Decrease in cost of collaboration	Economic
Decrease in cost of communication	Economic
Decrease in cost of conflict resolution	Economic

This study classifies benefits of gamification systems into two groups: operational benefits and strategic benefits. Operational benefits refer to the enhanced efficiency of an organization's operations in the short term. Strategic benefits refer to the enhanced competitive advantages in the long term. Operational and strategic benefits can be categorized into one of the following three types by the expression method. Economic factors are measured and evaluated in monetary terms. Numerical factors are measured and evaluated in numbers or volumes. Qualitative factors are expressed with the help of a Likert-scale or a specialist description. Operational benefit factors are outlined in Table 3.

Economics factors specified in Table 2-4 can be used to calculate the economic value of a gamification project that designs, develops and operates the gamification systems in monetary terms. NPV (Net Present Value) of gamification systems can be computed using the following Eq. 1:

$$NPV = PV(\text{Cost of gamification systems}) - PV(\text{Benefits of gamification systems}) \quad (1)$$

Numerical and qualitative factors outlined in Table 2-4 can be used to calculate the relative competitive value of multiple gamification projects. For example, if a management should choice one gamification project among five candidate gamification projects, it can use the numerical and qualitative factors provided in Table 2-4 to assess the score of each project.

CONCLUSION

This study has proposed the cost-benefit factors of gamification systems including cost factors, operational benefit factors and strategic benefit factors. The implications of the results of this study can be summarized as follows: the proposed cost-benefit factors may help managements to understand what kinds of cost factors should be considered when designing, developing and operating a gamification system. Managements can consider the proposed benefit factors to develop decision-making criteria for their gamification system.

Limitations and further research issues of the present study are as follows: the cost-benefit factors proposed in this study do not consider different characteristics of various application fields of gamification systems. Case studies that would verify the practical value of the proposed cost-benefit factors in various gamification fields should be undertaken.

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