Simulating the Factors that Support Faculty Adoption of Web-Based Instruction

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Abstract

This article attempts to build a simulation model of the impacts of factors that facilitates faculty adoption of Web-Based Instruction (WBI) from the perspective of the faculty' stages of concerns. Faculty have different concerns as they integrate new technology into their teaching. Without reducing these concerns, WBI integration will not be successful. Four main stages of faculty concern (information, personal, management, and impact concern) were identified based on Hall's concern-based adoption model. Reviewing literature on the diffusion of on-line education, we have identified support factors that may decrease faculty's concerns for adopting WBI in their education settings. These factors were incorporated into the simulation model in order to test the potential impacts of the factors on faculty adoption of WBI. The current simulation model built in Stella® will aid educators or administrators to evaluate the impact of the factors on adoption of WBI.

Introduction

Web-Based Instruction (WBI) has had explosive growth recently, becoming more attractive in higher education settings [Carr-Chellman, Choi, and Hernadez-Serrano 2001]. Many models of innovation have been proposed to provide a theoretical framework that facilitates adoption of new technology. For instance, Rogers [1971] suggests a model in which the adoption of innovation is explained within a social system. He explains the adoption process by a series of actions and choices over time. However, a common limitation of this type of study is that researchers fail to look at the psychology of the innovation and thus, the interventions studies are not persuasive enough to carry out desired change. According to Emirick, Peterson, and Agawala-Rogers [1977], two parallel dimensions occur simultaneously in the change process: 1) a systemic dimension that involves change in a user environment, and 2) a personal dimension, such as cognitive, behavioral, and affective components, that involves the change process within individual users. Given this importance of personal dimensions in the change process, research is needed to identify personal dimension variables that affect faculty adoption of WBI.

Faculty's concern of integrating new technology is one critical condition to be considered among personal dimension variables for successful adoption of WBI in higher education settings. Faculty often have concerns as they adopt new technology for their courses [Adams 2003; Howland 1999; Bradshaw 2002; Matthew, Peter and Wilkinson 1998]. The more concerns they have, the more likely they are to be resistant in their adoption of WBI. For this reason, it is important to identify the factors that can diminish faculty concern in adopting WBI. With the difficulty of testing such variables in practice due to the cost, simulating the impact of the innovation is expected to provide educators and decision makers with opportunities to assess the effectiveness of factors that will support WBI implementation in educational settings.

Therefore, the purpose of this article is to propose a simulation model that tests the impact of factors that support faculty adoption of WBI integration. To achieve this purpose, faculty's stages of concerns were identified based on concern-based adoption process. Second, the factors that support faculty WBI adoption at any stage during the adoption process were suggested. These identified factors were based on a literature review on the diffusion of online education. Finally, based on the identified factors in the different faculty stages of concerns, a simulation model with examples of its use is presented.

Concern-Based Adoption Process

Concern is defined as "the composite representation of the feelings, preoccupation, thought, and consideration given to a particular issue or task". What concerns do faculty members have as they integrate WBI into their course? According to Fuller [1969], the process of diffusion can be explained by a psychological shift from properties of an innovation to the concerns of users. He initially proposed a model that described three

phases of concern: a pre-teaching phase, early teaching phase, and a late teaching phase. These three phases were later named "self", "task", and "impact" concerns. Hall, George, and Rutherford [1977] extended these three concern stages into seven concern stages. According to Hall, George, and Rutherford, teachers have different concerns at different times as they go through the process of implementing innovations: awareness concern, informational concern, personal concern, task concerns, consequences concern, collaboration concern, and impact concern. The definition of each concern is represented in Table 1.

Table 1. Hall's Seven Stages of Concern

Stages	Definition of Concern
Awareness concern	Little concern about or involvement with the innovation is indicated.
Informational concern	A general awareness of the innovation and interest in learning more detail about it is indicated. The person is interested in substantive aspects of the innovation with selfless manner such as general characteristics, effects, and requirements for use.
Personal concern	The individual is uncertain about the demands of the innovation, his/her inadequacy to meet those demands, and his/her role with the innovation. This includes analysis of his/her role in relation to the reward structure of the organization, decision-making and consideration of potential conflicts with existing structures or personal commitment.
Management	Attention is focused on the processes and tasks of using the innovation and the best use of information and resources. Issues in this stage include efficiency, organization, management, schedule, and time demands.
Consequence	Attention focuses on impact of the innovation on students in his/her immediate sphere of influence. The focus is on relevance of the innovation for students; evaluation of student outcomes, including performance and competencies; and changes needed to increase student outcomes.
Collaboration concern	The focus is on coordination and cooperation with others regarding use of innovation.
Refocusing concern	The focus is on exploration of more universal benefits from the innovation, including the possibility of major changes or replacement with a more powerful alternative. Individual has definite ideas about alternatives to the proposed or existing form of the innovation.

Theoretical Model of Faculty Adoption of WBI

Stages of faculty concern in integrating WBI

Although most faculty members have a concern when integrating WBI into their educational settings, these concerns differ according to their stage of adoption process in integrating technology. Rogers [1995] presented the innovation process as follows: knowledge, persuasion, decision, implementation, and confirmation. In general, when someone is confronted with a new technology, he/she goes through an adoption decision process in which he/she gathers information, tests the technology, and then considers whether it offers a sufficient improvement to warrant the investment of time and energy that is required to add it to his/her repertoire of skills [Rogers 1995].

Based on Roger's innovation process, we assumed that there were five different categories of faculty in WBI adoption process: 1) *Faculty Unaware* who have little concern about the adoption of WBI, 2) *Faculty Aware* who are aware of WBI and gather information about it, 3) *Faculty Adopters* who apply WBI into their teaching, 4) *Faculty Implementers* who regularly use WBI, and 5) *Faculty Integrators* who are interested in extending the use of WBI in their teaching.

We expected that faculty would experience different concerns as they go through the process of implementing innovation: awareness concern for Faculty Unaware, information concerns for Faculty Aware, personal concerns for Faculty Adopters, management concerns for Faculty Implementers, and impact concerns for Faculty Integrators. Hall's last three stages of concerns (consequence, collaboration, and refocusing) were combined into the impact concern in our model because faculty experience all those concerns after adopting technology into their classrooms.

According to Bradshaw [2002], faculty need different support based on their status of concern. For instance, faculty with information concerns would like to know more about technology. Their focus is to gain information about the innovation rather than identifying the impact of the innovation. Next, faculty with personal concerns would like to know how using technology will affect their teaching in the classroom. Third, faculty with management concerns need time and support to develop web based activities. Finally, faculty with impact concern would like to extend their use of technology by planning for improved use of technology, and testing impacts of technology on teaching effectiveness and on student learning.

Factors that affect faculty adoption of WBI

How can we reduce such faculty concerns? Previous studies suggest various factors that contribute to technology adoption. Those factors include staff development opportunities, time [Beggs 2000], prompt technical support [Brace and Roberts 1996; Wilson 1999], incentives and positive attitudes towards technology [Buckenmeyer 2001], improved

student learning, advantage over traditional teaching, equipment availability, ease of use, time needed to learn, compatibility with materials, training, administrative support, personal comfort and colleague use [Spotts and Bowman1995, Beggs 2000], perceived value, resources and communication with other adopters [Marcus 1986], mission statements and institutional culture [Massy and Zemsky 1995], faculty development programs [Kahn and Pred 2000], personal conviction, motivation and experience, availability of time, and organizational support [Malayery 1986]; and academic discipline and age [Waugh 2002].

Examining literature on diffusion, of online education, we identified what we believe are the most important factors that decrease a faculty member's concern in using WBI in the classrooms. For faculty with *information concern*, entry level information should be given by any available media, individually, or in groups. At this stage, faculty members need *basic training* [Armstrong 1996] and *technology support* [Brace and Roberts 1996; McCoy 2000]. *Basic training* includes presentation software, developing simple presentations, use of internet resources, e-mail and simple course management software features, such as creating a syllabus. *Technology support* is also important to reduce this concern [McCoy 2000]. It includes support for hardware and software, access to technical staff for web-based course development and web page development, personal computers equipped with needed software applications, and other equipment availability.

Next, for faculty with *personal concern*, they should be given the opportunity and encouragement to learn and talk about technology, and its use. At this stage, faculty is in "learning/discovery" mode [Armstrong 1996]. Therefore, they need *intermediate training* [Armstrong 1996], and *instructional support* [Brand 1997]. *Intermediate training* must have an instructional focus that guides faculty to think first about their teaching and then helps them address how to integrate web-based technology into that teaching [Guhlin 1996; Persky 1990]. Faculty must understand how technology can support educational objectives [Brand 1997]. The training should include effective use of web-based technology in the classroom, incorporation of creativity in the presentations, use of course management software, and troubleshooting. In addition to training, faculty should receive *instructional support* by working with an instructional designer to learn more about instructional use of technology and design, development, and evaluation of technological applications [Brand 1997].

Third, faculty with *management concerns* need practical help to develop and implement web-based activities into their teaching. Strategies to reduce the management concern include *peer tutoring* [Milligan and Robinson 2000; Newcombe and Kinslow 2000], *administrator support* [Spotts and Bowman 1995], and *incentives* [Beggs 2000] to motivate faculty to use web-based technology in their teaching. *Peer tutoring* implies working individually with faculty mentors on their projects on an as-needed basis. Peer mentoring encourages faculty to "share expertise, perspectives and strategies with each other" [Newcombe and Kinslow 2000]. Another strategy to reduce management concern is *incentives* [Beggs 2000; Newcombe and Kinslow 2000]. Incentives include funding for technology purchases - hardware and software - [Armstrong 1996], financial compensation [Albright 1996], monetary grants to supplement income [Armstrong 1996], and released time to a) develop and maintain web based technology, b) learn more about

the technology, and c) attend training sessions and any other support activities. *Administrator support* encompasses such issues as the institutional climate [Albright, 1996] for technology use, providing promotion/tenure as external motivation for faculty integrating technology, and providing equipment [Brace and Roberts 1996].

Finally, faculty with *impact concerns* need to be involved in visioning and planning for technology [Bradshaw 2002], given enough resources, and supported for advanced improvement and development of web based technology applications. Given that impact concerns include three main concerns [consequence, collaboration, and refocusing), strategies for reducing the concerns should focus on decreasing those concerns. They include *advanced training* and *administrator support*. *Advance training* aims to provide information on how to analyze student performance, and evaluation strategies [Armstrong 1996]. *Administrator support* should provide opportunities for faculty to work together, share the knowledge and skills they earned during the previous stages, and improve instructional and administrative staffing.

It is expected that providing one of these supports would contribute to facilitate faculty adoption of the WBI integration. For instance, for a faculty member with information concerns, providing faculty with basic technology training can dramatically decrease his/her concern on integrating WBI.

Simulation Model of the Impact of Support Factors

Simulation Model Structure

A simulation model using Stella software was built on the assumption that various support factors decrease faculty information concerns. We have chosen Stella for modeling faculty adoption processes because the software is used to create models and simulations for a wide variety of disciplines. It is often used to develop modeling in natural science. However, current studies show that the software can be used to develop model for human behavior in the social system [Carr-Chellman, Choi and Hernadez-Serrano 2001]. Figure 1 represents an example of the Stella model structure in this project.

As shown in the model, faculty experience different stages of concerns (information concerns, personal concerns, management concerns, and impact concerns) as they integrate WBI. We assume that these concerns can be decreased by support factors. The support factors included technology support, basic training, instructional support, intermediate training, administrative support for management concern, faculty incentives, peer tutoring, advanced training, and administrative support for impacts.

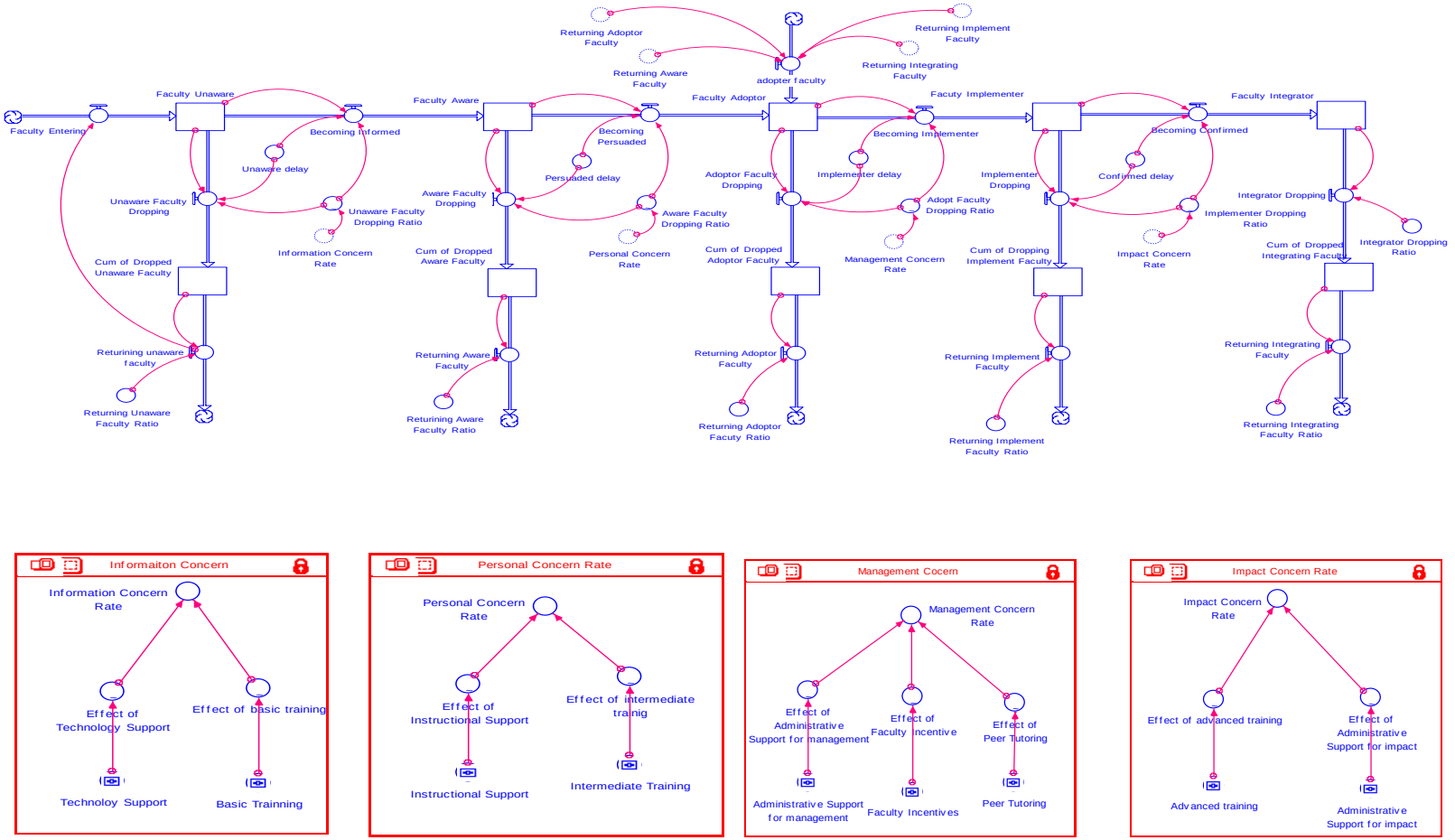

Figure 1 Stella's representation of overall model structure

Interface Overview of the Simulation Model

With the faculty concerns simulation model built in Stella®, educators or administrators can simulate the impact of factors that affect faculty adoption of WBI integration. Slide bars representing different factors were given in the control panel located at the bottom in Figure 2. For example, an administrator may choose a value that ranged from 0 to 20 for *technology support* and simulate the impact of this factor on WBI integration. The range scores of each support factors were determined by examining literatures related to the factor (See Table 2). There are total of nine slide bars that represent the support factors: 1) For information concern, technology support and basic training; 2) For personal concern, instructional support and intermediate training; 3) For management concern, administrative support, faculty incentives, and peer tutoring; 4) For impact concern, advanced training, and administrative support. Results are shown in a graph located up the Figure 2.

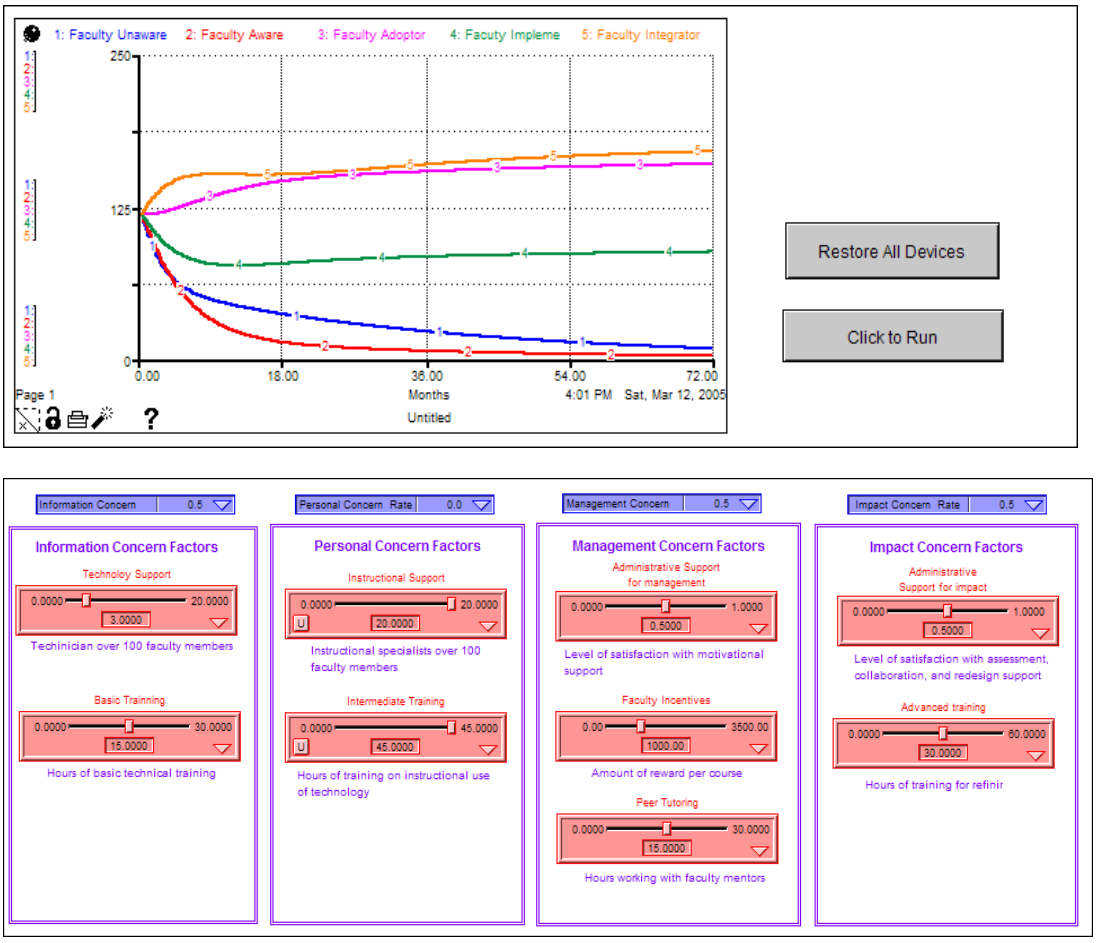

Figure 2 Interface of the Simulation Model

Table 2 Range of Support Factors

Concern Rate / WBI Factors	**Information Concern Rate**	**Personal Concern Rate**	**Management Concern Rate**	**Impact Concern Rate**
Factor 1	*Technology support*	*Instructional Support*	*Administrative Support*	*Administrative Support*
Range	0-20	0-20	0-1	0-1
Factor 2	*Basic Training*	*Intermediated Training*	*Faculty Incentive*	*Advanced Training*
Range	0-30	0-45	0-3500	0-60
Factor 3			*Peer Tutoring*	
Range			0-30	

How the Simulation Works

We assume that faculty can proceed from a certain stage of concern to other stages by having support over time. In running the simulation, the numbers of faculty with concerns are decreased over time. This would seem to support out assumption about the role of support factors at each stage. For instance, Figure 3-A shows a base run in which each concern rate sets .05. X-axis represents time measured by months while Y-axis represents the number of faculty in each category of concern. When we increased support factors (technology support, basic training) that were thought to decrease information concern rate, we were able to observe a change on Graph 1 that represents faculty who are unaware of the WBI. The numbers of faculty unaware was dramatically decreased within 18 months (See Figure 3-B).

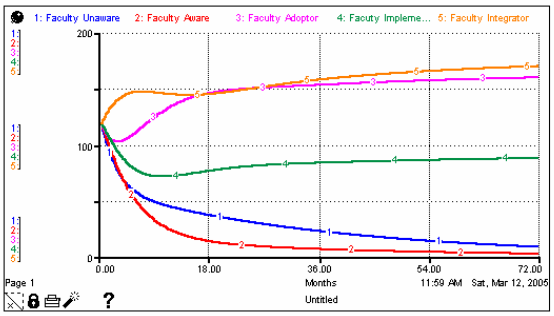

Figure 3-A Base run

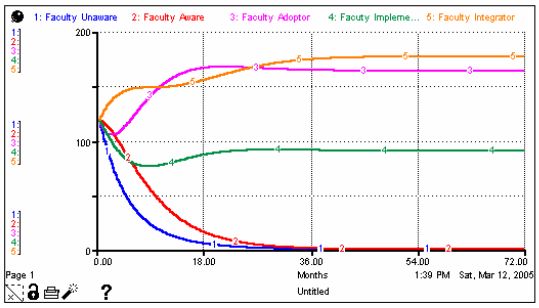

Figure 3-B Simulation model with support factors for information concern rate

Implications

The main purpose of this model is to show "decision makers" or "administrators" how a change in the setting of supports factors can affect WBI adoption. This model will help administrators understand the dynamics of various factors related to faculty adoption of WBI. By using this model, administrators can plan how many faculty members can move from a certain stage to the next stages over a time period. These results will provide them with evidence to persuade as many faculty members as possible to become faculty integrators. In addition, the results will convince administrators to fund workshops and improve incentives for technology adoption.

Although this WBI model is designed mainly for administrators of educational institutions to make proper decisions on boosting the use of WBI, it is also expected to be useful for individual faculty members. By using this simulation model, individual faculty members can get an idea of what kinds of supports factors are available and how much the factors will be helpful in decreasing their concerns. The results of simulation in turn can help them to find a best support factor that decreases their concern and thus, can contribute to facilitate faculty's adoption of WBI. For example, a faculty with information concerns may found the best combination of support factors to decrease these concerns. In turn, they could request the administrators to provide these support factors for the purpose of lowering the information concern.

Limitations and Future Work

There are several limitations in this model. First, the simulation model developed in this study might not be an accurate representation of the real change process. Although the researcher tried to build a change model according to faculty stages of concern, unknown factors may still remain. Thus, further efforts are needed to clarify the factors that affect each stage of faculty concern.

Second, the researchers identified support factors related to a certain stage of faculty concern and incorporated them into the simulation model. However, there might be different impacts from different factors. For instance, technology support might be more effective than basic training or other support factors for faculty who have information concerns. Future studies should include the different impacts on different factors used in the model.

Third, there might be oversimplification of errors in simulating this model. The researchers assumed that there would be factors that decrease faculty concerns such as technology use incentives and workshops. However, these factors are interrelated with each other in practice. It would be necessary, therefore, to find the interrelationships between identified factors in further studies. In addition, each factor consisted of various sub-factors. Therefore, further study should elaborate the model by including more factors that may affect faculty concerns in order to build a more accurate representative model of a reality.

While this model has limitations, it is expected to provide researchers and educational administrators with a useful tool on system change that helps them evaluate factors that decrease faculty concern and eventually contribute to the successful faculty adoption of WBI. The future application of the simulation model is expected to prove the effectiveness of the simulation model in testing the impact of support factors.

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