Jurnal Manajemen dan Bisnis
Vol. 11, No. 1, June 2022, pp. 126 - 135
Sekolah Tinggi Ilmu Ekonomi Indragiri (STIE-I) Rengat
https://journal.stieindragiri.ac.id/index.php/jmbi/issue/view/22
P-ISSN : 2302-4313
E-ISSN : 2621-4199

ANALYSIS OF DYNAMIC SYSTEM PERIODIC SIMULATION MODEL OF STUDENT FLOWS AT SEKOLAH TINGGI ILMU EKONOMI INDRAGIRI RENGAT

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Submited: 2022.07.20 Reviewed: 2022.07.21 Accepted: 2022.08.04
https://doi.org/10.34006/jmbi.v11i1.471

Abstract

An essential tool for a nation's progress is education. Higher education is one of the foundations of education, and it must maintain its quality to remain competitive and accountable to its users—whether they be students, employees, or the government. Paying attention to the human resource management plan can be one way to increase quality. A dynamic system is a technique that can assist the management or the university director in choosing the best plans or policies. An analysis of the existing research on dynamic systems in higher education was done for this study. Scope identification, variable identification, model selection, and model development are all included in literature studies. To decide on human resource management strategy for raising the standard of higher education, the Causal Loop Diagram (CLD) model was developed. In reality, the number of lecturers in a study program is not taken into consideration when accepting new students for a variety of reasons. This affects not just the learning process but also the slow rate of student graduation, creating an imbalance between the number of new students and those who graduate or leave the program (DO). The goal of this project is to create a dynamic model of the rate at which students enter and leave a program of study. A dynamic system simulation model between the number of student inputs and outputs is the end result of building this model. As a decision support tool for new student admissions policies, the simulation model that is produced can be employed.

Keywords: simulation, game, procurement, production system,

PRELIMINARY
Background

According to research done by the Asian Development Bank (2012), private universities in Asia, including Indonesia, face a number of challenges, such as expanding access to private campuses, increasing the number of students, offering college opportunities for those who are underprivileged and have disabilities, varying higher education quality, the high costs of private universities, and the difficulty in obtaining financial support. Competition for students and other resources is fierce in the academic setting, particularly at private universities. Given that tuition fees paid by students are the primary source of funding for private universities, the more students that enroll or are under the control of a private institution, the more money will be raised. Smoothness in the execution of education can be observed not only in the number of graduates generated and in the educational support facilities, but also in the actual learning process. If the amount of inputs and outputs in a process are balanced, learning in higher education will go without hiccups and generate graduates in accordance with expectations. The resources that belong to the object (student) will function more precisely and appropriately thanks to this balance. The imbalance between the input and output of the number of students causes teaching and learning activities to be more difficult because it makes available resources become limited. A number of policies must be implemented as a result of this mismatch, whether they are related to student entrance policies (input), teaching and learning methods (process), or policies regarding.

Policies that are not adopted after careful deliberation may actually worsen the system. It is clear from the reasoning above that a smooth education will result in graduates of high caliber. When the number of items to be processed and the available resources are the same, or when the number of inputs and outputs are equal, instructional activities can function smoothly. Numerous factors, both in terms of input and production, have an impact on this balance. These elements are dynamic, complex, and interconnected. One way to represent the idea of input-output balance in a student population in a study program is as a dynamic system notion. An strategy used to resolve difficult problems is the dynamic system. Using logic causality, a dynamic system illustrates how various input, process, and output components are related to one another. In this project, a dynamic model that balances input and output in terms of student numbers will be built. Using Powersim software, a simulation model will be created for this study in order to ascertain how the variables or factors in the system relate to one another and produce a balanced figure. The resulting model can be utilized as input when thinking about admissions decisions and graduation decisions for students, thus each time rules are made, many variables may be involved. A dynamic system simulation model is used to simulate various scenarios in order to determine how the system would behave while a decision is being made about policy. In short, the main task of law in the economic field is to always maintain and create safeguards so that the implementation of economic development will not sacrifice the rights and interests of the weak. Only in this way will the law continue to have a strategic role in economic development. The role of law in economic development is so important, not only in solving problems that arise, but more importantly in laying the foundations of development itself.

Research Question

According to prior study:

a. What are the variables that have an impact on human resource management?
b. What policy suggestions may universities make based on the dynamic system model in an effort to raise quality through human resource management?

Research Urgency

a. Being aware of the factors, based on prior study, that influence the management of human resources.
b. Being aware of the policy suggestions for enhancing the standard of higher education through the management of human resources.

LITERATURE REVIEW

Higher Education

The degree of education pursued beyond secondary schooling is known as higher education. Higher Education is a branch of education with the power to administer higher learning and award academic degrees. Lecturers and students make up the academic community, which is an academic community. It is the responsibility of the academic community to uphold and advance academic culture by recognizing science and technology as processes and products, as well as as acts of kindness and moral principles. 2018 Guidelines for the Development of Higher Education Curriculum in the Industrial Era

Dynamic System

System dynamics is a technique that can be used in many different contexts. Dynamic systems are used in the field of education to ensure the quality of postsecondary education, academic staff performance, and student enrollment (Galina, 2019). (Merkulov, et al., 2015 and Hallak, et al., 2019).

Galina (2019) found that there are 13 variables that affect the success of higher education quality assurance. These variables are broken down into three main groups of factors: leadership factors, human resource factors, and facilities and infrastructure factors. The study used a systems thinking approach to analyze the success of higher education quality assurance.

The system dynamics technique is a useful method to comprehend the link between various factors that affect education quality since controlling the quality of education is a challenging and complex undertaking. El-Nasr, M.A., and S.E. Hussein (2013).

Create a dynamic system model for quality assurance in education. They ran simulations to assess and analyze the trade-offs that must be made when deciding which ultimate policy to follow, as well as to better understand the behavior and interactions of the influence of resource distribution on the overall quality obtained.

Dynamic System Simulation

The system is made up of various items or parts that work together to accomplish a single goal. At least two components make up a system, and a component that can still be divided into more components is known as a subsystem. A dynamic system is one of a system's many properties. The system is dynamic as a result of the components' dynamic changes over time, which are influenced by a number of interrelated factors. Due to the system's intricate design, some issues that arise will be challenging to comprehend and resolve. The system dynamics method is one strategy that can be applied to issues having these traits.

Jay W. Forrester of the Massachusetts Institute of Technology (MIT) popularized system dynamics for the first time in 1956. The term "dynamic" (or "dynamic" in certain texts) refers to a system that is continuously changing throughout time. The system's condition will never stay the same from today to tomorrow; it will change (according to units of time, day, week or year). Using dynamic system simulations, patterns of these variables' behavior throughout time and their structure can be observed in addition to events and their causes. Dynamic systems have the capacity to forecast the future or observe the system's behavior in the past.

The dynamic system's behavior will be analyzed and emulated in the simulation. Cause and effect, feedback, and delay are the three guiding concepts that the dynamic system simulation is built upon.

Causing and resulting (cause and effect). Every event in this universe is a cause and an effect of an event that occurred before it or after it, as seen in a diagram that illustrates the causal relationship.

2. Reaction. Every cause and effect that exist in a genuine system will always have an impact on a variable in the system.

3. Holdups. In a system, a causal relationship does not merely happen. It takes time for components to change because they do so frequently. Delay is what we refer to as this.

METHODOLOGY

Research methods

Professor at the Massachusetts Institute of Technology Jay W. Forrester created the technique known as system dynamics. In order to better manage the system and inform policy decisions, Forrester (1961) said that "System Dynamics is used to watch the behavior of management systems by using feedback information characteristics in conjunction with a model of the system." Dynamic systems can aid in long-term strategic decision-making and are useful for researching and modelling complex, dynamic systems (Sterman, 2000 and Rebs, et al., 2019). Dynamic systems can be used to research environmental change, politics, economics, behavior, medical, engineering, and other subjects in addition to management (Forrester, 1991).

According to Albi in Sukhwal (2015), the dynamic system simulation is based on three principles: cause-and-effect, feedback, and time delays (Table 2.10). According to Bala, et al., (2017), the processes for putting dynamic system simulation into practice are as follows:

a. Create mental models of problems using verbal descriptions (problem conceptualization), identify problems, and then develop a dynamic hypothesis to explain problematic behavior using causal loop diagrams and stock flow diagrams.
b. Create a verbal model that represents the causal loop diagram's essential structure.
c. Include a causal loop diagram in the dynamic system's flow diagram.
d. Convert dynamic system flow diagrams using Stella, Vensim, or a set of concurrent difference equations.
e. Policy analysis, sensitivity analysis, and model validation.
f. Application model.

Table 1 Principles of System Dynamic Simulation

No	Principles	Notes
1	*Cause effect*	Cause-and-effect relationships that can be used to study the impact of different parameters on each other.
2	*Feedback*	the process by which a parameter directly influences another parameter.
3	*Time delays*	a fundamental component of all flows (flows). Additionally, the system may oscillate as a result of time delays. There are two types of delays: informational delays and material delays. Information delay is a delay in the perception process, whereas material delay is a delay in a physical flow.

Unit of Analysis

Students of Sekolah Tinggi Ilmu Ekonomi Indragiri Rengat

Collecting Data

The data used is secondary data. This secondary data will be used as another data generator in the simulation model. In addition to secondary data, this study also collects primary data by interviewing related parties as well as secondary data on regulations regarding the number of students in a study program for the design of causal loop diagrams and the structure of the simulation model to be made.

Data analysis technique

Analysis of the data or information collected is done gradually. According to Miles & Huberman, data analysis consists of three streams of activities that occur simultaneously, namely: (1) data reduction; (2) data presentation; and (3) drawing conclusions or confirmations. The reduction of data in this study mainly concerns the selection process, simplification, classification of gross data that has been obtained.

RESULTS AND DISCUSSION

The simulation model that was created as a result explores what might happen if the student population changes. Modelers can present findings using the autoreport feature of the Powersim software.

Causal Loop Diagram

Based on the collected data, a causal loop is created in this study. The foundation for creating dynamic system simulation models is this causal loop. The causal loop diagram depicts the framework for the simulation that will be run. According to applicable laws and regulations, the ideal number of active students is equal to 25 times (maximum 30 times) the number of present lecturers, in order to create a system that is balanced between student input and output. Image of a causal loop can be seen as follow

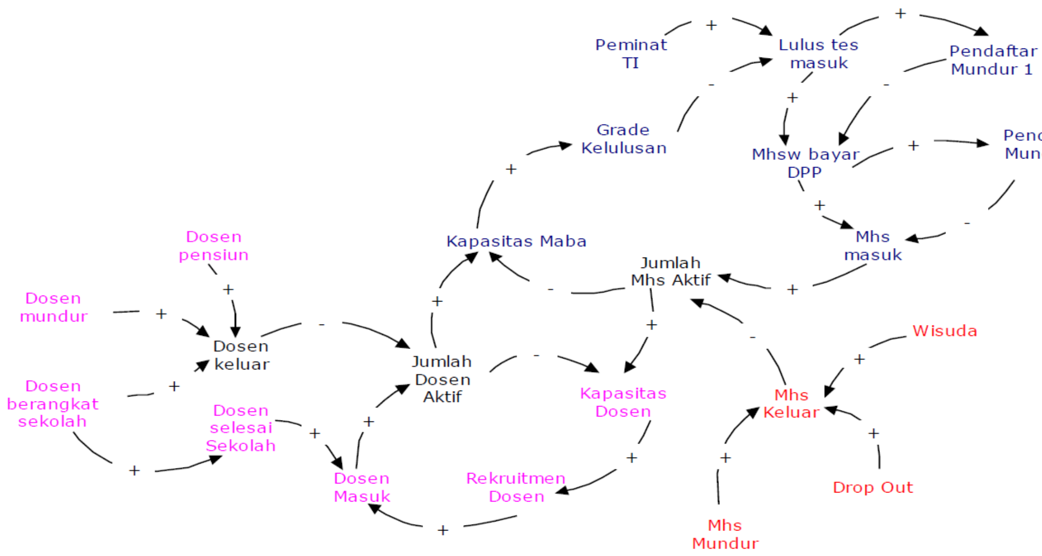


Diagram 1. Developing the causal loops

Making a flow diagram based on a causal loop that was generated using the powersim software is the first step in creating the simulation model. The resulting flow diagram matches Figure 2 exactly. The generated flow diagram shows the system's structure for maintaining the input-output balance for students. mathematical framework that links elements in accordance with Table 1.

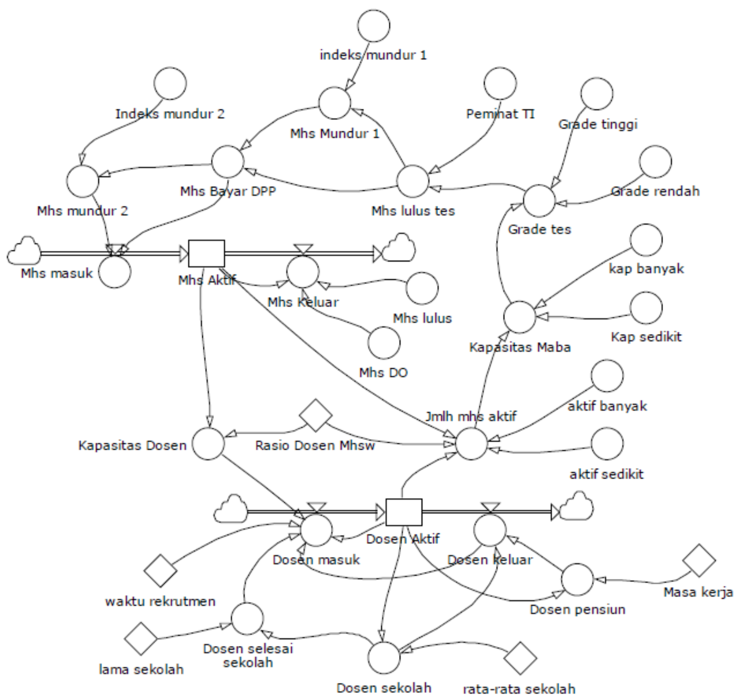
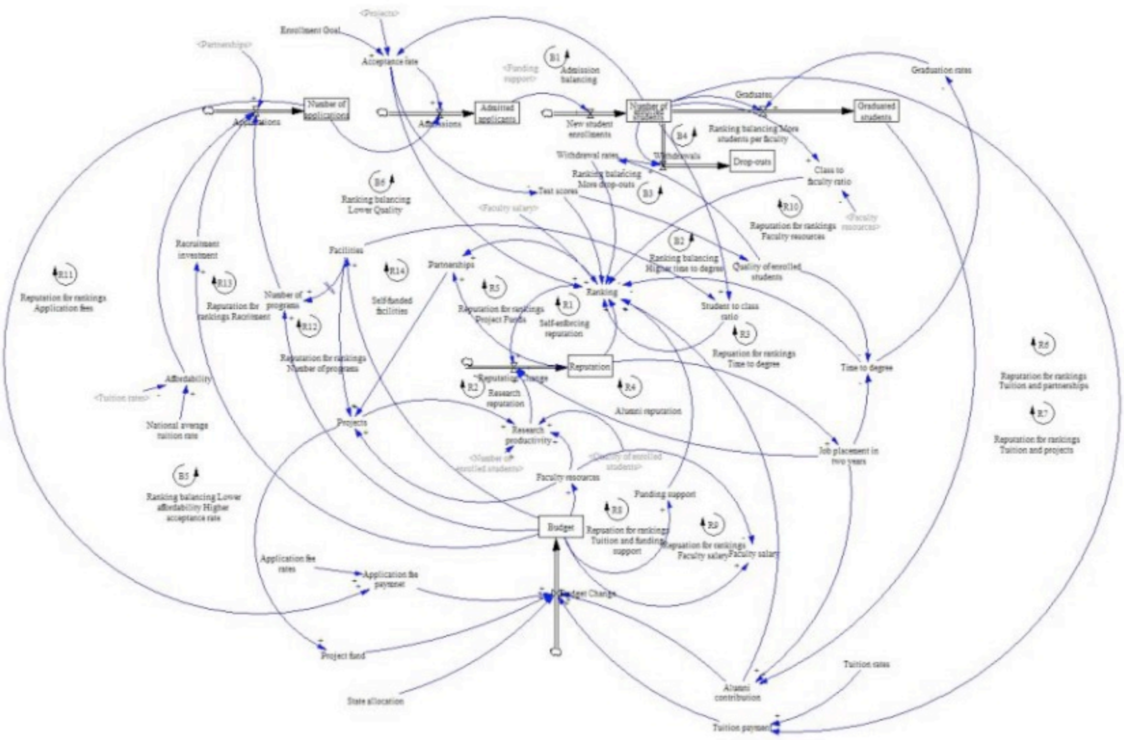


Diagram 2

Flows Diagram Simulation

Three models were discovered that are pertinent to the management of human resources (lecturers) to enhance the quality and sustainability of UST after defining the scope and variables connected to staff and students. The three models are the dynamic balanced scorecard causal loop diagram, the ITI causal loop diagram, and the enrollment and rankings model (Merkulov, et al., 2015). (Hawari, N.N., and Tahar, R.M., 2015). Picture 1 display the three models.



Picture 1 Enrollment and rankings model (Merkulov, dkk. 2015)

The CLD in Figure 1 indicates that rising university ranks will have an impact on rising university reputation, which will enhance a number of factors connected to admission, ranking, and the cost budget owned by institutions.
It will be possible to determine how the system acts by modifying the input or input into the simulation model. This study will simulate the number of students from 1999 to 2021 to see how many are necessary to have a balanced system.
By altering the input parameters of PSTI enthusiasts or registrants and the initial state (stock or level) of the number of active students, which fluctuates as a result of changes in the number of registrants, the simulation is conducted to ascertain the balanced condition of the number of students.
Based on the outcomes of the simulation, it is known that the ratio of students in the real system only reaches a balanced state in 2021, with 1 lecturer to 45 students. The same approach will be used to run a simulation model to determine how many students' inputs and outputs match a perfect system scenario and how many enthusiasts grow every year.

Due to the high number of candidates who were admitted the previous year, it is assumed that the number of current students did not change significantly when the number of applications increased by 1500. As a result, the system will be in a balanced state if the number of lecturers increases to 45, the optimal student acceptance is 500 students, taking into account the fact that there are still many active students, and as many students as feasible graduate—at least 300 students.

If the number of active students equals the proportion of lecturers to students, the simulation model's final output is a system in which the number of input – output students will achieve balance. To do this, the number of new students must be adjusted to the agreed-upon projected capacity based on the number of active lecturers, and the number of lecturers must be in accordance with the expected number of lecturers based on the active student population. In order to maintain a balance between input and output during the teaching and learning process, the exit rate of both students and lecturers must be taken into consideration separately.

This simulation model's end result is a system where the number of input – output students will balance out if the number of active students matches the proportion of lecturers to students. To achieve this, the number of incoming students must be adjusted to the expected capacity that has been decided upon based on the number of active lecturers, and the number of lecturers must be in accordance with the number of expected lecturers based on the number of active students. In order to maintain a balance between input and output during the teaching and learning process, it is necessary to pay distinct attention to the exit rates of both students and lecturers.

Furthermore, university reputation affects partnerships and job placements in two years in addition to having a direct impact on rankings; the better the university's reputation, the more partnerships and job placements there are in two years. The reputation of universities will improve with the rise in job placement in the next two years.

Additionally, when the project grows as a result of new partnerships, the productivity of the study will likely increase either directly or indirectly. Additionally, as project finances rise, the budget rate may also rise. In addition to project revenues, application fee payments, tuition payments, and governmental funding all have an impact on the budget rate. If the budget gained has increased, it can be utilized to raise teacher salaries, add more programs, invest in recruiting, and receive financing support. Applications will increase in quantity as the number of programs does.

CONCLUSION

The study's findings suggest that a simulation model of a dynamic system for balancing the number of student inputs and outputs has been developed. This model can be used as a decision support tool to help determine the appropriate number of inputs for both students and lecturers in order to achieve a balanced system state. Due to the discrepancy in the number of students arriving and departing, the number of students and lecturers at the research site has not been balanced.

Based on the scenario simulation performed, it is preferable to only accept a small number of new students, encourage graduation, and increase lecturers for the efficient learning process in the upcoming year, assuming the number of applications is increasing. There is still plenty that can be done to improve this research before it is considered complete. One of them is to take into account elements that have an impact on both new students' enrollment and graduates. Separating incoming students from those who drop out of school and those who graduate is also required so that they can be utilized as a benchmark for evaluating the study program in question.

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