Quality Monitoring in Engineering Education Using System Dynamic Modeling

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ABSTRACT

Current Research briefs an attempt that has been made to study impact of campus placement on quality of Institute by developing system dynamic model. What-if scenarios are generated by simulating the system dynamic model developed for long time horizon for optimum policy planning. System dynamics is used as methodology for developing a system dynamic model and testing various policies

Keywords

policy planning, What-if scenario, Time Horizon.

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Introduction

The Major objective of higher technical education is to cast students by enhancing their knowledge and abilities and gradually empowering them as lifelong critical, reactive learners and can be seen as a public Asset as it benefits the society as a whole [1].The higher education system in India grew rapidly after independence. By early 1985, there were hundred and fifty universities and five thousands colleges in the country enrolling around five percent of the eligible age group in higher education. Today, in terms of students on rolls, India is the third largest higher education system in the world, behind other developed countries like china and U.S.A., with 17975 institutions (350 universities and 17630colleges).The number of institutions is more than four times the number in United States and en-tire Europe. Higher education in China having enrolment in a higher education institution in India is about 600-700 students, a higher education institution in United States and Europe would have 3000-4000 students and in China this would be about 8000-9000 students (Source, AICTE). This makes the system of highly fragmented one that is far more di cult to manage than any other system of higher education in world. But it is accepted and unfortunate facts that accept few premiere Institutes of national importance providing high quality higher education rest are substandard. Irony is that all premier Institutes get the creamy layer of intakes. Meritorious students getting admission in pioneer Institutes are natural professional. Unfortunately substandard Institutes get non creamy layer of intakes and are just producing Technical graduates having certificate but no skills because of non quality practices. There is a need to find out the factors which affect the quality of the Technical education system.

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Literature review

Various approaches have been used in higher technical education quality re-search. The major well known are statistical analyses[1],Multi criteria decision making [5],Goal Programming [6],Data management[8,18],System dynamics modeling and simulation[2],Hierarchical linear modeling and participatory action re-search[14].

System dynamic modeling

System dynamics is a computer based modeling approach for analyzing and solving complex problems through policy design and analysis. The problem addressed by system dynamics are based on the premise that the structure of a system, that is the way essential system components are connected, generate its behavior. If dynamic behavior arises from the feedback within the system, ending effective policy intervention requires understanding system structure. Once a model is build, it can be used to simulate the act of proposed actions on the problem and the system as a whole. As [4] notes the activeness of system dynamic model for studying behavior of complex system.[7]provides a comprehensive taxonomy of publications describing various system dynamics models on higher education issues. These include topics such as, external forces, corporate governance, planning, resources and budgeting, human resources management, teaching quality, teaching practice, micro world and admission demand. The potential value of system dynamics modeling lies in addressing higher education quality issues is in its ability to: Model feed-backs or interactive views in dynamic system like higher education. Incorporate non linear relationship inherent in higher educational quality issues. Accommodate soft factors such as effectiveness of student's projects supervision, competence, quality of students, quality of research, and quality of teaching. Model time delays to study certain policies on quality such as faculty recruitment delays, training of students, and investment in new student's capacity.

Features of System Dynamic Modeling

The main features identified by [12] of system dynamic methodology are discussed here. Focus on feedback driven, mainly internally generated dynamics: The systems modeled are networks of closed loops of information. High degree of operationality: System dynamics relies on formal modeling for reaching possibilities for the combination of qualitative and quantitative aspects of modeling and simulation. High level of generality and scale robustness. Availability of powerful application software: The packages such as Powersim,Venesim are easy to handle and give access to a high variety of mathematical functions. Potential synergies: Potential of clubbing with many other tools and methodology in both aspects principally as well as technically. Given the diversity of system dynamics strength, an equivalent area of system dynamics as already highlighted exists. The emerging trend of mixing other methods with system dynamics further confirms the superiority of system dynamics features. Examples of the latter include dynamics synthesis methodology involving case study and system dynamics [16],soft system dynamics methodology [14],managing from clarity[10],Group model building with clients Anderson[3],Action research[11],Collaborative systems modeling[9],Object role modeling[14].

System Dynamic AS a modeling

System Dynamics is used as a methodology for studying impact of campus placement on quality of Institute. System dynamic model is generated and by simulating the model over a time horizon of 10 years scenario are generated. System dynamic model is developed in three phase. First the causal loop for the placement of student is developed than in second phase stock and flow diagram of placement sector is developed and in third phase by simulating the model scenario are generated.

Causal Loop Diagram

By studying causal loop diagram for placement of students we find that as placement of students increases the meritorious student are placed in the job and as a result students of low merit joins technical education system which decreases the quality of technical education system. As placement increases the attraction towards engineering education increases as a result of which as student increases and result of which quality of technical institute decreases. Fig. is shown below.

Stock and Flow Diagram

Based on the Causal loop diagram of placement of student module stock and flow diagram for placement of student is developed on system dynamic software powersim version 2.1.

Simulation of the model

Stock and Flow diagram developed is been simulated for 10 years and impact of placements of student through campus on quality of Institute is studied and what-if scenario are generated for policy interventions which are shown in results section.

Analysis of Result

what-if scenario are generated as a simulation result by running the model and is shown in the table below. First base case scenario is shown in Table 1.

Year		Quality In Numbers
2004		12.10
2005		182.36
2006		170.98
2007		157.78
2008		77.63
2009		133.73
2010		124.32
2011		164.79
2012		165.49
2013		167.28
2014		109.31
2015		111.01
2016		112.71
2017		114.42
2018		116.12
2019		117.82
2020		119.52
2021		121.22
2022		122.92
2023		124.62
2024		126.32
2025		128.02

Table2.what-if Scenario if student placement is increased to 30percent.

Year	Quality In Numbers
2004	13.25
2005	183.51
2006	172.13
2007	158.93
2008	78.79
2009	134.88
2010	125.47
2011	165.93
2012	166.64
2013	168.44
2014	110.46
2015	112.17
2016	113.87
2017	115.57
2018	117.27
2019	118.97
2020	120.67
2021	122.37
2022	124.07
2023	125.77
2024	127.47
2025	129.17

Table3.what-if Scenario if student placement is increased to 50 percent.

Year	Quality In Numbers
2004	13.45
2005	183.71
2006	172.33
2007	158.13
2008	78.99
2009	134.08
2010	125.67
2011	165.13
2012	166.84
2013	168.64
2014	110.66
2015	112.37
2016	114.07
2017	115.77
2018	117.47
2019	119.17
2020	120.87
2021	122.57
2022	124.27
2023	125.97
2024	127.67
2025	129.37

Table4.what-if Scenario if student placement is increased to 80 percent.

Year	Quality In Numbers
2004	13.95
2005	184.16
2006	172.78
2007	159.58
2008	79.44
2009	135.53
2010	126.12
2011	166.58
2012	167.29
2013	169.09
2014	111.11
2015	112.82
2016	114.52
2017	116.22
2018	117.92
2019	119.62
2020	121.32
2021	123.02
2022	124.72
2023	125.42
2024	127.12
2025	129.82

Conclusion

Results depicted in tables confirms that as the placement of students is increased the quality of the institute increases the trend remains the same as the percentage increases this is similar with the real behavior of the system as the institute that has high quality has high placement. So from the above study we reveal that increase in placement can be the optimum policy for enhancing the quality of the institute.

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