Using Systems Mapping to Inform the Strategic Planning Process in Higher Education

Hyunjung Kim, Ph.D.
Associate Professor
Department of Management
College of Business
California State University, Chico
Phone: 530-898-5939
Fax: 530-898-5501
Email: hkim18@csuchico.edu

Michael T. Rehg, Ph.D.
Department Chair
Department of Management
College of Business
California State University, Chico
Phone: 530-898-5663
Fax: 530-898-5501
Email: mrehg@csuchico.edu

Abstract

In this paper, we present a case of a higher education institution where systems mapping was used in parallel to a strategic planning process in order to deepen the understanding of connections among sub-sectors of the system and elicit dynamic insights for decision making and policy implementation. We describe the process used to generate systems maps and how they were communicated, and provide examples of dynamic insights that became available from the mapping sessions. The key objective of this article is to share our experience with the system dynamics community so that we collectively build a repertoire of effective practices contributing to the strategic planning process, particularly in higher education.

Introduction

Strategic planning for institutions in higher education can take many forms, but often follows a set of traditional approaches to strategy. In some cases, previous studies have used basic strategy concepts like SWOT analysis (Andrews 1971), the five forces model (Porter 1980) and the resource-based view of the firm (Barney 1991) to engage in strategic planning. Others developed balanced scorecards (Kaplan and Norton 1995) to align their strategic goals and organizational activities. These institutions sometimes share their experiences as case studies and reports (for example, Cyert 1988; Morrill 1988), encouraging other institutions to be more systematic in their planning process.

Researchers and practitioners involved in the strategic planning process in higher education often recognize that there are unique aspects to higher education institutions that set them apart from other organizations. Weick (1976) described educational organizations as a loosely coupled system where different units and elements are attached but also maintain their own identity and separateness. In such case, the strength of the coupling may change with time and there may be multiple means-ends relationships in the system. Foote (1988) notes, unlike other organizations, power is shared in universities among the board, the president, administrators, faculty, and students. Their product is "ideas" that are impossible to quantify, and insufficient resources must be allocated among the "limitless needs of students and professors." Autonomies and intellectual freedom is most valued, but the competitive environment forces schools to allocate their resources in a strategic manner to meet the student and industry demands. In public universities, higher institutions are embedded in the broader context of administration and external constraints influencing their internal decisions.

Recognizing the complexity of the higher education system, some institutions have used a system dynamics approach to strategic planning. A comprehensive review of system dynamics study of higher education can be found in Kennedy (2009). Examples of the topics include funding allocation based on performance (Galbraith 1998), student-faculty ratio dynamics and their implications on teaching and research effectiveness (Barlas and Diker 2000), resource allocation among departments (Vahdatzad and Mojtahedzadeh 2000), funding and its implications on performance (Oyo *et al.* 2008), and student enrollment and faculty hiring (Trailer 2012). These studies use a combination of approaches including qualitative systems mapping, formal simulation modeling, system archetypes, and interactive game interface.

In this article, we present a case of a higher education institution where systems mapping was used in parallel to the traditional strategic planning process in order to deepen the understanding of connections among sub-sectors of the system and elicit dynamic insights for decision making and policy implementations. We describe the process used to generate systems maps and how they were communicated, and provide examples of dynamic insights that became available from the mapping sessions.

The key objective of this article is to share our experience with the system dynamics community so that we collectively build a repertoire of effective practices contributing to strategic planning process, particularly in higher education. This paper is organized as follows: First, we discuss how strategic planning can benefit from a system dynamics approach. Then, we will briefly introduce a case of a public university in the United States where systems mapping was used to inform the strategic planning process.

Then, we will present examples of key dynamic insights generated from the mapping exercises and how they might have informed the key decision makers. Finally, we will discuss some of the benefits and challenges we experienced and how future studies can be conducted to support a wider range of planning activities.

The Need for System Dynamics in Strategic Planning

Mintzberg (1994) noted that corporate strategic planning has been practiced since the mid 1960's, but criticized planners for being too formal and too far removed from reality. Many institutions engage in top-down strategic planning which too often results in a product that is not used to guide decision-making. But planning has been defined as "a formalized procedure to produce an articulated result, in the form of *an integrated system of decisions*." (p. 12, italics added) It should be obvious to researchers and practitioners of system dynamics that *an integrated system of decisions* is exactly what system dynamics maps and models produce, and are used to support decision-makers. System dynamics is well-suited for organizational planners faced with complex decisions, such as those in higher education institutions.

Rowley, Lujan, and Dolence (1997) noted the difference between traditional planning and strategic planning along several dimensions, and the failure of higher education institutions with strategic planning due to the inherent differences between universities and businesses. Dill (1996) pointed out that university planning has been poorly designed due to informal planning processes, self-interest among units, and the use of practices borrowed from others rather than ones developed organically. He makes the case that the planning process in universities "…must be designed as a primary means of organizational *integration*" (p. 40, italics in the original), and should also promote collaboration. In system dynamics, maps and models serve as the boundary objects (Black 2013), and organizational integration and collaboration are one of the key goals of the system mapping and modeling process, especially when using the Group Model Building (Richardson and Andersen 1995; Andersen and Richardson 1997; Vennix *et al.* 1997; Hovmand *et al.* 2011).

Both Rowley et al. (1997) and Dill (1996) call for a process that is inclusive of all stakeholders, so that buy-in from those implementing the plan will be achieved, and to promote an approach that is fair and open. As Willson (2006) found in the Cal-Poly Pomona experience, traditional planning approaches fall prey to the pressures of budget shortfalls and disparate goals of groups across campus and cannot generate the trust required to achieve the buy-in being sought. Using stakeholders to develop systems maps and simulation models is a more effective means to promote both of these goals of a university planning process. However, most of the literature on planning clearly advocates a process that is linear in nature, and "calculating" as Mintzberg (1994) states. Kennedy and Clare (1999) pointed out the problems of using a linear approach found in input/output models, which "ignore the dynamic interaction between the input /output factors and the nature of the 'transformation' taking place." (p. 5). When a set of initiatives is listed under various categories, or goals, the interactions and feedback loops among the initiatives cannot be seen, and decision makers cannot possibly comprehend them due to the limits of bounded rationality (Sterman 1994). The decision maker is left with falling back on their own judgment about what is most important, critical in the short run, or least costly to implement. The result is likely to be biased to the decision maker's values, and be met with resistance from those who implement the actions, but feel that they have not been consulted.

We contend that a greater understanding of the system structure will promote buy-in among the stakeholders of a university, more so than traditional forms of strategic planning have accomplished. Naturally, this depends on the level of involvement of those stakeholders, and whether ownership of the systems maps and simulation models has been truly transferred to the stakeholders. Nevertheless, we believe there is more potential of this happening with the system dynamics approach than in other strategic planning exercises. The result will be less planning and more synthesis, as Mintzberg (1994) advocated.

Case Description: Systems Mapping for Academic Planning

The authors of this article have been involved in the academic planning process of a public university in the U.S. In 2013, the provost kicked off a new academic year with an approach to revising an expired academic plan. To guide the process, a committee of 14 members was formed consisting of administrators, deans, department chairs, student representatives and clerical staff leaders. More than 600 members of the campus community were invited to participate in a total of 61 "possibility conversations" - meetings across campus with various groups of faculty, staff and students to answer three basic questions, including how to prepare students to thrive in the 21st century.

In the following semester, the committee performed a content analysis of the data collected from the possibility conversations, and from the data emerged various ideas for success in six key themes:

1. Support and Prepare students for lifelong success
2. Promote excellence in teaching and learning
3. Build Community through connections, relationships and collaboration
4. Commit to faculty renewal
5. Commit to staff renewal
6. Enhance organizational processes, communication and transparency

The committee members were then divided into the six theme groups, and they invited diverse stakeholders around the campus to come up with a list of action plans for achieving success in their assigned area. Recently, the groups have combined the action plans and presented the materials to the provost for prioritization and implementation of the actions.

System dynamics was first introduced to the committee as the groups were organized around the six theme areas. At the time, the groups were in the process of organizing and analyzing the data from the initial conversations and engaging relevant stakeholders to elicit action items. While working in their own area, the groups were concerned about being in the silos and wanted to explore how different issues and actions in their area have a system-wide impact. The authors offered systems mapping as a way to represent the system-level connections and understand the dynamics generated by feedback loops, accumulations, and time delays.

The authors used the mapping language consistent with the system dynamics practice: causal loop diagramming (CLD) and stock and flow diagramming. The mapping exercises took some of the key scripts from the Group Model Building processes (Andersen and Richardson 1997; Hovmand et al. 2011). However, the mapping exercises were not problem-driven, and they were more intended to capture the big picture across the group conversations.

The committee members had the following goals for the systems mapping exercise:

1. Represent the connections between different actions and their outcomes beyond the theme boundaries
2. Provide a way to understand and manage the system complexity
3. Identify high-impact actions
4. Identify stakeholders possibly impacted by different actions
5. Provide coherent narratives for selected actions

In the current stage of the project, the systems mapping has achieved the first two goals. The third goal is partially met, but a formal simulation model would be needed to quantify the degree of impacts. The fourth goal would require an additional analysis of stakeholders and reorganization of the systems maps around the stakeholders. The final goal can be achieved when the systems maps are further developed and modified by decision makers who select and implement actions.

Process Used to Generate Systems Maps

In this section, we summarize the systems mapping process used in the case.

Initial Preparation. Before engaging with the six groups in the committee each working on a different subsector of the system, the authors created a handful of systems maps based on the report that analyzed the data collected from 61 possibility conversations. For each group, two to three maps were created. The purpose of these maps was to introduce the mapping language, initiate conversations, and encourage member inputs—similar to Concept Models (Richardson 2013) in Group Model Building. These maps were modified later with the group inputs, if not discarded completely.

First Round of Meetings with the Groups. The first round of the mapping exercise was carried out with the six groups—one group at a time. Each group was composed of two to four members from different levels and functions of the university. The meeting typically took about 2 hours per group. During the meeting, the basic CLD and stock and flow concepts were briefly introduced. This took less than 10 minutes. Then, the pre-generated systems maps pertaining to the group's key area were shared and input from the members was collected. The conversations mostly focused on the key issues, possible policies and their expected outcomes.

Generation and Modification of Systems Maps. After the first round of group meetings, the authors created 16 sub-sector maps representing different parts of the institution. The maps were organized by issues and involved stakeholders, and a typical map would incorporate inputs from multiple groups. We also created an overview map showing how the 16 sub-sector maps were connected.

Second Round of Meetings with the Groups. We returned to each group with the sub-sector maps relevant to the group's area for their review. Each group reviewed four maps on average, and a meeting typically lasted for an hour. In these meetings, the modelers elicited further inputs from the group and made sure the maps were appropriately representing the group's perspectives.

Modification of Systems Maps and Key Insights Generated. With the inputs from the second round of meetings, the sub-sector maps were modified and further polished. For new issues that emerged in the meetings, additional maps were created. After the second round of the meetings, we ended the mapping exercises with 20 sub-sector maps. In this paper, we discuss some of the findings from the systems mapping exercises, using three of the maps as examples.

Dynamic Insights Gained from the Mapping Exercise

Across the six theme groups, we generated 20 sub-sector maps representing various issues and aspects of the system. In this section, we present three examples illustrating how the maps have identified important dynamic complexities in the system.

1. Curriculum and Pedagogical Innovations

Curriculum and pedagogical innovations were one of the key issues mostly discussed in the "teaching and learning" group. However, many of the specific innovation ideas were discussed in the "student success" group, and the faculty workload influenced by the innovations was discussed in the "faculty renewal" group. Therefore, the map was generated with the inputs from the three groups.

The map below conceptualizes the faculty workload in teaching as a pressure coming from the ratio of teaching hours needed to available. The number of students would be the major factor influencing the demand side, but even with the same number of students, if the quality of student-faculty interaction were to increase, more teaching hours would be needed. The quality of student-faculty interaction is positively associated with teaching effectiveness, which would result in a greater rate of student success. (Figure 1-1)

When there is an increase in the teaching demand, the pressure for faculty teaching hours can be alleviated by three major means: (1) faculty hiring, (2) greater allocation of faculty work hours to teaching, and (3) bigger class/section size. These are all balancing loops trying to address the problem in the system.

An increase in the section size may be the quickest fix to meet the teaching demand, but it will not be a fundamental solution for the system due to its negative implication on the quality of student-faculty interaction.

Enhancing the quality of student-faculty interaction without adding faculty workload pressure is a challenging task. Can we address these tradeoffs with curriculum and pedagogical innovations? In general, curriculum innovations would focus on what is taught (i.e. program) and pedagogical innovations would focus on how it is taught (i.e. practice). In the systems map below, curriculum innovations and pedagogical innovations (CI/PI) are conceptualized as a supply chain of innovation projects. (Figure 1-2)

Although it is important to note that different innovation initiatives have different goals and expected outcomes, such differences are not captured in the map.

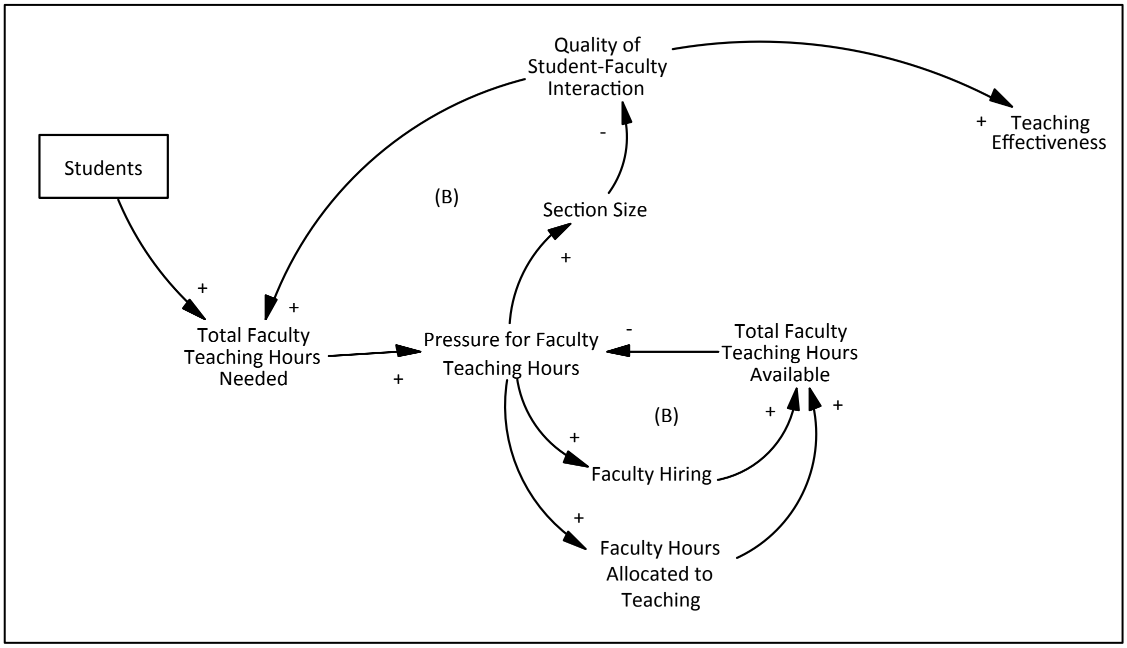

Figure 1-1.

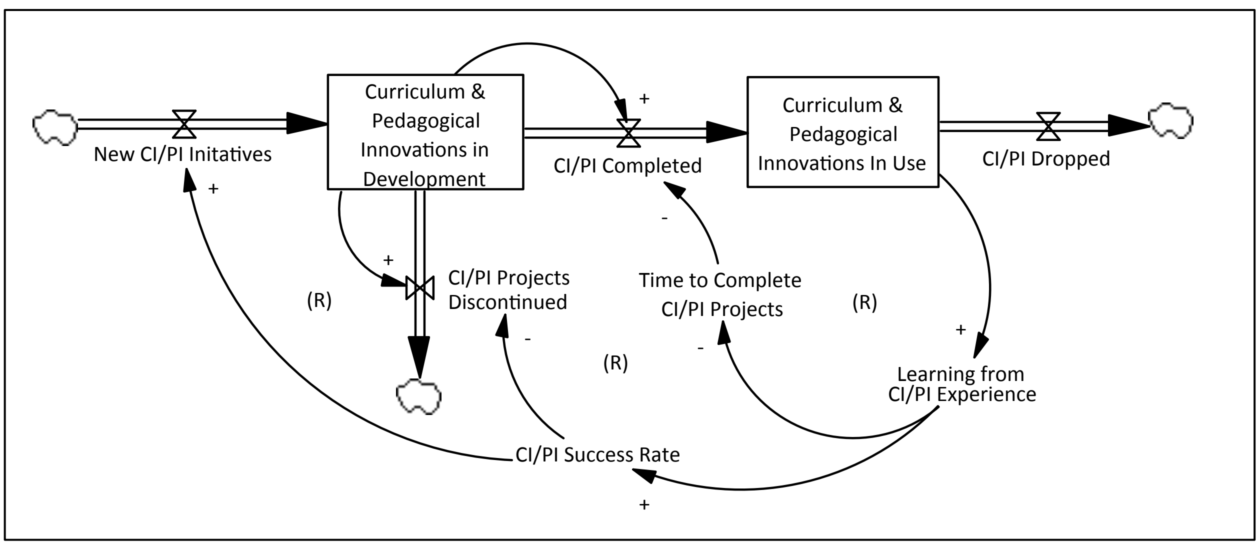

Figure 1-2.

The reinforcing loops in Figure 1-2 depict a learning curve: As more curricular innovation projects are successfully completed and launched, we gain more experience in curriculum and pedagogical innovations. The collective experience increases the success rate, which will encourage new initiatives and reduce the number of discontinued projects. The experience also reduces the time to complete innovation projects. These reinforcing cycles will result in the growth of curriculum and pedagogical innovations in use.

Figure 1-3 connects the curriculum and pedagogical innovations to their impact on teaching effectiveness and the faculty workload. When these innovative projects are under development, they require additional faculty work hours leading to greater workload pressure. This will discourage faculty commitment in starting new innovation initiatives. This is a balancing loop counteracting the efforts to increase the curriculum and pedagogical innovations.

On the other hand, some curriculum and pedagogical innovations are targeted to enhance faculty teaching efficiency. When successfully launched, they will reduce the faculty teaching hours needed relieving the workload pressure. This can positively influence the start of new initiatives, creating a reinforcing dynamics.

There are other curriculum and pedagogical innovations that may not necessarily increase the faculty teaching efficiency but may target other positive outcomes such as innovative practices for enhancing student engagements and currency in teaching.

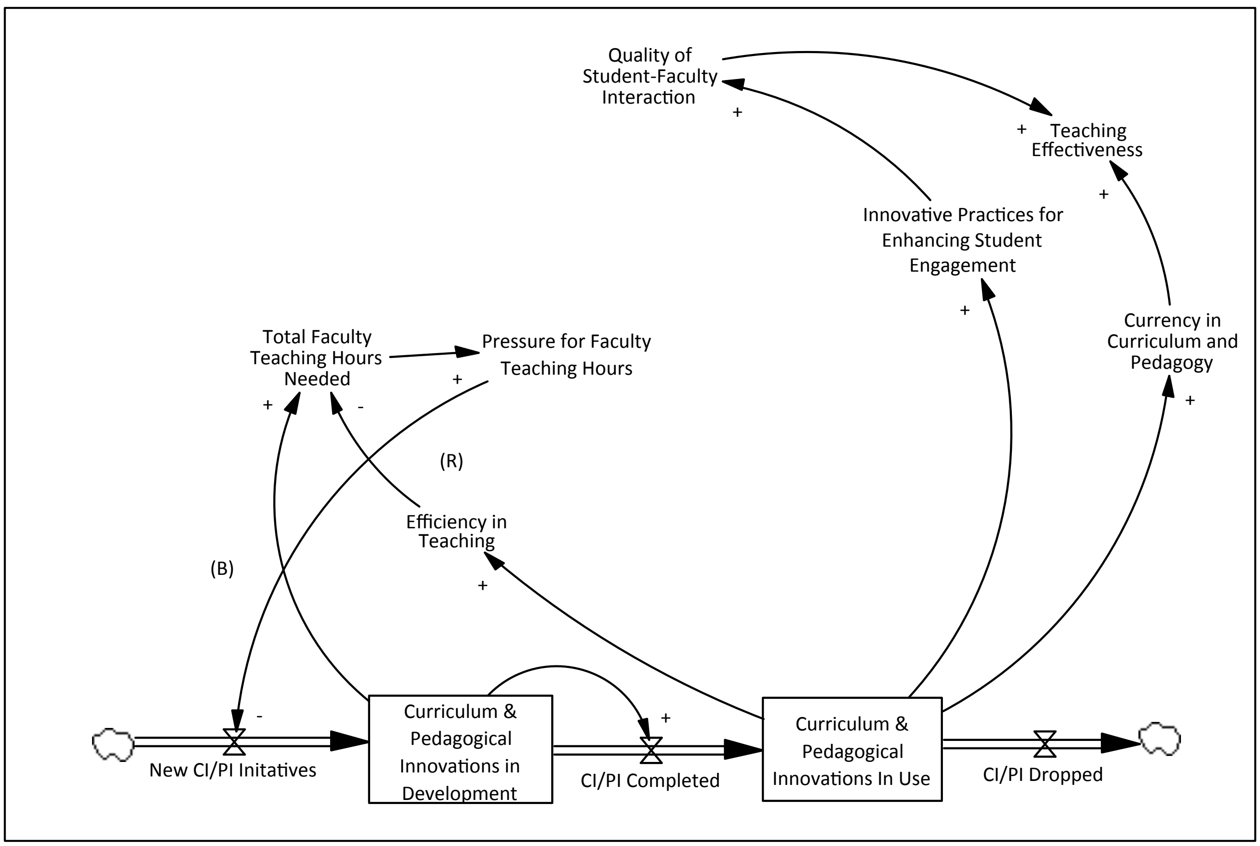

Figure 1-3.

From this mapping exercise, the following dynamic insights are gained: First, the curriculum and pedagogical innovations that achieve faculty efficiency in teaching and at the same time increase student engagement may present a high impact opportunity.

Second, even with the innovations enhancing faculty teaching efficiency, there may be a worse-before-better effect in the faculty workload, because there is a greater faculty time commitment in the development stage. This initial negative outcome should not discourage the efforts and investment in the curriculum and pedagogical innovations, as they will mitigate the faculty workload pressure in the long term. Therefore, strong administrative support to alleviate the initial workload pressure in faculty is needed.

Third, once the system learns to effectively develop and launch innovative projects, the reinforcing dynamics will promote more innovations. Until the system reaches this self-growth phase, administrative support for innovations is needed as a push in the right direction.

2. Faculty Hiring and Service Load

Faculty hiring is one of the key decisions in the higher education system. Tenure track hiring is often associated with the school's long-term strategic plan as well as the tenure density (i.e. the ratio of tenure track and tenured faculty to adjunct faculty). Hiring adjunct faculty can fill immediate teaching needs with less impact on financial resources. (Figure 2-1)

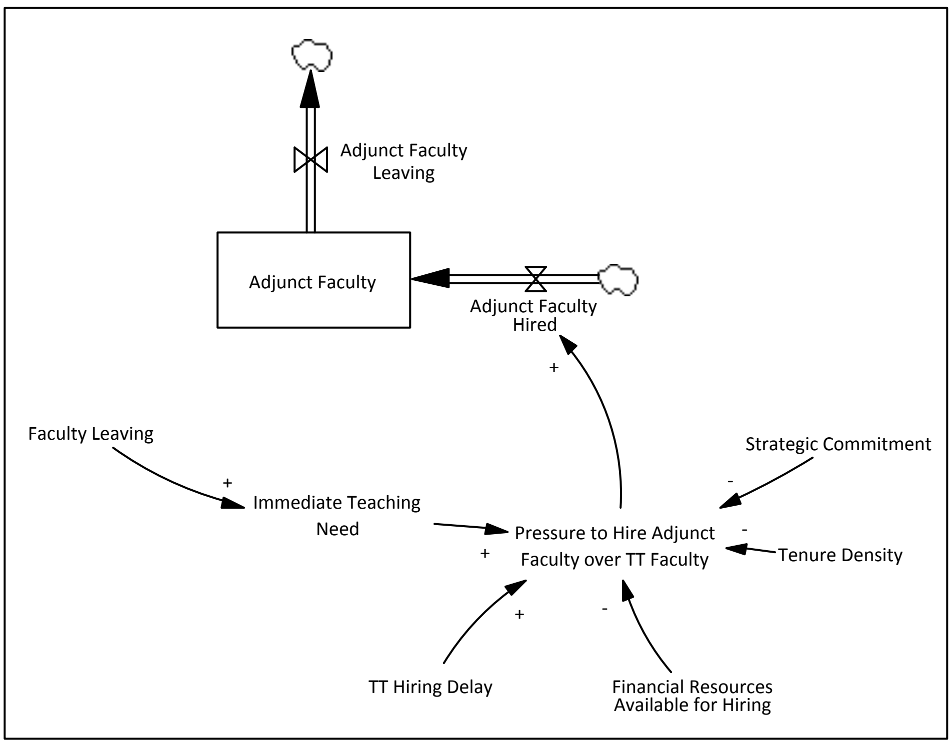

Figure 2-1.

A problem can arise when a tenure track or tenured (TT/T) faculty member leaves and an adjunct faculty is hired to fill the immediate teaching need. While adjunct faculty can pick up the teaching load, the vast majority do not share the service duties with the TT/T faculty. New adjunct faculty members need mentoring, performance reviews and appraisals. This increases the service load of individual TT/T faculty and could eventually cause faculty burnout and a lower level of morale. This is a reinforcing dynamic, because the burnout can result in higher TT/T faculty turnover, requiring more adjunct faculty hiring to fill in the position. (Figure 2-2)

Therefore, it is important to pay attention to the TT/T faculty service load as well as strategic considerations (such as maintaining AACSB accreditation in the case of business schools) to make faculty hiring decisions. When faced with an immediate teaching demand with a limited financial resource, hiring adjunct faculty can be a temporary solution, but it compromises the service and research activities of TT/T faculty.

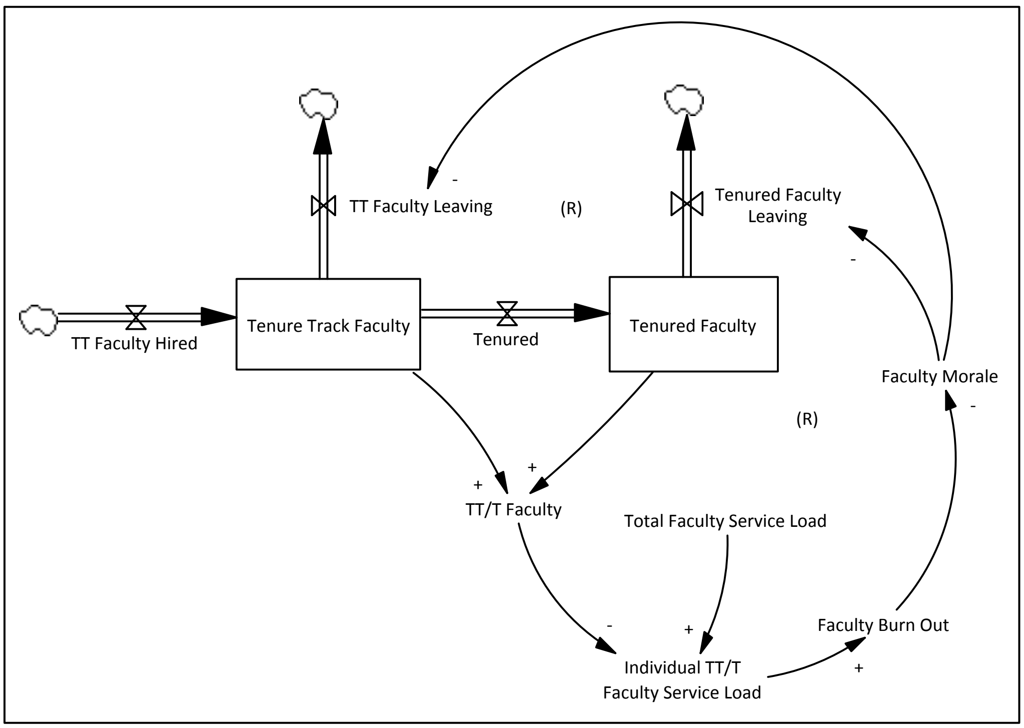

Figure 2-2.

There is another dimension to faculty hiring. There are service duties that can be performed mostly or solely by the tenured faculty—such as the review of Retention, Tenure, and Promotion (RTP) packages or junior faculty mentoring. Thus, hiring TT faculty can lead to a higher service load for the tenured faculty until the TT faculty become tenured, a process which usually takes 4 to 6 years. In that sense, there is a worse-before-better effect when hiring TT faculty to alleviate the service load. (Figure 2-3)

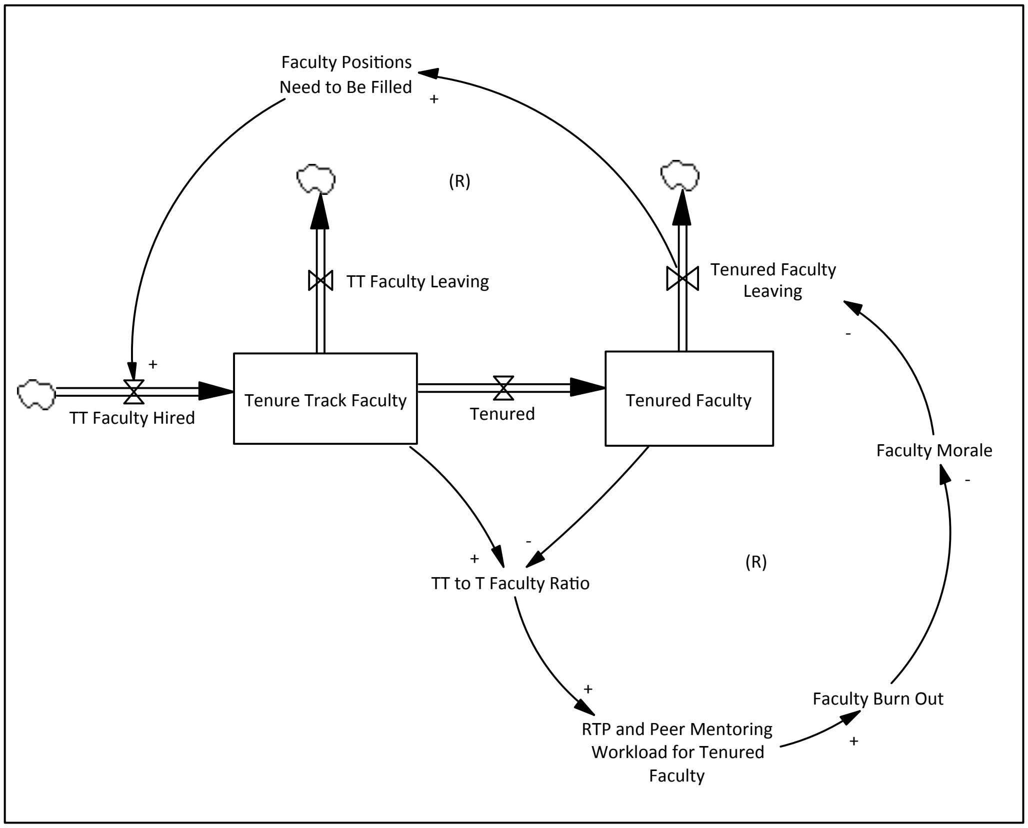

Figure 2-3.

3. Faculty Compensation

In the public university system described in the case, inequity in faculty salary has been one of the major factors negatively affecting faculty morale. The phenomenon is sometimes referred to as salary inversion, and it occurs when the existing faculty's salary rate fails to catch up with the increase in the market salary rate.

As shown in Figure 3-1, when the market salary rate for TT faculty increase, there is a pressure to increase the TT faculty hiring salary in order to match the market rate. Otherwise, the school must lower the hiring qualifications to fill the needed positions. If the hiring qualifications were lowered, they would have a negative impact on the faculty teaching and research effectiveness. Therefore, the school makes an effort to keep the hiring salary rate somewhat comparable to the market rate.

Due to the system budget constraints, the salary rate of existing faculty has failed to reflect the changes in the market salary rate. There are cases of salary inversion where the existing faculty salary is lower than the newly hired TT faculty salary. This salary inequity leads to low faculty morale and increases the faculty turnover. When existing faculty leave (in Figure 3-2, represented as tenured faculty leaving), the hiring must take place at the TT level at the market salary rate. If we assume a continuous increase in the market salary rate, the new TT hiring will push up the hiring salary rate, leading to even greater gap between existing and new faculty salaries. This is a reinforcing dynamics (R).

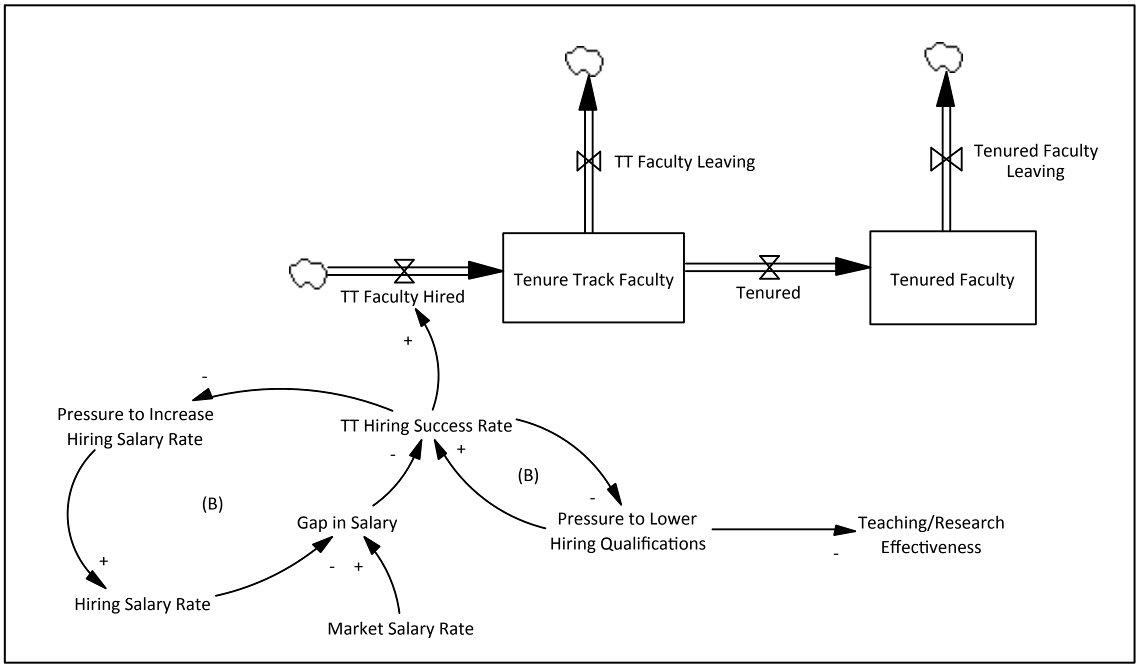

Figure 3-1.

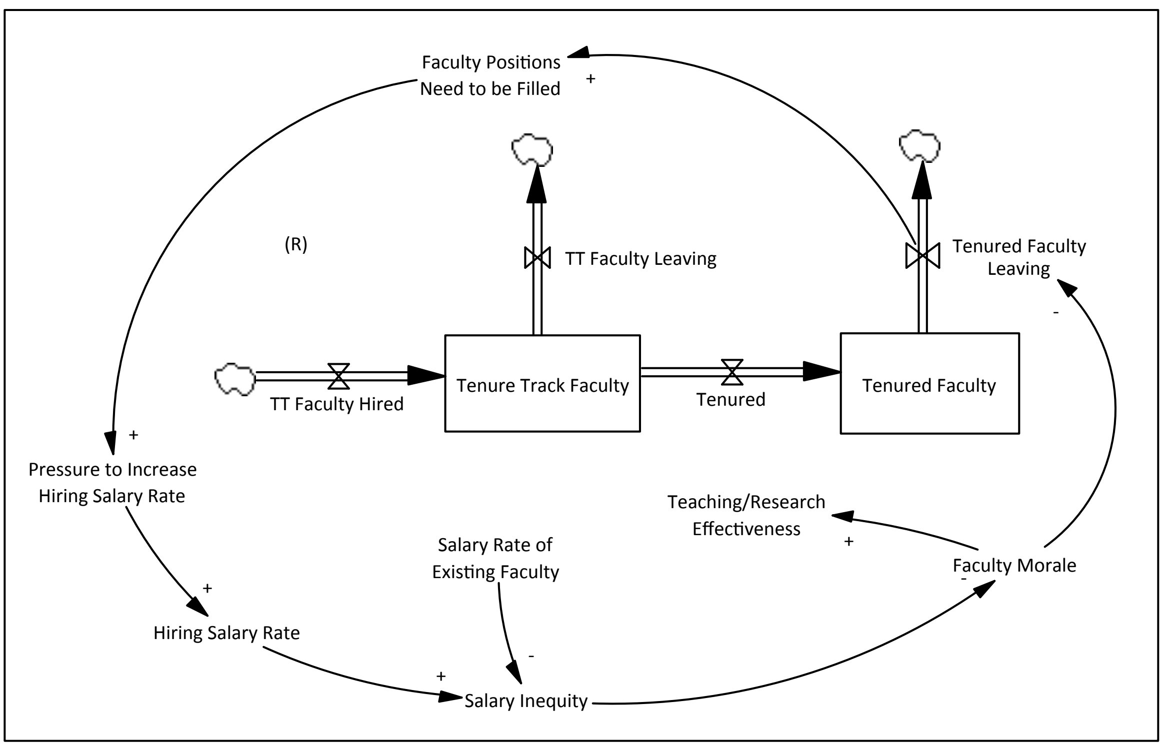

Figure 3-2.

Therefore, at the system level, a better solution would be raising the existing faculty salary rate to address the salary inequity. That way, the school retains the faculty and there is less need to hire new TT faculty at the market rate. This is more cost effective approach and it will also enhance the faculty morale leading to a better faculty performance.

Conclusions and Discussion

In this paper, we described a case of higher education institution where system mapping was used in parallel with the traditional strategic planning process to gain an understanding of the system complexity and its dynamic implications. The mapping process was inspired by the Group Model Building (GMB) scripts (Andersen and Richardson 1997; Hovmand et al. 2011), but it was modified to meet the need of the academic planning committee. Consistent with the recommendation of Bell, Cooper, Kennedy, and Warwick (2000), we worked with key decision-makers in the process, at least at the level of academic affairs, which holds one of the vice presidential positions on the campus. In addition, seven of eight academic deans were involved, and several department chairs. Further stakeholder involvement was achieved with numerous meetings across campus during the process. The resultant themes that emerged encompassed a wider range of stakeholders than were identified by Kennedy and Clare (1999).

While working with the six theme groups within the planning committee, we generated 20 sub-sector maps—where each map incorporated the inputs from two to three groups. In this paper, we presented three of those 20 maps, and described some of the key dynamic insights gained from the systems maps. In general, insights from the process and outcomes of the systems mapping exercises can be summarized as follows:

First, systems maps show how different parts of the system are connected. These connections exist beyond the sector boundaries, and the maps present an organized way to visualize and understand the complexity of the system. In strategic planning, understanding these connections are critical for effectively defining goals, performance measures, outcomes, and stakeholders.

Second, systems maps show the effect of feedback dynamics (i.e. reinforcing and balancing) in the system. They draw attention to vicious/virtuous cycles and policy resistances, and this enriches the strategic planning process by identifying leverage points and unintended consequences.

Third, systems maps show the effect of system delays. They provide perspectives on the short-term and the long-term effect of different policies and possible trade-offs. For strategic planning, this allows goals to be set with different time frames, and expected outcomes to be more realistic.

Overall, systems maps are effective communication tools that can illustrate the connection between stakeholders, goals, actions, and their impacts in a dynamic sense. This understanding is valuable in strategic planning in any organization, including higher education institutions, where each unit in the system functions independently with its own goals and resources yet embedded in a highly integrated context.

As the authors carried out the systems mapping sessions, we were also faced with a number of challenges:

First, because the mapping exercises were incorporated in the academic planning process as the need has emerged, the modelers could not optimally align the mapping progress with the planning process. The two processes mostly ran in parallel. Based on anecdotes, we believe the systems mapping contributed to the academic planning process by bringing in additional insights. However, if the mapping sessions were systematically integrated in the academic planning process from the initial stage, it could have made more impact with clear objectives, defined deliverables, and learning outcomes.

Second, the mapping process was inevitably affected by an unforeseen leadership change in the organization. Two months into the second year of the academic planning process, there was a turnover of the provost who had initiated the process, The academic planning committee continued the process, but a key administrator who supported the system dynamics effort was no longer present.

Third, because the maps were intended to bridge the communication among different groups within the academic planning committee, effective distribution and communication of the systems maps proved to be important. This communication aspect of modeling is addressed in limited system dynamics literature (Ghaffarzadegan *et al.* 2011), and we hope more research is done in this area to develop a repertoire of best practices.

Finally, as our case, some systems mapping exercises may be geared towards generating a holistic representation of the system without a clear problem definition. In such case, we may need to adopt mapping activities or deliverables different from that of GMB. In GMB, groups collectively define problems and build causal loop diagrams around the problem. The causal loop diagrams serve as a qualitative sketch for the formal simulation model structure. However, in our case, the maps present complex connections between different parts of the whole system, and turning those maps into a formal simulation model would not have lead to a problem focused model—unless a model pick a specific problem embedded in the larger system depicted in the maps. Systems thinking literature may be helpful in this case, but we also call for system dynamics modelers to document their mapping and modeling processes, so that we can collectively learn from our experiences.

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