Collective System Design in Higher Education:
Lifecycle Approach to Achieve Desired Student Outcomes

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***Abstract*—Purdue Fort Wayne (PFW), a public university in northeast Indiana (USA), faces challenges including demographic shifts, financial strain, and staff turnover. These challenges hinder its ability to achieve its mission of student success. The Student Success Standard Process Lifecycle (S3PL) uses systems insights to improve the institution's ability to foster student success.**

Design: The S3PL Team uses a method called Collective System Design (CSD), which is informed by the Deming method and the Lean movement. CSD aligns workers in an enterprise around shared goals, calls on workers to define "normal" processes used to achieve those goals, and initiates continuous improvement using the "plan-do-check-act" (PDCA) cycle. To meet this challenge, the team created diverse groups of PFW personnel and conducted system design sessions and ethnographic interviews. These efforts facilitated creative problem-solving, which led to several notable breakthroughs.

Findings: Several breakthroughs were critical as the Team adapted CSD for use at PFW. One breakthrough was devising the "*Student Lifecycle*," which describes the stages successful students move through toward graduation. The Team focused attention on cross-unit collaboration and information flow rather than the successes and failures of individual units. University personnel were directed to define collaborative processes, diagram them on a flowchart, and verify each process. The verification method was another breakthrough and involved gathering documents from relevant units and confirming student impact. Early indicators have been positive; administrators report improvements on key student success metrics.

Research limitations/implications: This project is significant because CSD had never been used at a university before. One challenge faced in the project is the diverse pathways that bring students to the university and that they take as they progress toward graduation. Some students arrive as freshmen right out of high school, others arrive as transfer students. Some students declare a major before they start their first semester, others change their major in the middle of their studies. The diversity of student lifecycle flows created a demand for diverse information flows that the Team has been addressing.

Value: The application of the systems engineering lifecycle approach demonstrates the power and flexibility of CSD. CSD is an approach to enterprise improvement that can help other non-profit enterprises facing complex and fast-changing externalities. Where manufacturing systems strive to deliver "the right product to the right place at the right time," the university must deliver "the right information to the right place at the right time" to ensure student success.

***Keywords*—System design, higher education, organizational leadership, logistics, systems engineering lifecycle.**

I. INTRODUCTION

Purdue University at Fort Wayne (PFW) is a public university in northeast Indiana, USA, serving about eight thousand students. Its vision is to "empower every person, every day, to improve the world." Like many American institutions of higher education, PFW faces daunting challenges, including demographic shifts, financial strain, and staff turnover [2, 11, 15].

In recent years, PFW has failed to achieve targets on important metrics of student success, such as student retention. Because Indiana state funding formulas penalize institutions that underperform on these metrics, the university receives less funding than it would need to operate successfully. By one unpublished internal estimate, every 1 percent decrease in student retention means six hundred thousand dollars less of state and tuition revenue. In recent years, PFW leaders have responded in a variety of ways, including creating an academic program prioritization task force to identify programs for restructuring, realigning the management of the university, reorganizing advising services, and hiring consulting firms to assess university operations. No evidence has been produced to demonstrate that these efforts improved key metrics or the university's financial situation.

The PFW Student Success Standard Process Lifecycle (S3PL) uses the expertise of PFW faculty to address the challenges faced by the institution. The work was initiated by Dr. David S. Cochran, Professor of Systems Engineering and Director of the PFW Center of Excellence in Systems Engineering, and Dr. Noor O'Neill Borbieva, Professor of Anthropology. Dr. Cochran developed a method of improving the sustainability of complex enterprise systems. The method, called Collective System Design (CSD), has been used in manufacturing enterprises and health care institutions to jumpstart innovation and build infrastructure for continuous improvement, allowing enterprises to respond more agilely to changing externalities [4, 21, 22]. The S3PL work is the first time CSD has been applied to an institution of higher education.

The S3PL work demonstrates the relevance of CSD to the field of supply chain logistics. Originally developed for manufacturing enterprises, CSD has achieved successes at PFW by applying basic supply chain logistics principles to the challenges faced by the university. Where manufacturing systems must deliver "the right product in the right place, at the right time," the university must deliver "the right information in the right place, at the right time" to fulfill the mission entrusted to it by community stakeholders.

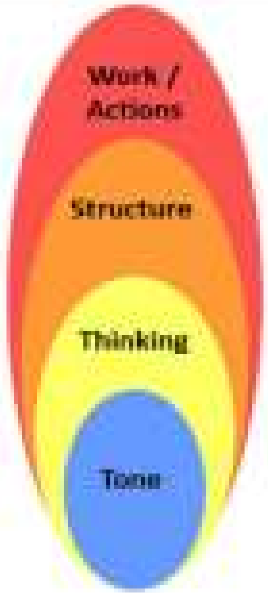

Fig. 1. CSD Flame Model of a System.

II. METHODOLOGY

A system is an integrated collection of parts (processes, structures, people, etc.) [13]. Human-created systems, such as a manufacturing enterprise or a university, are created with the intention that they will achieve certain goals. In systems engineering, the goals that a system exists to achieve are called its "Functional Requirements" (FRs). Many conditions impact a system's ability to achieve its FRs. Sometimes these conditions originate in one component part of the system, but more commonly they emerge as different parts interact. For this reason, systems engineers say that an enterprise's ability to meet its FRs is determined not by how effectively individual units or workers perform but by how effectively the units or workers work together. Systems can be improved not by finding inefficiencies in isolated component units, but by improving the interfaces between units [12].

Collective System Design (CSD) uses familiar design principles [7] to turn inefficient organizations with siloed units and low morale into integrated systems unified by collective goals. In CSD, work on a system occurs in four stages, analogous to the different colors of light in a flame (each level fueling the next): tone, thinking, structure, work (Fig. 1). CSD uses this "flame model" as it helps an enterprise standardize processes, improve information flow, and create a culture of continuous improvement [5].

The first stage of CSD is "tone." Tone is reflected in the way people in the enterprise talk about the enterprise and their work; in social theory terms, it is the dominant discourse within the enterprise. Tone is largely set by an enterprise's leadership, whose language and actions establish the tone that either motivates or demotivates workers. CSD work begins with establishing correct (i.e., positive) tone. CSD's concern with tone is informed by research on manufacturing systems that demonstrates that conflict and fear among workers can create undesirable disorder in a manufacturing system [7, 10, 12]. In an enterprise whose leaders have not established the correct tone, workers are afraid of being fired or experiencing conflict or harassment in the workplace, so they prioritize self-serving goals such as survival, financial gain, and status, over the enterprise's FRs. In such enterprises, negativity and conflict are common. Leaders establish a correct tone by communicating that they value, respect, and want to listen to workers. Workers are then more likely to prioritize the enterprise's FRs and participate in continuous improvement by generating ideas that contribute to the enterprise's agility [4, 16, 17, 18]. As work expands to include more stages of the flame model, it is important to maintain correct tone to ensure workers are invested in the success of the enterprise.

The tone at PFW when S3PL formed in 2020 was not correct or positive. Employee morale was low. In the previous six years, a popular chancellor had been forced to step down. The new chancellor cited financial shortfalls to justify the creation of a task force that implemented a program prioritization process based on the "Dickeson model" [8], which is widely used in North America. The task force created unit-based viability metrics and used them to assess university units. Units were reviewed by task force members far removed from the unit under review. Task force reviewers were not given the opportunity to ask follow-up questions of the units, even where additional context would have been helpful. The administration used the task force's reviews to justify the elimination of several programs, including academic programs, and the termination of some workers.

PFW administrators insisted that unit-based assessment would benefit the institution by enabling the administrators to invest resources more wisely: they would be able to identify and invest in high-performing units and divest from underperforming units. As leaders in manufacturing system design have long known, however, divesting from underperforming units will not improve an enterprise's ability to meet its FRs [12]. The existence of underperforming units is a sign not that personnel are deficient but that something is wrong with the design of the system. In order for the enterprise to thrive, the system must be redesigned so that the information that flows across units and the processes for that flow are clearly defined [12].

Morale on campus after the task force completed its work and units and workers were eliminated was extremely low. Many members of the S3PL Team had been personally impacted by the task force's work. To establish a more positive tone in the S3PL Team, two key messages were communicated to the Team. First, it was established that CSD does not look for underperforming workers or units. CSD acknowledges that problems in an enterprise are more likely to be caused by deficits in the system design than by irresponsible units or workers. Second, the S3PL Team heard university administrators commit to not using outcomes of the Lifecycle work as a justification for staff layoffs. Administrators communicated their conviction that by improving the university's ability to attract and retain students, the S3PL work would improve the university's financial situation and increase job security for all workers. By making this commitment, the leadership team moved beyond unit-based thinking with a shift to system-based thinking [19].

The second stage in the CSD flame model is "thinking." This stage involves articulating the Functional Requirements (FRs) that an enterprise exists to achieve. Once the correct tone has been established, workers and management can discuss their goals transparently. FRs generally reiterate an enterprise's mission, putting that mission into practical terms. FRs also articulate the needs of stakeholders. FRs exist at different levels of operation; broad, high-level FRs express overall goals for a system, and low-level FRs break those goals into component parts.

In CSD, the thinking stage of the flame model can be informed by an enterprise's strategic plan. Although PFW's strategic plans have always included student success as central to PFW's mission, the program prioritization process ignored that goal and instead worked to achieve the goal of saving money. Although the task force created metrics that were informed by the Strategic Plan, the actual changes precipitated by the metrics were all about short-term cost-savings (in the form of unit and personnel cuts), to the detriment of student success.[1]

The thinking level of CSD at PFW took the form of conversations within the S3PL Team about Team members' understandings of PFW's mission. These conversations allowed the Team to articulate the high-level FR for PFW as "**Ensure Student Success**." This articulation aligned with PFW's current Strategic Planning process, which identifies "student success" as central to three of the institution's six "priority strategic activities." The Team further refined the FR by defining student success as the consistent progress of students through their years of coursework at PFW toward timely completion of a degree and into a rewarding career.

A key insight at this stage of the work was to define the achievement of the FR, "**Ensure Student Success**," in terms of a specific design solution: student flow through the "*PFW Student Lifecycle*" (Fig. 2), comprising a series of Student Success States (S0 to S7). Corresponding with each Student Success State (S0 through S7) in the Student Lifecycle are process steps, which describe the cooperative activities workers in campus units perform to move students through transitions from one Student Success State to the next. The Student Lifecycle comprises seven process steps that accomplish seven Student Success State transitions.

Special note should be made of Student Success State S4. The Team decided to decompose S4 into S4.1 ("ready to start first semester"), S4.2 ("ready to start second semester"), *etc.*, culminating in S4.n, "ready to start final semester and apply for graduation." Although many of the processes across S4 repeat, students are at a higher risk of dropping out during their earlier semesters (PFW's internal data show that students are most vulnerable in the transition from first spring to second fall, meaning they have successfully achieved S4.2, but they fail to achieve S4.3). The unequal risk faced by students across different semesters, and the likelihood that risks leading to dropout emerge several semesters before a student actually drops out, led the Team to decompose S4 in this way.

The Team's decision to adopt the design solution, "PFW Student Lifecycle," consisting of the seven Student Success States, was informed by lessons learned from applying CSD to manufacturing enterprises [4]. Improving the way a good moves through a manufacturing system yields better results than improving the work done at any individual step. The preferred approach is referred to as working "horizontally" (looking at how units work together to facilitate student success through the system), and the less preferred approach is referred to as working "vertically" (looking at the interaction of each unit with students as separated activities) [19]. The vertical approach does not identify problems related to the interaction among units in the enterprise or the student experience from unit to unit. Improving the work in any one unit may have a negligible or negative impact on the student-success state FRs if the improvements impact other units in unanticipated ways. Adoption of the design solution, "PFW Student Lifecycle," ensured that the S3PL Team used a horizontal approach that focused on the student experience as students progress toward graduation, rather than a vertical approach, which would have looked at what each university unit (academic departments, administrative offices, etc.) does as a unit-based optimization problem.

Another important decision made by the Team was to decompose the high-level FR, "**Ensure Student Success**," into lower-level FRs based on four *Student Wellness States* (TABLE I) that are integral to student success: academic wellness, financial wellness, professional wellness, and holistic wellness. The rationale for this decision was that for the high-level FR to be achieved (i.e., to ensure students move steadily through the Student Success States toward graduation), the university—through the work done by its staff and faculty—must foster these Student Wellness States.

Fig. 2. PFW Student Lifecycle

[1] The authors, both of whom served on the task force, have seen no evidence that the program prioritization process resulted in any significant long-term savings or improvements to student success.

TABLE I. STUDENT WELLNESS STATES

Academic wellness	Maintaining good academic standing, attending class, submitting assignments on time.
Financial wellness	Paying bills on time, understanding what college costs, understanding the student loan system, living within means.
Professional wellness	Preparing for a career during college by seeking out appropriate professional development activities (internships, jobs, coursework, etc.), learning needed professional soft skills, finding mentors.
Holistic wellness	Participating in student groups, having a reliable support network of friends and family, maintaining a healthy work-life balance, finding a good living situation, taking care of health and physical wellbeing, taking care of mental wellbeing.

A process step defines the work and actions by PFW units to achieve the four wellness states. The wellness states are defined by the FRs of the system design which codify the desired student-success outcomes. The completion of a process step (S1… to …S7) is designed to ensure student success by achieving the four states of student wellness.

In CSD, before achievement of FRs can be measured (by FRms) the activities that each unit perform to achieve the FRs must be defined. Without defining activities, it is impossible to design or make improvements that will have predictable results. Improving workers' activities without defining the baseline normal through standard work is analogous to "pushing on spaghetti."

To avoid ineffectual effort, CSD identifies "structure" as the third stage of work in the flame model. This stage involves defining "normal" through "standard work" done to achieve each process step's FRs. Systems engineers refer to structure as a design solution or "physical solution" (PS) of the system; it is the result of a decision to achieve the FR. In a manufacturing enterprise, the structure stage involves designing the physical infrastructure (machines, factory floor layout, assembly work and methods, etc.) used in manufacturing as well as the work employees do as they interact with the physical infrastructure. PFW does not manufacture goods; its FR is **Ensure Student Success**, so in working on the structure stage, the S3PL Team discussed not physical infrastructure but information logistics. The following four questions organized the Team's work during the structure stage:

- What information do students need from PFW units and when do they need it?
- What information do PFW units need from students and each other and when do they need it?
- How is information moved around so the right information goes to the right place at the right time?
- How do we know that a task involving the information has been completed?

Describing all the activities done for all process steps in the Lifecycle would be a very large task, so the S3PL Team decided to begin with one process step: the transition from S3.0 ("admitted and committed to PFW") to S4.1 ("ready to start first semester"). During this transition, students interface with a variety of PFW units. These units also work with each

Fig. 3. Activities, Connections, and Flows Swim Lane Diagram

other collaboratively on administrative tasks that serve students. The S3PL Team brought in representatives from PFW units most relevant to this process step (the Admissions Office, the Bursar, Office of Financial Aid, several advising units, Student Affairs, and others) to discuss the way information was moving among units and between units and students during the summer before first semester. LUCID, a flowchart software, was used to capture what was learned during these conversations. The result was an Activities, Connections, and Flows diagram that mapped information flow among units and to and from students during the process step S3.0 to S4.1. Using LUCID allowed the Team to create an intuitive and accessible diagram that any member of any PFW unit (including new hires) could consult to understand where their work fit into the S3.0 to S4.1 process step. Fig. 3 is a detail from the LUCID flowchart for S3.0 to S4.1.

The last stage of CSD is "working on the work" [12]. After structure (PSs or "standard work") has been defined, the structure can be assessed and, where necessary, improved. Improvement is indicated when the PS is not being implemented correctly, when the PS does not achieve the FR, and/or when external conditions have changed enough that FRs, PSs, or both need to be revised. Working on the work begins with developing metrics that indicate when one (or more) of these conditions exists. Where metrics suggest that the PS has not been implemented correctly or that the PS does not effectively achieve the FR, improvements need to be made. After improvements are implemented, they will be assessed again, and the cycle, called the "Plan-Do-Check-Act Cycle," or PDCA, continues. PDCA contributes to the long-term viability of an enterprise, because PDCA shifts workers away from relying on last-minute, one-off solutions to challenges (systems engineers call this the "putting out fires" method) to ongoing systemic flexibility.

The goal of CSD is to create resilient enterprises. Resiliency refers to an enterprise's ability to survive over time, and it is produced when an enterprise can respond agilely to a complex environment [1]. Even if today's processes work effectively to help the enterprise meet its FRs, externalities can change in the future, requiring adjustment. For this reason, CSD builds resilient enterprises by establishing a culture of continuous improvement.

III. Findings

This section discusses the findings of the S3PL Team (systems engineering project leaders, unit representatives, and administrators) as it adapted CSD to the higher education context. These findings emerged as the Team worked through the flame model stages. Informed by the success of user experience (UX) research in the tech industry, project leaders also conducted ethnographic research. They interviewed students and faculty to learn about the student experience, and they staged re-enactments of experiences students have had with the university, presenting these stagings to diverse groups of staff and administrators. Conversations and ethnographic research revealed that suboptimal information flow is the biggest obstacle to success at the university. The findings discussed here explain how the Team improved information flow at PFW.

A. Finding One: Right Information, Right Place, Right Time

One finding of the S3PL Team is that student success depends on the efficiency, accuracy, and predictability of units' information transfers to students, from students, and with each other. This finding emerged during Team conversations and ethnographic interviews with students, during which the inconvenience of "holds" was discussed. At PFW, placing a "hold" on a student's account allows a unit to communicate to a student that the student needs to take a specific action. Holds are placed on students in a variety of ways, and different holds have different impacts. Some holds prevent students from registering for their next semester of classes. When a student is notified that they have a hold, the notification may not clearly explain how to resolve the hold, so the student must guess how that is done. The typical student will reach out to a university unit that they think can help them, but often that unit is not the correct unit, and the person the student talks to in the unit does not know which unit will be able to help. That person may send the student to another unit, but that unit also may not know how to help. Often the hold can be lifted easily if the student finds the one person who knows how to lift it, but neither the student nor most PFW workers are able to identify that person for many common holds. Students call this the "the Mastodon Shuffle" (PFW's mascot is the mastodon).

The Mastodon Shuffle is not limited to holds; it occurs whenever a student, trying to resolve an administrative issue that is impinging on their ability to move successfully through the student lifecycle, is sent to one or more units but fails to resolve their issue or resolves it only after considerable difficulty. The Mastodon Shuffle takes time away from students' academic work and leaves students feeling devalued by the university. According to PFW advisors, some students who stop out (*i.e.*, students who do not return in the subsequent semester) cite the Mastodon Shuffle as a reason they did not return. The cost to the university of the Mastodon Shuffle is high: students do not succeed (the university does not achieve its FR) and the university's financial stability is impacted.

The Mastodon Shuffle is an emergent property of suboptimal information flows within the system. It manifests when people in different PFW units do not know what other units are doing, resulting in the transfer of inaccurate information to students. As discussed above, the S3PL Team used LUCID to create an accessible diagram of every activity of every unit during the process step S3.0 to S4.1, to increase the likelihood that activities were occurring when they should (i.e., the right information was getting to the right person at the right time) and to reduce the likelihood of people making inaccurate assumptions about what others were doing and communicating those inaccurate assumptions to students.

B. Finding Two: Capturing Normal, Standard Work with LUCID Diagrams

The LUCID flowchart serves two important purposes. First, it facilitates information transfer; it is a reliable source of information about the way information is being moved during a process step. Second, by defining the process's normal work, the flowchart readies the process for the PDCA cycle of continuous improvement.

Although many members of the Team working on S3.0 to S4.1 wanted to improve existing processes as they were mapping them, the systems engineering members of the Team encouraged the Team to make sure all activities and processes had been fully captured on the flowchart (i.e., that the current "normal" or "standard work" had been defined) before improvement attempts were made. Creating an exhaustive map of the activities people were already doing revealed the extent to which people in different units did not know what each other were doing. It also exposed the lack of agreement among units regarding how some processes or activities were being completed. Building the flowchart forced every unit to agree on the information that was being moved into each activity, how it was processed, and moved out and formatted for students and other units.

C. *Finding Three: Information Management Through Verification*

Informed by the Activities, Connections, Flows model of information logistics, each activity mapped on the flowchart is represented as a box in the "swim lane" of the unit that completes the activity. The box includes text that describes the type of information that the activity transfers and the means of transfer. An arrow connects the box in question to the box that represents the next activity that uses the information. This second box is entered in the swim lane of the unit that completes the second activity. If the information is given to students, the arrow connects to a box in the student swim lane. Text in the receiving box indicates the activity expected of the receiver (i.e., what information the receiver needs to pass to the next box). Every box that represents an activity includes links to relevant documents, such as the text of an email or a form. These documents are stored on the S3PL SharePoint site and accessible to anyone at PFW. Every box also includes a link to a worksheet (also stored on SharePoint) for verifying the activity.

It is a basic design principle that the connection between two activities that are important in a system needs to be verified in the form of an unambiguous response indicating that the connection was (or was not) achieved [20]. The S3PL Team built a verification process into the LUCID flowchart to ensure that this principle was being upheld. To verify an activity, the unit in charge of the activity must answer the following questions:

1. How does this activity benefit the student or why are we doing the activity?
2. Define the timing of the activity: (a date or event that triggers a unit to perform this activity).
3. Define the details of the activity.
4. Define the means of communication:
   a. Define the input information that you require to complete the activity.
   b. Define the output information that you send to the student or unit. (i.e., include a screenshot, sample form, template email, other).
5. How do you know that the receiving unit or student has completed the activity?
6. What do we do if the activity is not completed?
7. What is the impact if the activity is not completed?

Answers are entered on a verification worksheet, and the worksheet is uploaded to SharePoint. Every activity that has been verified in this way is marked with a green checkmark on the flowchart. This has allowed the S3PL Team to identify a useful "doing" metric: the percentage of activity boxes with green check marks out of the total number of activity boxes. A high percentage of green boxes indicates that a process step (e.g., S3.0 to S4.1) is ready to move into the fourth stage of the CSD flame model, "working on the work," which includes the PDCA cycle.

IV. Research Limitations

One challenge facing the Team is the variety of paths students take as they move through the Lifecycle. This is a limitation because it means that even if a process step has been fully mapped in the LUCID flowchart, this map will apply to some student populations but not others. Additional flowcharts will have to be created for other student populations, and it is unclear whether it will be possible (or recommended) to exhaustively map all possible variations on student flow through the Lifecycle.

One example of a variation was encountered during work on S3.0 ("committed to PFW") to S4.1 ("ready to start first semester"): students who come to the university as high school admits need different information and thus require of PFW units a different set of activities than transfer students starting their first semester at PFW after earning credits at a community college or another university or returning to college after years away. In Summer 2021, the S3PL Team started mapping standard work for S3.0 to S4.1 for traditional students (admitted directly from high school), and this work benefited units who organized Summer 2022 New Student Orientations. Since then, the Team has decided it needs to define activities for transfer students starting their first semester at PFW, because some of these activities will vary depending on if a student is straight from high school or a transfer.

Another example of a variation with impacts on the S3PL work is the different ways students declare a major. Administrators want each student to declare a major before the student starts their first semester, and then graduate with that major, but it is unrealistic to expect even most students to do that. Many students declare majors they are unprepared for (such as engineering students without the required math background), some students change majors because their career goals change, and other students take longer to decide. Eventually, it will be necessary to capture the impact of different paths students take to choosing a major on the lifecycle flowchart. The diverse paths students take to get to PFW and move through the student flow create difficulty in the work, but the Team believes it will be better to map standard work for diverse flows rather than map one flow and expect unit representatives to improvise ("put out fires") when faced with "exceptions."

V. Impact

The Lifecycle work has already led to positive outcomes. Staff who worked on the New Student Orientations during Summer 2022 reported that the Lifecycle work improved the effectiveness and efficiency of orientation events. The Lifecycle work has also brought representatives from diverse units together to talk about their jobs and has resulted in notable improvements in the tone of conversations among those workers. When Team members experience that their ideas and concerns are acknowledged and acted upon, they feel enthusiastic about their work and become more dedicated to the institution's FR, student success. Furthermore, as Team members see the benefit of articulating shared goals, defining the standard ("normal") work for each process step, and collaboratively working on improvements, they are shifting from thinking in terms of obstacles, "*we can't do this*" to thinking in terms of overcoming constraints, **"we can do this."**

VI. Next Steps

The S3PL Team is beginning two new steps in Fall 2022. First, it is beginning the verification process for alternative student flows (not straight-from-high-school) for the process step S3.0 to S4.1. Second, it is working on the process step S4.1 ("ready to start first semester") to S4.2 ("ready to start second semester") for students admitted straight from high school. As this work expands to include more process steps, the Team will initiate PDCA for process steps begun earlier. Establishing a sustainable PDCA process requires building the appropriate infrastructure. The S3PL Team has already begun this work by setting up an online system to collect improvement ideas using SharePoint and Qualtrics [16].

VII. Value

Where manufacturing systems strive to deliver "the right product to the right place at the right time," a university must deliver "the right information to the right place at the right time" To facilitate student success and the achievement of the four wellness states. The Student Success Standard Process Lifecycle demonstrates that enterprises in the information economy can benefit from the important insights that have been developed in areas like manufacturing system design, supply chain management, and information logistics. By using the design principles represented in CSD's flame model, enterprises can reduce information flow complexity and adapt to fast changing environments. When universities thrive, entire economies can thrive. Universities provide a critical resource—human capital—to local and national markets. As the PFW team expands the Lifecycle work for additional process steps, the impact that PFW has on its stakeholders and on industries across northeast Indiana is substantial.

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