Understanding the Impact of KS-LSAMP Undergraduate Scholars Activities at Kansas State University with the Implementation of Lean Manufacturing Techniques

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Abstract

Lean management has been widely used in manufacturing industries because it increases productivity and improves quality. However, this existing universal management framework has not been widely used in higher education. Lean Manufacturing key principles are customer value, continuous improvement and respect for individuals. The aim of the present poster is to emphasize the importance of applying lean manufacturing principles in a program for supporting the needs of underrepresented students and identifying potential beneficial outcomes. The hypothesis being tested was that providing students with the opportunity to engage in hands-on discovery-based activities, offering experience in laboratory environments, allowing them to conduct undergraduate research, and offering mentorship as part of a community would help students develop a strong self-identity in STEM and strengthening their self-efficacy, and has added value to students of different background. The results show improvements in recruitment, retention, and inclusion of students from underrepresented groups in STEM disciplines. The Kansas LSAMP alliance, led by Kansas State University, offers multiple activities aimed towards the success of underrepresented identities and first-generation students. For instance, Research Immersion: Pathways to STEM, KS-LSAMP Scholars Program, KS-LSAMP T.E.A.M Mentor Program, Transfer Visit Day, and KS-LSAMP Connect. With integrating the lean manufacturing tool of "identifying value" where value corresponds to all the characteristics or functions of something that meets a person's needs from feedback surveys, led the outcomes of activities and programs being flexible and individualized plans for each student making KS-LSAMP educational program more efficient and effective.

Keywords

KS-LSAMP alliance, Undergraduate scholars, STEM, Graduate student poster, Lean principles.

Introduction

Lean management originated from the Japanese automobile industry in the early fifties of the 20th century for improvement of production performance by removing unnecessary losses which were reported daily [1]. Two main pillars support the "Toyota Way": Continuous Improvement and Respect for People. Toyota believes the success of their business is created by individual effort and good teamwork [1]. After successful application in the production sector, other industries, including healthcare, construction, and service, found their benefit in applying Lean management practices. Based on the success of Lean management practices in a number of industries, there is now interest in applying Lean principles in higher education. The goal is to

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find better solutions to attract new students, enrich teaching, enhance research, and provide quality service to students.

Kansas State University has been leading the Kansas Louis Stokes Alliances for Minority Participation (KS-LSAMP) program of the National Science Foundation since 2013. KS-LSAMP promotes recruitment and retention programs throughout Kansas in support of increasing participation of Hispanic/Latino Americans, African Americans, Pacific Islanders and American Indians in science, technology, engineering and math fields. KS-LSAMP alliance includes six partners: Barton Community College, Dodge City Community College, Garden City Community College, Seward County Community College, Donnelly College, and Wichita State University. The alliance initiatives include focused and enhanced recruiting; development of detailed transfer guides; training for admissions personnel and academic advisors; student enhancement programs such as student research opportunities, internships, math immersion, and alternative spring break; a focus on career counseling; formal and peer tutoring; and implementation of improved student tracking.

The poster will discuss how members of the KS-LSAMP have established recruitment and retention activities aimed at serving the needs of underrepresented students including African Americans, American Indians, Pacific Islanders, and first-generation students in additional to Hispanic/Latino students with the implementation of lean management principles.

KS-LSAMP Programming

KS-LSAMP has multiple educational pillars to increase recruitment and retention of underrepresented students. These pillars include Research Immersion: Pathways to STEM, KS-LSAMP Scholars Program, KS-LSAMP T.E.A.M Mentor Program, Transfer Visit Day, and KS-LSAMP Connect.

Research Immersion: Pathways to STEM is an 8-week summer research program offered annually at Kansas State University. This program pairs students with research mentors who help students to conduct an independent research project. The overall goal of this program is to provide summer academic and professional preparation to underrepresented students in STEM fields to transfer to a four-year institution. Each summer an average of ten participants from the KS-LSAMP alliance partners arrive on campus where they conduct rigorous research in the span of 8-weeks and connected with faculty and peer mentors. Participants learned about campus resources through professional development seminars, acquired knowledge on how to extract and read technical literature, conduct lab experiments, generate results, publish their findings on posters at the Kansas State University Undergrad Research Showcase, and gained the opportunity to experience a four-year institution.

The KS-LSAMP Scholar program aims to help students become more knowledgeable about themselves and what tools they need to succeed. This program helps students gain insight by engaging with a community of peers, take responsibility in utilizing campus resources and

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manage their behaviors through goal setting. The program provides a $500 stipend for active participation in the program, along with a flexible plan tailored to students' goals and schedules.

The KS-LSAMP T.E.A.M. (Transfer Engagement and Mentorship) program is designed to help community college students make a successful transition from their two-year institution to K-State by connecting with current K-State students. This is a distance-mentoring program that aims to make the experience flexible for all participants.

KS-LSAMP transfer visit day is where KS-LSAMP collaborates with the K-State Admissions Office to coordinate a two-day experience for interested students. The first day of the event introduces K-State and many of its resources. Community college students gain the opportunity to go on a campus tour with current K-State students and hear from different offices on campus. The following day students attend the K-State Transfer Visit Day, which is hosted by the K-State Admissions Office. During this, event students meet with academic advisers, have lunch with current K-State students and participate in additional campus tours.

The KS-LSAMP Connect program was first launched in spring 2023 semester. The goal was to provide a mixture of professional development and social experiences for our KS-LSAMP students. Several seminars and events encouraged students to attend. KS-LSAMP eligible students who attended at least three of the four events received $150 at the end of the semester.

Program Outcomes

For the KS-LSAMP RiPS program, 95% of community college participants have transferred to a four-year institution [2]. This is exceptional as a recent report from the National Student Clearinghouse Research Center noted that from a 2010 cohort of 852,439 students, 31.5% of students transferred to a four-year institution within six-years [3]. Academic coaching in the KS-LSAMP Scholars program has shown progression with students' GPAs, scholars exhibited an average GPA of 3.77 [4]. As for the KS-LSAMP RiPS program, this undergraduate research opportunity demonstrated and promoted an increase in recruitment and retention. Retention rate for students who have participated in the LSAMP Scholar program at K-State is first year 91.8%, second year 86.6%, four year 58.2%, and six year 76.9% [4]. Overall, KS-LSAMP activities have created a strong science identity in underrepresented groups and students have shown yearly-improved persistence among STEM disciplines [4]. However, there is always room for improvement.

Methodology

In this work, all KS-LSAMP activities have been reviewed using the Lean management framework to improve KS-LSAMP teaching seminars, mentorship, and research. Previous work by the scholar Sunder [5], has looked at applying the Lean management framework in higher education. He emphasized the importance of finding new and improved ways of teaching, redesigning institutional infrastructure, and processes to survive and compete in higher education. He explains that practical knowledge brings more value to students' learning and future work. The main types of waste in education are waiting and inventory [6].

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Results and Discussion

The Lean management framework has five steps: Identify value, Map Value Stream, Create flow, Establish pull, and continuous improvement [7]. The first step is identifying value, where value refers to all the characteristics or functions of the product that meet the customer's needs and for which the customer is willing to pay. This is the starting point of the Lean Manufacturing approach. It is crucial to properly identify value by product and customer in order to define in the next step (Map Value Stream) the best flows and critical production steps. KS-LSAMP RiPS information was advertised at community college partners and a four-year institution. As this program was designed as an introduction to undergraduate research, students did not need to have prior research experience. Applications included a personal statement and two letters of recommendation from STEM faculty members [8]. Data taken from post-test surveys showed that students valued novel research, self-management, personal responsibility, and mentorship [8].

The second step in lean manufacturing is mapping value stream. Value streams are the different sequences of activities required to design, produce and deliver a product to the customer, including information processing and material supply. They must be designed to reduce or even eliminate activities that do not add value for the customer, which are considered losses. Students are provided flexibility when participating in any KS-LSAMP activity, such as students having access to Canvas and interactions with the courses prior to the start date allowing them to complete assignments at their own pace. This limits the waste of students' time and productivity due to students gaining a head start without waiting for an exercise to begin or waiting for an educator to prepare their material.

Step three is creating flow; the principle is to achieve continuous production. Production must be as fluid as possible, eliminating unnecessary waste as much as possible. With KS-LSAMP to create flow, we implemented the usage of standardized work. Standardization brings several benefits. It improves the reproducibility of production and limits variations. It facilitates improvement because everyone can think about a single method known to everyone. For instance, with the KS-LSAMP Scholars program, students interacted with an academic coach that includes individualized conversations, allowing students to drive the reflection with the coach who then provides follow up questions to guide students to think in a direction of actionable steps and standardized approach towards their academic and professional goals.

Step four is when establishing pull occurs. The principle of this lean manufacturing step is to set up a pull production system. It strengthens any system since it is necessary to produce only what is necessary at the downstream step. It provides the final touch of reducing work-in-progress to a maximum. Now that KS-LSAMP Scholars have a standardized approach and actionable steps to achieving their goals, within this final meeting students are asked to return to their goals and evaluate if they have met their semester goals and/or steps towards their long-term goal. Future steps are considered to either continue or maintain progress on the set goal.

Lastly, step five is continuous improvement. Toyota's two most important lean principles are continuous improvement and respect for people. They prevail over any other "technical"

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principle or method of lean manufacturing. KS-LSAMP puts students first. The program utilizes pre and post surveys after each program activity to gain insights from participants in STEM fields to continuously improve the program activities, increase retention, increase transfer student rates, and promote academic success of underrepresented students.

Recommendations and Future Work

For continuous improvement of the program the following recommendation:

1) Collect and compare data for all program elements
2) Continue to collect feedback from students and other constituents such as faculty, administrators, and employers
3) Have an annual meeting to discuss program data

The implementation of Lean management framework in KS-LSAMP program activities should help to continue to improve student academic performance and professional development.

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