Easing the Transition from the Community College to an Engineering Technology Bachelor's Degree Program

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Abstract

Kansas State University's Department of Engineering Technology (ET) is receiving far more employer requests for graduating students than there are students available to fill the need. This is not merely a local trend; it is a global phenomenon that has potential for lasting social and economic consequences. Nationally, demographic data reveal that our hope for strengthening our engineering home front lies in assisting the educational pursuits of our traditionally underrepresented students. Statistics show that one in three school-age children in the US are of minority status. Furthermore, a large percentage of ethnic minorities begin their postsecondary experiences at two-year institutions. Easing the transition from community college to engineering-related bachelor's degree programs has become paramount to engineering educators and administrators. This paper outlines a strategy deployed by Kansas State University at Salina to establish collaborative agreements with Kansas community colleges.

Introduction

The problem. The National Academy of Engineering and National Research Council confirms that domestic supply of qualified workers is not keeping up with the skill demands in fields that require strong backgrounds in science, technology, engineering and mathematics (STEM).[1] In a document entitled "Tapping America's Potential: The Education for Innovation Initiative," 15 prominent US companies declared their concerns regarding America's ability to continue as a leader in scientific and technological superiority given this shortage of qualified personnel.[2] While an increase in the employment of foreign nationals has been a means of filling the demand, Chubin et al. remind us that national security concerns have put a damper on this strategy.[3] It is important to note however, that national programs such as Project Lead the Way (PLTW) are making efforts to address the decline of interest in engineering. A not-for-profit organization, PLTW is attracting students at the middle and high-school levels through "hands-

on experience" in problem solving, teamwork and problem-based learning."[4] Still, educating and preparing engineers for future generations remains a formidable challenge.

The community college connection. Research reveals that the crisis facing engineering educators, and educational communities at large, is not local and requires us to realign engineering education with our technical and community college cohorts.[5] For example, India, one of the leading producers of engineers (350,000 graduates annually to 140,000 in the US) is in dire straits—it projects a need of "2.3 million engineers by 2010 but may miss that goal by 500,000."[6] In response to this shortfall, India is relying on its second-tier technical schools to build the engineer base it needs to sustain its phenomenal economic growth. Demographic data reveal that the US hope for strengthening the engineering home front lies in the education of traditionally underrepresented students enrolling in community college/technical colleges. One in three of school-age children in the US are of minority status. Trends indicate that this underrepresented group will account for the greater portion of the workforce as the century progresses.[7] To boot, a large percentage of ethnic minorities begin their postsecondary experiences at two-year institutions. Interestingly, forty percent of existing engineering bachelors and masters degree holders in the US have attended a community college; twenty percent of engineering-degree holders showed 10 or more community college credits.[1] It behooves our secondary and postsecondary education institutions to bridge the chasms that prevent this select student population from reaping the benefits of careers in engineering and technology.[5]

K-State at Salina. The College of Technology and Aviation, a consequence of a merger of the Kansas College of Technology with Kansas State University (K-State) under an enactment of the 1991 Kansas Legislature, has its own campus, located approximately 75 miles west of the main campus in Manhattan, Kansas. Students enjoy the benefits of a Big-12 University within the close-knit community of a small campus. Localized versions of all standard student services and support programs representative of a functional institution of higher learning are located on-site, guaranteeing not only access, but also services geared toward specific needs of this particular college population. The K-State at Salina is comprised of three academic departments--Aviation, Arts Sciences and Business, and Engineering Technology--as well as library faculty, and the Division of Continuing Education. The Department of Engineering Technology provides students with a choice of enrolling in either an associate or baccalaureate degree program. The department offers associate of technology degrees in Construction Engineering Technology, Computer Systems Technology, Web Development Technology, Electronic and Computer Engineering Technology, and Mechanical Engineering Technology. Bachelor of Science degrees are offered in Computer Systems, Mechanical, and Electronic and Computer Engineering Technology. The Construction, Mechanical, and Electronic and Computer Engineering Technology programs are accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC-ABET).

Purpose

K-State at Salina has embarked on a cooperative enterprise with Kansas community colleges to construct an innovative articulation model for seamless transfer of community college credit hours. The plan fosters a mechanism by which transfer students can secure an Engineering Technology Bachelor's degree from K-State at Salina in one of the three degree options. Two

objectives guide the initiative: (a) To increase the number of community college transfers awarded baccalaureate degrees in engineering technology, (b) To increase the number of traditionally underrepresented students (low-income, rural, first generation, ethnic and gender minorities) in STEM areas. Chronicled in the following paragraphs are elements of methodology along with documented testimony of objective accomplishments.

Methodology

Importance of shared governance. It is imperative to the success of any collaborative endeavor, whether in the public or private sector, that participants contribute to its realization and that plans are conceived and implemented in a timely fashion. According to the American Federation of Teachers (AFT), this sentiment is especially true in institutions of higher education. AFT affirms in a publication entitled Shared Governance in Colleges and Universities: A Statement by the Higher Program Policy Council that shared governance is a means for guaranteeing college and university faculty a voice "in decision-making."[8] Consequently, faculty should possess the right to set priorities and assist in directing the department's future. In support of this premise, faculty should remain at the center of deliberations concerning courses for transfer and remain involved throughout the entire articulation process. Doyle asserts "articulation agreements, common course numbering, and curriculum decisions that the policymakers develop all play a pivotal role in determining how many credits will be accepted and hence the likelihood of students' attaining their educational goals."[9]

Priority directive. In 2004, Dr. Duane Nellis, K-State University Provost, prioritized nine strategic themes developed by the K-State community to guide the planning and development of the institution.[10] He subsequently correlated these themes to four of six Kansas Board of Regents (KBOR) system goals adopted under Senate Bill 647.[11] Dr. Nellis challenged the academic departments and divisions of K-State to establish priorities and set goals relative to these themes. Specifically, department heads were required to embark on activities that yielded three specific outcomes:

1. Identification of department areas of specialization.
2. Definition of a set of priorities for the department in order to realize these areas of specialization.
3. Development of a plan of action to implement the priorities over three years.

The ET faculty commenced on a plan during the fall 2005 semester that would lead to the attainment of the aforementioned outcomes. The plan comprised the following operational tasks:

1. Share K-State's vision with ET faculty, students and staff.
2. Isolate the Department's potential for, and area(s) of, excellence.
3. Modify existing departmental goals to align with University themes.
4. Develop a strategic plan for realization of departmental goals.

SWOT analysis. Items 2-4 comprised a three-phase Strengths, Weaknesses, Opportunities, and Threats (SWOT) exercise which necessitated external intervention due to the complexities associated with strategic planning. SWOT analysis is a basic, straightforward management tool that provides a scan of the internal and external environments of an institution. Through this process a university may isolate its strengths (what it is doing right), determine weaknesses

(problem areas in need of improvement), and segregate the opportunities (potential favorable conditions) from the threats (potential unfavorable conditions). Ultimately, findings are assessed and reviewed in light of the organization's resources and mission statement to establish goal and objective prioritization.[12]

Strategic planning outcomes. The SWOT exercise proved very effective and successful. Faculty were able to coalesce as a unit and identified three priorities along with strategies for priority realization. The priorities included:

Priority #1: Increase student recruitment/retention initiatives
Priority #2: Sustain teaching and curriculum quality
Priority #3: Strengthen industry partnerships

Each sequence of priority strategies had strong affinity to the University strategic themes. Noteworthy, the notion of developing articulation agreements with community colleges was elected the top recruitment strategy under the first priority. The next step would encompass building an articulation model on tried measures and linking it to the University's mission.[13]

Performance agreements. The KBOR comprises a nine-member body which governs six state universities, and supervises and coordinates 19 community colleges, five technical colleges, six technical schools and a municipal university. The Board instigated articulation accountability among institutions of higher education in Kansas by way of the Performance Agreement passage drafted under Senate Bill 647. This performance-based resolution linked new state funding beginning July 1, 2005 to evidence of completion to four of the six State mandated goals.[11] Consequently, Kansas post-secondary institutions were to align their respective goals to the prescribed KBOR goals. In response, K-State coupled its institutional goal of increasing "collaboration with Kansas community colleges" to the Regents goal of "Increase[ing] system efficiency/effectiveness/seamlessness."[10]

ET articulation origins. The ET Department solidified its first articulation agreement with Wichita Area Technical College (WATC) in 2003 under the auspice of its Mechanical Engineering Technology Bachelor's degree. Documentation consisted of a transfer planning guide (TPG) and written testimony of the agreement. The TPG identified courses a student could take at WATC while similarly outlining the K-State at Salina courses required for degree completion. The agreement was a demarcation of the transmissions conveyed through the TPG (see Appendix A). Wording and ascribed institutional commitments were surveyed by K-State's attorney to verify legality of the exchange. In this instance, the Mechanical Engineering Technology Bachelors degree curriculum was compared to its community college complement. Thus, course equivalency decisions were limited to one degree disallowing consideration of related associate technical degrees like Manufacturing Engineering, for example. While this initial process resulted in a meaningful and useful covenant, the method proved too unilateral for universal application. An improved articulation process plan was warranted, given K-State's pledge to the State.

An innovative articulation model. The US Department of Education cites data from a 2001 study that 82 percent of transfer students who had all of their credits accepted by senior institutions graduated with a bachelor's degree within six years.[9] With this in mind, the new approach

focused on matching community college courses to the ET degree rather than trying to equate one degree curriculum to the other. This model differs from current articulation approaches in that regard—it defines a systematic and effective means of attaining articulation initiatives with the objective of maximizing transfer credits (see Appendix B). In addition, a targeted set of community colleges was identified to benchmark successes throughout the academic year. As described in Appendix B, the first step in the process involved tracking established K-State/community college transfer equivalencies. The bulk of the work transpired during Phase II in which ET faculty deliberated and registered transferability of courses for their respective programs. Visitations were made to community colleges for the purpose of sharing results, meeting faculty counterparts and touring campuses. Afterward, community college representatives were invited to the Salina campus. Once the faculty cohorts reached consensus on TPG contents, it was scrutinized by the K-State at Salina's Associate Dean of Academics for conformity to University policy. He then drafted the agreement and submitted the documentation to community college administrators who had final approval. An official signing took place at each community college campus to formalize agreements. This presented a great public relations opportunity and served to fortify relations with host institutions.

Conclusion

Established agreements. The described articulation model has propelled K-State at Salina to become the premier senior level institution in the State for formulating agreements with Kansas community colleges. Noteworthy, the average number of transfer credit hours applicable to the ET Bachelor's degree has escalated to a commendable 65. Appendix C provides agreement status by community college: four have been finalized, three are pending approval, and four are in progress. Also shown are the major underrepresented population groups located near the colleges. Two of the institutions, Dodge City Community College and Garden City Community College, include significant Hispanic populations. Hispanics are foremost among the most traditionally underrepresented populations in Kansas and these agreements will certainly improve their educational prospects. The Department projects agreements with the rest of the colleges by 2007; thus, matriculation data will be collected and analyzed during the spring 2007 semester to determine plan effectiveness.

NSF-STEM grant. Outreach efforts have encouraged the ET Department to submit an NSF-STEM grant entitled "Kansas State's Enhancing Lives through Technology and Engineering (ELITE) Scholarship Program." Currently under review, the proposal requests $500,000 for five years. Funding will help ensure the increase of associate and baccalaureate degrees among the academically talented but financially needy students of Kansas. The proposal features financial aid and student support systems that will enable qualifying students to secure an Engineering Technology degree from K-State at Salina. Through efforts of a multi-disciplinary team of faculty and campus-wide student support service specialists, ELITE scholars will be recruited, retained, mentored, graduated and ultimately placed in the workforce. By building on current partnerships with high schools and enhancing those with community colleges, interested students from around the State will have the opportunity to become ELITE scholars. To that end, ELITE scholars will comprise freshmen, current K-State students, and most notably, transfer student populations.

Final thoughts. In addition to generating unprecedented articulation inroads, the described process fostered remarkable faculty commitment to ensuring reciprocity of curricula quality throughout this endeavor. This was manifested in their continued presence throughout the process; from screening curricula for transferability of courses to making on-site visits. Furthermore, and perhaps more importantly, they were afforded the opportunity to experience the integral connections between on-going departmental efforts, the University mission, and the education goals of the State of Kansas.

References

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[12] World-Wide URL http://www.quickmba.com/strategy/swot/. Last Accessed June 10, 2006.

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Biographies

John E. De Leon

Dr. De Leon is currently Professor and Head of Engineering Technology at K-State at Salina. He worked 10 years in industry prior to joining academia where he served 11 years as a faculty member teaching in areas of computer aided design, quality control, industrial ecology and industrial safety. Additionally, he has published several manuscripts on subject matter related to these curricula. His scholarly pursuits include securing extramural funding for assisting traditionally underrepresented students in engineering complete their education.

RAJU S. DANDU

Raju S. Dandu is the program coordinator and an associate professor of Mechanical Engineering Technology at Kansas State University-Salina. He teaches courses in CNC Machine Processes, Material Strength and Testing, Advanced CAD/CAM, Industrial Instrumentation and Controls, and Automated Manufacturing Systems II. He is active in offering workforce training in reliability centered maintenance, process instrumentation and PLCs. His areas of interest are: Reliability Centered Maintenance, Energy Efficient Lighting, CAD/CAM, Industrial Automation, and Smart Materials. He is a member of ASEE, ASME, and SME.

Appendix A

Articulation Agreement
between
Wichita Area Technical College
and
Kansas State University at Salina

Wichita Area Technical College (WATC) and Kansas State University at Salina's College of Technology and Aviation (KSU) agree to work cooperatively to facilitate a student's study at WATC and subsequent transfer to KSU to obtain a baccalaureate degree in Engineering Technology with an option in Mechanical Engineering Technology. Normally, a student will begin his/her studies at WATC and complete an Associate of Applied Science (AAS) degree in Mechanical Engineering Technology. When accepted into the program at WATC, the student may use the services of a KSU faculty advisor, who will facilitate the transfer process. After completing an AAS degree at WATC, a student can ordinarily transfer the equivalent of 30 semester credit hours from WATC and 15 semester credit hours of general education from an accredited regional college or university. The student will qualify for use of the current curriculum requirements at the time of admission to KSU, as published in the *Kansas State University Undergraduate Catalog.*

After completing the WATC Mechanical Engineering Technology associate degree, an additional 81 semester credit hours of course work would be needed to obtain a Bachelor of Science degree in Engineering Technology with a Mechanical Engineering Technology Option. Attachment I lists those courses that are accepted for transfer by KSU, provided the final grades are "C" or better. A suggested program for completing the 81 semester credit hours at KSU is given in Attachment II.

The two institutions will each identify a liaison officer whose role will be to communicate with the other institution regarding procedures and requirements, curriculum matters, equivalent transfer credit, course equivalencies, course requirements, changes in personnel, and academic advisement as needed to operate the program. Written and telephone inquiries from students and staff of WATC will be welcomed by the liaison officer at KSU, so that a student's questions can be answered prior to arrival at KSU.

The liaison officers from KSU and WATC will meet periodically to discuss matters related to this agreement. One of the objectives of these meetings will be to endeavor to establish common syllabi and common textbooks for the courses accepted for transfer per Attachment I. Attachments I and II can be modified by mutual written consent by the respective deans of the two institutions.

Wichita Area Technical College agrees to make its students aware of the opportunities afforded by this articulation and will identify the Kansas State University at Salina College of Technology and Aviation's Articulation Agreement in its catalogs. WATC also agrees to notify the KSU liaison officer of any changes that influence the program.

This document will be re-evaluated annually to determine whether or not this agreement should be modified or continued. It is not intended to confer enforceable rights on any third party.

Accepted for Wichita Area Technical College by:

_____ _____

Vice President of Academic Affairs Date

Accepted for Kansas State University at Salina by:

_____ _____

Dean, College of Technology and Aviation Date

Attachment I
Courses Approved for Transfer from WATC to K-State at Salina

K-State at Salina MET Courses		Credit Hours	WATC Courses		Credit Hours
MET 111	Technical Graphics	3	GET 154	Engineering Graphics I	3
MET 117	Mechanical Detailing	3	GET 164	Engineering Graphics II	3
-	MET Technical Elective	3	GET 255	Industry Co-op	3
ECET 100	Basic Electronics	4*	GET 258	Fund. Of Electricity/Electronics	3
MET 121	Manufacturing Methods	3	MET 150	Machine Tool Practice	3
MET 231	Physical Materials & Metallurgy	3	MET 160	Engineering Materials & Testing	3
MET 125	CNC Machine Processes	2	MET 250	CAM I	2
MET 252	Fluid Power Technology	3	MET 252	Fluid Mechanics with applications	3
MET 264	Machine Design Technology I	4	MET 262 and MET 268		4
MET 230	Automated Mfg. Sys I	3	MET 266	Automation and Controls	3
			Total Transferable Technical Credit Hours:		**30**

* WATC student will needs one additional credit hour of technical coursework to meet this course requirement.

K-State at Salina and Wichita Area Technical College
Attachment I
Mechanical Engineering Technology Transfer Planning Guide

Freshman Fall Semester

K-State at Salina MET Courses		Credit Hours	WATC Courses		Credit Hours
ETA 020	Engineering Technology Seminar	0			
MET 111	Technical Graphics	3	GET 154	Engineering Graphics I	3
MET 121	Manufacturing Methods	3	MET 150	Machine Tool Practice	3
MATH 100	College Algebra	3	MATH 111	College Algebra**	3
MATH 151	Applied Plane Trigonometry	2	MATH 123	Trigonometry**	2 of 3
CMST 101	Applied Basic Programming	2			
ENGL 100	Expository Writing I	3	ENGL 101	Composition I**	3
	TOTAL:	**16**		**TOTAL:**	**14**

Freshman Spring Semester

K-State at Salina MET Courses		Credit Hours	WATC Courses		Credit Hours
ETA 020	Engineering Technology Seminar	0			
MET 117	Mechanical Detailing	3	GET 164	Engineering Graphics II	3
MET 125	CNC Machine Processes	2	MET 250	CAM I	2
CHM 110	General Chemistry	3			
CHM 111	General Chemistry Lab	1			
PHYS 113	General Physics I	4	PHYS 111	Physics**	4
SPCH 105	Public Speaking IA	2			
	Humanities/Social Science Elective	3	PSY 111	General Psychology**	3
	TOTAL:	**18**		**TOTAL:**	**12**

Sophomore Fall Semester

K-State at Salina MET Courses		Credit Hours	WATC Courses		Credit Hours
MET 231	Physical Materials and Metallurgy	3	MET 160	Engineering Materials and Testing	3
MET 252	Fluid Power Technology	3	MET 252	Fluid Mechanics with Applications	3
MATH 220	Analytic Geometry and Calculus I	4			
CET 211	Statics	3			
ECET 100	Basic Electronics	4	GET 258	Fundamentals of Electricity/Electronics	3
	TOTAL:	**17**		**TOTAL:**	**9**

Sophomore Spring Semester

K-State at Salina MET Courses		Credit Hours	WATC Courses		Credit Hours
MET 230	Automated Manufacturing Systems I	3	MET 266	Automation and Controls	3
MET 246	Dynamics of Machines	3			
MET 264	Machine Design Technology I	4	MET 262	Design of Mach. Elements & Assemblies	4 of 8
			MET 268	Capstone Design Project	
MET 245	Material Strength and Testing	3			
ENGL 302	Technical Writing	3			
	TOTAL:	**16**		**TOTAL:**	**7**

Junior Fall Semester

K-State at Salina MET Courses		Credit Hours	WATC Courses		Credit Hours
MET 314	Computer-Aided Solid Modeling	3			
ECET 304	Electrical Power and Devices	3			
MET 365	Machine Design Technology II	3			
MATH 221	Analytic Geometry and Calculus II	4			
	Computer Systems Technology Elective	3			
	TOTAL:	**16**		**TOTAL:**	**0**

Junior Spring Semester

K-State at Salina MET Courses		Credit Hours	WATC Courses		Credit Hours
MET 346	Elements of Mechanisms	3			
MET 353	Fluid Mechanics	3			
MET 382	Industrial Instrumentation and Controls	3			
ENGL 200	Expository Writing II	3			
	Technical Elective	3	GET 255	Industry Co-op	3 of 4
	TOTAL:	**15**		**TOTAL:**	**3**

Senior Fall Semester

K-State at Salina MET Courses		Credit Hours	WATC Courses		Credit Hours
MET 462	Senior Design Project I	1			
MET 481	Automated Manufacturing Systems II	3			
	Basic science elective	4			
	Humanities/social science elective	3			
	Upper-division humanities/soc. sci. elect.	3			
	TOTAL:	**14**		**TOTAL:**	**0**

Senior Spring Semester

K-State at Salina MET Courses		Credit Hours	WATC Courses		Credit Hours
MET 464	Senior Design Project II	2			
MET 471	Thermodynamics and Heat Transfer	3			
	Technical Elective	3			
	Business Elective	3			
	Upper-division humanities/soc. sci. elect.	3			
	TOTAL:	**14**		**TOTAL:**	**0**

**** These general education courses are offered by Wichita State University and are required in the WATC associate degree.**

TOTAL WATC HOURS TRANSFERRED TO KSU: 30
TOTAL WSU GENERAL EDUCATION HOURS TRANSFERRED TO KSU: 15
TOTAL HOURS TRANSFERRED TO KSU: 45

Appendix B

Department of Engineering Technology
Transfer Planning Guide Process

Phase I: Generate transfer planning guide framework/initialize CC contact

A. Identify CC programs having related curricula to ET programs
B. Scan KSU web page for availability of CC transfer equivalency information
C. Match courses accepted as direct transfers to ET program requirements
D. Identify technical courses that require faculty review
E. Initialize visits with CC campuses offering technical program

Phase II: Review of CC technical courses

A. Identify CC courses deemed compatible to technical courses by use of course descriptions
B. Request course syllabi from CC as needed
C. Approve CC technical courses for transferability
D. Enter approved courses and complete TPG draft

Phase III: Community college review of TPGs

A. Forward TPGs to CC
B. Review Phase II TPGs
C. Address concerns/issues via phone or personal visit

Phase IV: Complete articulation agreement draft

A. Write narrative outlining terms of agreement; TPGs to accompany document
B. Verify agreement details

Phase V: Finalize articulation agreement

A. Approve articulation document and TPG contents
B. Sign agreement for implementation

Appendix C

K-State at Salina, Department of Engineering Technology: Status of community college articulation agreements by institution and ethnic representation.				
Community College	County	Major Underrepresented Groups in County %		Status of Articulation Agreement
		African Americans	Hispanics	
Allen Co	Allen	1.6	1.9	Yet to Start
Barton Co	Barton	1.1	8.3	Approval Pending
Butler Co	Butler	1.4	2.2	Finalized
Cloud Co	Cloud	0.3	0.6	Finalized
Coffeyville	Montgomery	6.1	3.1	Approval Pending
Colby	Thomas	0.4	1.8	Yet to Start
Cowley Co	Cowley	2.7	3.6	In Progress
Dodge City	Ford	1.6	37.7	Finalized
Ft. Scott	Bourbon	3.1	1.3	Yet to Start
Garden City	Finney	1.3	43.3	Approval Pending
Highland	Doniphan	2.0	1.2	Yet to Start
Hutchinson	Reno	2.9	5.7	In Progress
Independence	Montgomery	6.1	3.1	Finalized
Johnson Co	Johnson	2.6	4.0	In Progress
Kansas City Kansas	Wyandotte	28.3	16.0	Yet to Start
Labette	Labette	4.7	3.1	Yet to Start
Neosho Co	Neosho	0.9	2.9	Yet to Start
Pratt	Pratt	1.0	3.1	Yet to Start
Seward Co	Seward	3.8	38	Yet to Start
State of Kansas: Blacks 5.7% Hispanics 7.0% Gray cells indicate populations above state average. Source: Kansas Board of Education				