

Community College/University Articulation
A Programmatic Approach in Engineering and Technology

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Abstract

The educational missions of the typical Community College and University are diverse. Within the sciences and liberal arts there is a similarity in offerings, and students have the ability to matriculate from the 2-year institutions to the 4-year institutions. However, in the areas of Engineering Technology the two institutions have objectives that are both similar and diverging. Within Technology, there is a group of students that complete 4-year degrees through the transfer process, however, there is also a group of students who enroll in the Community College to obtain specific knowledge which is typically vocational in nature, either in CAD, CNC, Machining, HVAC, to name a few. The mission of the 4-year institution is to provide a broader based education. Even though each institution has a constituent audience to which it must provide educational programs, there is an overriding need to provide accessibility to students from all of the communities served. To provide students with this type of access, in which they can chose the career direction, Rock Valley Community College (Rockford, Illinois) and Northern Illinois University (NIU) have developed a unique series of programs within the Technology realm. As part of this program, students can choose their desired degree path and stopping point; after 2-years or 4-years. In addition the students can determine the appropriate level of Technology that will suit their educational needs. As a result, students will be able to obtain the needed technical knowledge to obtain employment after two years at RVC or continue their education career through transfer to NIU. This aspect of the program is not novel, however, both institutions have worked together to develop a program that satisfies both constituent groups, while most of the credits are transferred between institutions. This paper will outline the array of technology programs around which articulation initiatives have been developed, and how these programs fit within the educational needs of the Northern Illinois region.

Current Articulation Programs within Illinois

To obtain a 4-year degree in one of the many technical fields, students typically choose one of two options; matriculation directly into a University, or into a Community College followed by transfer to a 4-year school. The transfer process is gaining a wide recognition, especially as the students and their families examine cost and accessibility issues associated with higher education [1-5]. While the route to transfer is difficult in any major, the difficulty is increased in a vertically structured curriculum like Engineering and Technology. In these areas, the entry point and course prerequisites are of great concern. Within the State of Illinois, there are many Community Colleges, each offering a multitude of different programs. In order to provide the population with access to quality cost-effective education within the various areas of

technology, namely, the sub-disciplines within Engineering and Technology, the State of Illinois Board of Higher Education has developed a statewide articulation initiative. This articulation initiative provides a means through which students have a clear path in determining coursework that will transfer between each institution. This process looks at the groupings of courses that students should be taking at each institution to ensure that, upon transfer, the taken courses will apply at the universities and the proper prerequisites will be fulfilled. In addition to the statewide articulation initiative, articulation efforts are also in place between the University and each Community College, which typically examines course level information, rather than programmatic issues to enhance the ability to transfer from one institution to another.

The articulation issue is complex, since one is dealing with numerous programs, disciplines, and Community Colleges, each of which has a constituent group that must be supported [1,3]. The NIU College of Engineering and Engineering Technology, and specifically, the NIU Department of Technology has determined that due to the wide range of skills and needs, students need the ability to choose the level of technology which is appropriate. The State of Illinois Articulation program was developed to specifically address transfer issues in the engineering disciplines. However, through dealings with the regional Community Colleges, it was determined that there needed to be a program for technology based articulation issues. Therefore, NIU started working with RVC, which is located 30 miles northwest of the NIU DeKalb campus.

The NIU College of Engineering and Engineering Technology offers the following technical programs,

- Engineering – Mechanical, Electrical, and Industrial
- Engineering Technology – Manufacturing, Electrical
- Industrial Technology – Plastics, Manufacturing, Safety, and CAD

Over the years, it was found that the NIU Engineering and Industrial Technology meshed well within the RVC program offerings, and thus, this program was the first developed for formal articulation during the mid-1990's. During the 02/03 academic year, it was determined that the Engineering Technology areas represented a strong need for articulation. To provide access to this student group, a new articulation initiative was undertaken allowing for a nearly 1:1 transfer.

Curriculum Issues and Needs

The NIU Engineering, Engineering Technology, and Industrial Technology programs represent a very diverse set of skills and fundamental abilities. Table 1 outlines the fundamental course differences between the three areas involved in the articulation process. In addition to the basic skill requirements within the programs, each program has outcomes that are different. Engineering students develop research and design capabilities, while the Engineering Technology students are taught design skills, emphasizing applications of the various systems and concepts. The Industrial Technology program seeks to train students in the areas of management and supervision within technology. Thus, while there is some amount of overlap between the programs, each develops unique skill sets that are valued in industry.

Table 1. Fundamental skills in Engineering and Technology

	Engineering	Engineering Technology	Industrial Technology
Math Fundamentals	Algebra Trigonometry Calculus I Calculus II Calculus III Differential Equations Statistics	Algebra Trigonometry Calculus I Calculus II Statistics	Algebra Trigonometry Statistics
English Fundamentals	Rhetoric and Composition I Rhetoric and Composition II Oral Communications	Rhetoric and Composition I Rhetoric and Composition II Oral Communications	Rhetoric and Composition I Rhetoric and Composition II Oral Communications
Basic Sciences	Physics I Physics II Physics III * General Chemistry I	Physics I General Chemistry I	Physics I General Chemistry I

* not required by all Engineering disciplines

Engineering Articulation

The Illinois Articulation Initiative (IAI) [6] was started in the early 1990's, with the goal of providing equality and transferability of coursework between the Universities and Community Colleges. As a result of this initiative, students can move between the Community College to the University, assuming that all of the rules are followed, and not lose any credits in the process. The IAI process was initially started for the Engineering disciplines, to provide access to fundamental and basic engineering courses. To oversee the articulation charge, a panel of educators representing the Colleges and Universities was created. This panel developed outcomes for each course which must be covered before the course can be included for transfer. The IAI Engineering panel meets every semester to evaluate courses that are proposed by the various universities and colleges. The transfer agreement in mechanical engineering includes the courses shown in figure 1.

<p>Prerequisite Courses (28-36 credit hours - recommended)</p> <ul style="list-style-type: none"> • Mathematics – Calculus I, II, and III and Differential Equations • Sciences - Chemistry I with lab, Calculus-based Physics with lab (Both I and II) • Computer Programming - Fortran or C (C++) depending on the specialty <p>IAI General Education Requirements (9 to 18 credit hours - recommended)</p> <ul style="list-style-type: none"> • Communications - two-course writing sequence and one-course in oral communications • Humanities and Fine arts - Select one course in each area and one additional from either area. • Social and Behavioral Sciences - Select 3 courses from at least 2 different disciplines as specified <p>Mechanical Engineering Specialty Courses (7 to 16 credit hours)</p> <ul style="list-style-type: none"> • Engineering Graphics/CAD • Engineering Statics • Engineering Dynamics • Strength of Materials/Mechanics of Solids • Thermodynamics • Electrical Circuits
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Figure 1. IAI Mechanical Engineering course articulation

agreements were created in all of the engineering disciplines covered across the state. A student operating under this agreement can transfer a maximum of 66 hours of credit, however, all of the credit will transfer and be applicable to the University's Engineering curriculum.

Technology Articulation

Unlike the State led initiative in Engineering articulation, there is minimal input into the articulation within the area of Industrial Technology; due to the vast variations in the technical education programs offered throughout the State of Illinois. Thus articulation in this area is left up to the institutions and departments to initiate on a course-by-course or a programmatic basis. To satisfy the needs of the students in Northern Illinois, the NIU Department of Technology has been working with the traditional feeder colleges to form these agreements. As part of this goal, it was decided that students should have the ability to move into any program that meets their educational, career goals, and ability. Traditionally, the NIU Industrial Technology program has been developed as a facilitator for transfer, and thus, articulation was developed in which transfer would minimize the loss of transferable credit. To provide additional program access, the Departments of Technology at NIU and RVC have been developing two Engineering Technology programs that offer additional avenues of articulate between the institutions. Therefore, through three technical programs that are available for articulation between NIU and RVC, students now have the ability to choose an area that suits their educational goals and also have the ability to complete a 4-year degree in a typical time frame.

Peer-to-peer articulation agreements are one of the main forms of articulation that is used at NIU. For these agreements, the Community Colleges provide course information, typically the course syllabi, to the four-year institution. The four-year school's transfer coordinator then sends the information to the proper department for their decision on whether the course meets the Department's course requirements. After the process is complete, the transfer office compiles a listing of all of the articulated courses from each Community College. This articulation information is then made available to all parties that rely upon the transfer of coursework (http://www.reg.niu.edu/regrec/Com_Coll/Handbook.htm). Figure 2 shows one group of articulation entries for the CDT program offered at RVC and the courses that transfer to NIU.

ROCK VALLEY COLLEGE		
CATALOG YEAR: 2001- 2003 NIU CATALOG: 2003-2004 DATE: JULY, 2003		
EFFECTIVE FOR COURSES TAKEN FALL 2003, SPRING 2004, AND SUMMER 2004. PAGE: 4 OF 12		
COMMUNITY COLLEGE COURSE NUMBER/TITLE	NIU SUBSTITUTION	IAI CODE
COMPUTER-AIDED MECHANICAL DESIGN TECHNOLOGY (CDT)		
103 MATERIALS OF INDUSTRY	TECH 393	MTM 912
104 MANUFACTURING PROCESSES	TECH EL	MTM 913
141 DESCRIPTIVE GRAPHICS	TECH EL	
142 TECHNICAL GRAPHICS	TECH EL	
150 INTERPRETATION OF INDUS DRAWINGS	TECH EL	
211 INDUSTRIAL ORG AND OPERATION	TECH EL	
220 MECHANISMS (220 + 221)	TECH 214	
221 MACHINE DESIGN (221 + 220)	TECH 214	

Figure 2. Articulation of courses from RVC CDT program into NIU

From the experiences of the authors in transferring students and the facilitation of transfer, the course-by-course articulation policy is very difficult to present. This type of articulation works well for individuals who are looking at taking a few courses and transferring to a four-year institution. Individuals who are trying to complete the true 2+2 program need to know how their complete program will allow them to move from the 2-year to the four-year institution, and thus, one must look at complete program articulation. To satisfy the initial goal for the transfer process, providing accessible, quality education within a wide range of technical

areas, the Departments of Technology at NIU and RVC have developed several programmatic transfer agreements. These programmatic agreements allow for complete (or nearly complete) transfer of credits from one institution to the other, in all of the technical areas that are offered. Students are now presented with education access in the wide-ranging fields within the realm of Technology.

Industrial Technology - Special Technical Studies

The Industrial Technology (IT) program lends itself very nicely to two goals of the NIU Department of Technology,

- the ability to articulate the program with the Community College
- the ability to offer this program at off-campus sites.

The NIU IT program requires 120 hours for graduation, of which include:

Credit hrs	Courses
18	General Education
15	Technical Electives
12	English, Communications, and Technical Writing
17	Math, Science, Statistics, and Accounting
10	Technology Fundamentals
72	Total Hours

The remaining hours include the following management/supervisory technology based courses,

Tech 395 - p:Math155 Ind Data Processing - (f,s)	Tech 434 Hum Fact in Ind Acc Prv - (f,s)	Tech 442 Work Simplification - (s)
Tech 402 Ind Training and Eval - (s)	Tech 429 Plt Layout and Mats Hndl - (f)	Tech 391 - p:STAT 208 Ind Qual Cont - (f)
Tech 404 Supervision in Ind - (f,s)	Tech 302 Graphic Pres and Comm - (f,s)	Tech 496 - p:Tech265,302,395 Industrial Project Mgmt - (f,s)

as well as a 23 credit hour technical area of study. To satisfy the needs of the on-campus students, the Department offers technical areas of study in plastics, computer-aided-design, manufacturing, and safety. However, there is also a 23-credit special technical studies area that allows the Department to transfer the technical Associates of Applied Sciences (AAS) degrees from the various Community Colleges. For the off-campus programs, students are instructed to take basic and fundamental courses and complete an AAS degree, in addition to the NIU management/supervisory courses and technical electives that are offered at remote sites [4]. To further simplify the transfer process, the Technology Departments at NIU and RVC have developed a programmatic transfer agreement for this program. Figure 3 shows the 2-year Automated Manufacturing Technology offered at RVC.

Fall Semester - Year 1			Spring Semester - Year 1		
AMT 120	CNC Machine Setup / Operation	2	AMT 226	CNC Programming I	3
AMT 121	CNC Manual Programming	2	CDT 103	Materials of Industry	4
CDT 104	Manufacturing Processes	4	CDT 150	Interpretation of Ind Drawings	3
CDT 110	Introduction to Technology	1	CDT 162	Applied Physics	4
CDT 133	Computer Drafting I	3	ENG 101	Composition I	3
MTH 125	Plane Trigonometry	3			
SPH 131	Fundamentals of Communication	3			
		Total			17
		Total			18
Fall Semester - Year 2			Spring Semester - Year 2		
AMT 240	CNC Programming II	3	AMT 249	Cost Estimating for Manufacturing	3
AMT 247	Manuf. Methods and Proc Planning	3	AMT 243	Cellular Manuf. and Mat Handling	3
CDT 146	Hydraulics and Pneumatics	3	CDT 211	Industrial Organization / Operation	3
QLT 106	Metrology	3	QLT 102	Fundamentals of SPC	4
GEN ED	Science requirement	4	GEN ED	Elective	3
		Total			16
		Total			16

Total Credits taken at RVC 67

Figure 3. RVC Automated Manufacturing Technology (AMT) Program

Using the RVC AMT program, the authors developed a transfer template (figure 4). This same system was used for all of the AAS programs offered by RVC (and many other Community Colleges in the State). It should be noted that the initial goal of a 1:1 transfer was not possible in these types of programs due to the programmatic and educational needs of the RVC population.

Major area of study	RVC	NIU	credits - IT Program
AMT 120			23
AMT 121			
AMT 226			
AMT 240			
AMT 243		TECH 444	3
AMT 247			
AMT 249			
CDT 103			
CDT 104		TECH 265	3
CDT 110			
CDT 133			
CDT 146			
CDT142			
CDT 162			
CDT 211		TECH 404	3
QLT102			
QLT106			
Total from this area			32
Gen Ed REQUIREMENTS - Chosen from the NIU transfer courses			
ENG 101		ENG 103	3
OR SPH 131		COMS 100	3
MTH 125		MATH 155	3
PHY 112		NONE	
OR CHM101		CHEM 210	4
One Gen Ed course which is part of IAI			3
Total from this area			16
Total Transfer as of 6/20/01			48

Figure 4. NIU/RVC Automated Manufacturing Technology Program Articulation

Engineering Technology Articulation

Over the past five years, students have requested the ability to transfer into programs in Engineering Technology, an applied engineering program which focuses more on the technical and design applications, as opposed to the theory of a pure Engineering program. To satisfy the needs of this student population, and thus, provide students with a wider selection of educational options, the NIU and RVC Departments of Technology developed a unique transfer agreement within the Engineering Technology areas. Since the Engineering Technology programs

(Manufacturing and Electrical) are new to RVC, the selection and development of courses was made with an eye toward transferability. In addition, Engineering Technology, at the 2-year level, is a new program within the State of Illinois. To facilitate the ability for this student population to transfer from one institution to the other, the MET and EET programs at RVC were developed such that almost all of the coursework is transferable to NIU. This provided much work for the faculty members from both institutions. The faculty at RVC had to develop courses and revise courses based upon the courses offered at NIU, and the faculty at NIU were involved in providing assistance in the development and redevelopment of the proposed courses. The results of the Manufacturing Engineering Technology program articulation is shown in figure 5; the articulation for the EET program follows a similar format.

RVC	CHr	NIU	CHr
EET 131 Intro to DC/AC Networks	4	TECH 175 Electricity/ Electronics Fund and Lab	4
CDT 108 Computer Drafting - AutoCAD	3	TECH 211 Computer-Aided Design	3
AMT 110 Manufacturing Processes I	3	TECH 260 Machine Production Processes	3
CDT 206 Statics and	3	TECH 210 Engineering Statics	2
CDT 207 Dynamics	2	TECH 212 Engineering Dynamics	2
AMT 160 Manufacturing Processes II	4	TECH 265 Basic Manufacturing Process	3
AMT 120 CNC Machine Setup/Operate	4	TECH 362 Numerical Control Systems	3
AMT 121 CNC Programming (Manual)			
CDT 219 Strength of Materials	3	TECH 369 Strength of Materials	3
CDT 103 Materials of Industry	3	TECH 393 Structure/ Properties of Materials	3
QLT 106 Metrology	3	TECH 365 Metrology	3
MET electives - Choose one (3 credits):	3	MET electives - Choose one (3 credits):	3
CDT 210 Solidworks		TECH 311 Computer-Aided Modeling	
AMT 240 CNC Programming II (MCAM)		TECH 364 Advanced NC Programming	
AMT 247 Mfg Methods / Process Plan		TECH 444 Production Control Systems	
AMT 243 Cellular Mfg / Material Hndl		TECH 429 Plant Loc, Layout, Material Hndl	
QLT 102 Methods of SPC		TECH 391 Industrial Quality Control	
Other Approved Elective		TECH Elective (other approved)	
TECHNICAL CREDITS:	35	MET CREDITS:	32
ENG 101 Composition I	3	ENGL 103 Rhetoric and Composition I	3
ENG 103 Composition II	3	ENGL 104 Rhetoric and Composition II	3
SPH 131 Fund of Communications	3	COMS 100 Fund of Oral Communication	3
CHM 100 Intro Inorganic Chemistry	4	CHEM 110/111 Chemistry and Lab	4
MTH 125 Plane Trigonometry (3)	3	MATH 155 Trig and Elementary Functions	3
MTH 135 Calculus Analytic Geo. I	5	MATH 229 Calculus I	4
MTH 235 Calculus Analytic Geo. II	4	MATH 230 Calculus II	4
PHY 201 Mechanics and Heat	4	PHYS 250 General Physics I	4
GEN ED Humanities or Social Science	3	GEN ED Humanities or Social Science	3
GEN ED CREDITS:	32	GEN ED CREDITS:	31
TOTAL CREDITS TAKEN:	67	TOTAL TRANSFER CREDITS:	63

Figure 5. NIU/RVC MET program articulation

In this articulation, the students are given credit for a broad range of courses that are taken during the two-year Engineering Technology Degree offered by RVC. The program requires the students to complete many of the fundamental courses while at RVC; a benefit to both the students and the NIU Department of Technology.

Conclusion

Within the vast areas of technology, the educational mission of the typical Community College and University are diverse. Examining the student body at each institution in the technology area, there is a group of students that will complete a 4-year degree through the transfer process, however, there is also a group of students who enroll in the Community College

to obtain specific knowledge, and will graduate with a 2-year AAS degree, or even just take a few courses. In all cases, there is an overriding need to provide accessibility to a quality 4-year education to students from all of the communities served. To provide students with this type of access, in which they have the ability to choose from wide-ranging educational programs in various areas of technology, RVC and NIU have developed a unique series of technology based educational transfer programs. Through this transfer program, students have the ability to choose areas of study in the areas of Engineering, Engineering Technology, and Industrial Technology. In all programs, the two institutions have worked together to create relatively seamless programs which allow students to matriculate from one institution to another with a maximum credit hours permitted in transfer. Through this transfer work, RVC has initiated a novel educational program, in the area of Engineering Technology, at the Community College level. As a result of the development work, students in Northern Illinois now have accessible quality education within a wide range of technical areas, which include the fields of Engineering, Engineering Technology, and Industrial Technology.

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Biographical Information

CLIFFORD R. MIRMAN received his Ph.D. degree from the University of Illinois at Chicago in 1991. From 1991 until 1999, he was a faculty member in the Mechanical Engineering Department at Wilkes University's. He is currently the Chair of the Department of Technology at NIU. His research areas are CAD, Finite-Element-Analysis, and kinematics, both securing grants and writing publications. Dr. Mirman is actively involved in ASEE and SME.

GORDON SKATTUM received his M.S. degree from the Northern Illinois University in 1997. From 1991 until 2000, he was Director of Integrated Manufacturing, and from 2000 to 2004 he served as the Director of Engineering and Technology for RVC. His research areas include measurement systems analysis and dimensional metrology. Mr. Skattum is a senior member of both ASQ and SME, and is certified as a Manufacturing Technologist, Quality Engineer, and Calibration Technician. He is actively involved in ASQ, SME, and NCSLI.