The Arrowhead Institute of Technology

A Comprehensive Plan for Providing Post Secondary, Upper Division, and Graduate Technical Education in Northeastern Minnesota

October 2009

Prepared for the

Iron Range Higher Education Committee

By

SERTICH

CONSULTIN

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About the AIT Plan

The Iron Range Higher Education Committee (IRHEC) was created to provide higher education programs in the taconite assistance area of Northeast Minnesota.

Concern for the provision of higher education, especially that related to technical learning and training, in northeast Minnesota is being driven by the over $6 billion of potential new investment in mines, steel production and energy generation and the unfolding turnover of the workforce due to large scale retirements. The region correctly perceives a need for re-engineering the higher educational infrastructure to anticipate the needs of employers and workers, and to foster a level of creativity and entrepreneurship that will energize the regional economy.

This document presents the comprehensive plan for the Arrowhead Institute of Technology (AIT), a transformed version of the existing Arrowhead University Consortium. AIT was crafted as the response to address the documented gap between the needs of regional industry and learner-workers, and, the educational system's current response to those needs. In particular, AIT will be the vehicle by which regional learner-workers access a ladder of educational opportunities, particularly four-year and graduate degrees.

AIT is being initiated through two engineering programs – one a masters program through the University of Minnesota-Duluth and the other leveraging the innovative engineering program at Itasca Community College now being offered as a Bachelors in Mechanical Engineering by Minnesota State University -- Mankato. In addition, five new programs are recommended – Industrial Technology, Process Automation, Industrial Lab Technician, Industrial Construction, and Information Management.

AIT's first round of programs were generated through the extensive efforts of a program design team comprised of representatives from regional industry and education institutions. And, they were based upon documented regional needs. This needs-based driving of learning opportunities is the hallmark feature of AIT.

Acknowledgements

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Funding provided by Iron Range Resources.

Executive Summary

Purpose

The Iron Range Higher Education Committee (IRHEC) was created to provide higher education programs in the taconite assistance area of Northeast Minnesota.

Concern for the provision of higher education, especially that related to technical learning and training, in northeast Minnesota is being driven by the over $6 billion of potential new investment in mines, steel production and energy generation and the unfolding turnover of the workforce due to large scale retirements. The region correctly perceives a need for re-engineering the higher educational infrastructure to anticipate the needs of employers and workers, and to foster a level of creativity and entrepreneurship that will energize the regional economy.

The IRHEC is calling for a new approach to academic design – one that takes a wide-ranging perspective on emerging social and economic dynamics that leads to concrete actions.

As a result of this project,

Learner-workers will achieve focused, continuously improving higher education outcomes contributing to Northeast Minnesota's sustainable competitive advantage in the global economy.

This document culminates a process of research, analysis, and design in which the educational gap within the region was identified, the specifications for addressing that need were articulated, and the design by which the needs were satisfied within the framework of the specifications was developed.

Concurrent to the development of this comprehensive plan was an effort that identified and began implementation of two pilot programs that both informed the creation of the plan and initiated its use.

Process / Product	Description
Gap Analysis	Defines the gap between customer needs and provider capacity / programming.
Framework for Post Secondary, Upper Division, and Graduate Technical Education in Northeast Minnesota	Designs specifications of a working outline for the comprehensive plan.
Design	Details how human and material resources are to be used in support of teaching and learning.
Comprehensive Plan	**Describes potential programs, organizational structure, delivery systems, and institutional arrangements used to meet post secondary technological education needs in the region.**
Pilot Implementation Action Monitoring Report	Describes pilot programming or work done, results, and lessons learned in testing Design elements.

The Need

The foundational step in the development of this comprehensive plan was identifying and understanding the gap between the combined needs of regional businesses and learner-workers, and, the education and training provided by regional educational institutions. Upon this foundation would be built programs and approaches to bridging the gap. The following statements summarize the existing gap between need and educational programming.

Institutional / System (K-16)

- Disconnect from Regional Industry
- Not a Seamless Institutional System
- Not a Seamless Lifelong Learning System
- Not Oriented to Incoming Students.

Program Mix

- Programming Not Geared to Regional Business and Industry Needs
- Incomplete Soft Skill Programming

Skill Profiles

- There is inadequate articulation of skill training across educational levels in which previous education/training provides foundation for subsequent education/training.
- Skills taught are not well connected to emerging business models.
- Insufficient emphasis on "core skills" across program areas.
- Technical skill expectations versus technical skill funding: schools cannot afford to acquire the cutting edge technology required by industry and industry is unwilling to pay for this in the classroom.
- No educational offerings in critical areas (e.g., production systems, mining).

Delivery Systems

- Absence of 24/7 portal(s) providing easy access for businesses and students alike.
- On-line learning expectations versus on-line learning reality: people say they want it but there is low learner-side participation and steep drop off in participation once they are in.
- No evidence of shared learning model(s) among providers.
- Significant shortage of funding.

Industry – Higher Education Engagement

A hallmark feature of this endeavor was its need driven basis. Nothing underscored the seriousness with which this undertaken or the value it brought to the final product than the broad and strong participation of regional industry and business in the design process. Over half of the Program Design Team, which identified and defined the initial programs being recommended in this plan, was representatives of key regional businesses. Their commitment to the process and sense of urgency drove this effort and was exemplified by full attendance at the final of five meetings.

They were complemented on the Project Design Team by representatives from Northeast Higher Education District (NHED) colleges, regional K-12 school systems, and innovative regional educational programs. The solid engagement of industry and education system personnel produced substantive recommendations that address regional economic needs and reflect the willingness of the higher education system to meet them.

This need driven analysis and system response has been fully incorporated into the recommended comprehensive plan. It is the mechanism that implements the plan's Continuous Quality Improvement philosophy.

Arrowhead Institute of Technology: A Strategic Enterprise

The needs analysis identified a *Regional Strategic Advantage* that supports innovative measures to bridge the needs/capacity gap. Components of that advantage are:

- Diverse, abundant and accessible natural resources capable of sustaining current and emerging economic activity, including enterprises that add value to raw materials within the region.
- Existing and emerging industrial base including supply chain vendors possessing variety of career opportunities and high paying jobs.
- Strong educational and research infrastructural foundation dispersed across the region with coordinating programs and mechanisms connecting the region geographically and vertically through the educational systems.
- Leadership willing and capable of effecting transformational change
- An independent source of financing of a magnitude capable of sustaining that change.

The result of this process is a comprehensive plan for the creation of the Arrowhead Institute of Technology (AIT), an entity that utilizes the region's strategic advantage to cross the needs gap in higher education.

AIT transforms the existing and successful Arrowhead University Consortium structure into a robust organization that will be a nexus offering regional students ready access to three- and four-year and graduate level education without having to leave the Iron Range. In doing so, AIT will work with NHED and its constituent colleges to coordinate needs analyses and program responses as they relate to AIT's core programming. And, similarly, AIT will work with the Applied Learning Institute on complementary programming for regional secondary students.

Figure 1. Sequencing of Regional Educational Access

	Education Level	Delivery Structure
Customized Training	Four-year / Graduate Degrees	Arrowhead Institute of Technology
	Two-year Degrees	Northeast Higher Education District Individual Community Colleges
	Secondary	Applied Learning Institute School districts

Basic recommendations of this plan are:

- Creation of Arrowhead Institute of Technology including its General Program Advisory Committee, which is the linchpin for insuring Continuous Quality Improvement and a strategic focus on regional needs as basis for educational programming.
- Continued support for new recently instituted engineering programs.
- Implementation of five new technology oriented programs.
- Support development of a "Life Experience Counts" Center.

A Strategic Enterprise for the Future

The comprehensive plan proposes the establishment of the Arrowhead Institute of Technology as the mechanism best suited to provide opportunities for regional students to secure three- and four-year and graduate level education and training in technology oriented fields associated with regional economic enterprises. While AIT is not intended to be a general, four-year liberal arts institution, it will provide connections to providers of programming in non-technical fields especially for four-year degrees and it will stress liberal arts education for its students as means to learn vital soft skills.

The philosophical underpinnings for AIT are expressed in its Vision, Mission, and Design Specifications.

Vision

Regional learner-workers possess the higher education and training essential to sustain the region's technology oriented economic activity and drive creative economic enterprise regionally and globally.

Mission

The Arrowhead Institute of Technology is a nationally recognized innovative mechanism by which regional learner-workers access baccalaureate degrees, graduate degrees, and customized training tied to regional economic activity so learner-workers are prepared for employment and advancement in their fields of learning-working by gaining transferable education and skill, occupational proficiency, and personal enrichment.

The Arrowhead Institute of Technology will achieve its mission by undertaking these basic functions:

- Continual assessment of need and capacity among regional industry, learner-workers, and providers.
- Coordination and liaison among all forms of providers.
- Secure program providers.
- Secure program funding.
- Coordinate facility improvements needed to deliver programs.
- Assist learner-workers to access programming.

Design Specifications

This plan is distinctly not oriented towards the achievement of fixed goals or objectives. Instead, it is built around the concept of Continuous Quality Improvement (CQI) in which an ongoing iterative process of analysis is followed by action is followed by monitoring which is then analyzed as the basis for making changes and undertaking new actions. The guidelines for this process are Design Specifications, which are the intrinsic, core principles that define the essential character and operating philosophy of the institution.

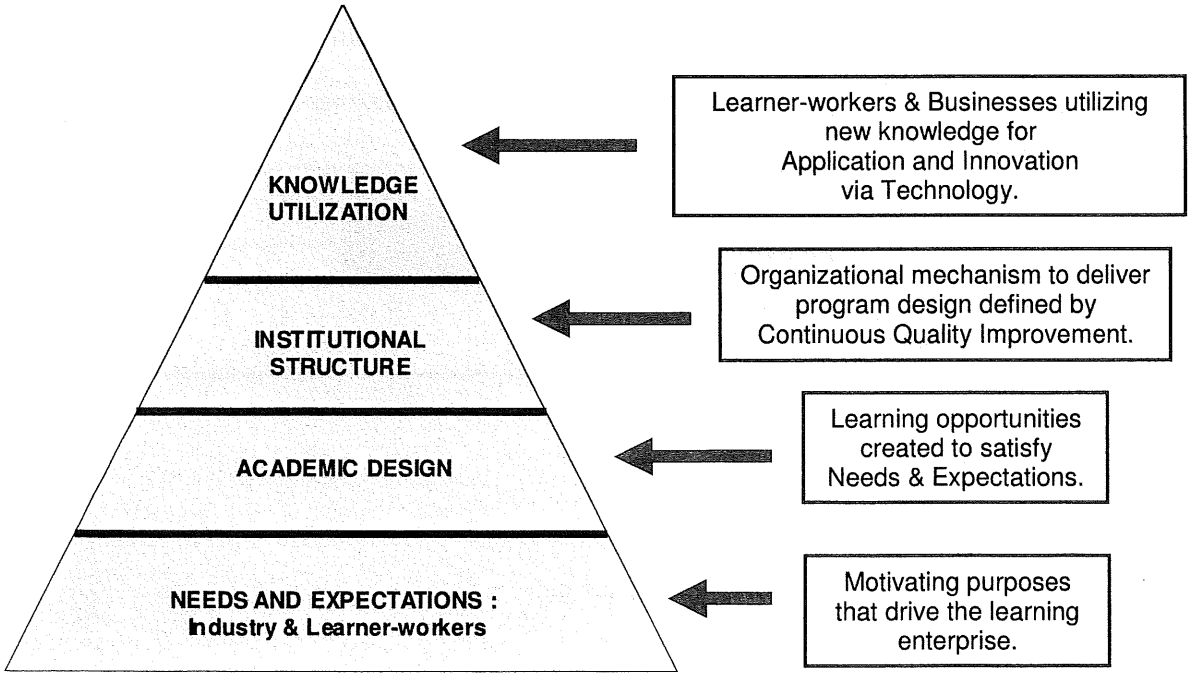
The following are the Design Specifications for the four basic functional areas of the Arrowhead Institute of Technology.:

- **Academic Design Specifications**
  - Focus on technological competency in support of emerging regional economic sectors

- Offer full range of skill sets – general work skills, soft skills, core industrial skills, site/business specific skills.
- Signature programs -- Innovative blend of classroom and unique regional business sites (mills, mines, research facilities, etc.).

- **Institutional Structure Specifications**
  - Build upon existing institutional structures, current programs, delivery options, and existing facilities to reduce costs, avoid duplication, and facilitate timely implementation.
  - Meet system-wide academic standards and review procedures.
  - Finance new and expanded programs through additional revenues and targeted funding sources.
- **Learner-worker Access Specifications**
  - Single "portal" / entry point for businesses and learner-workers.
  - Seamless in all facets of operation (accreditation, delivery of courses, transfer, design and delivery flow from secondary to post secondary and customized training, etc.).
  - Flexibility in terms of course offerings, course content, timing and production of courses, location of courses, method of delivery.
  - Support and foster career ladder for workers.
  - Credit on-the-job-training and certificate training knowledge towards degrees.
- **Implementation Specifications**
  - Anticipate and respond to unique and distinctive educational needs of existing and emerging regional industries.

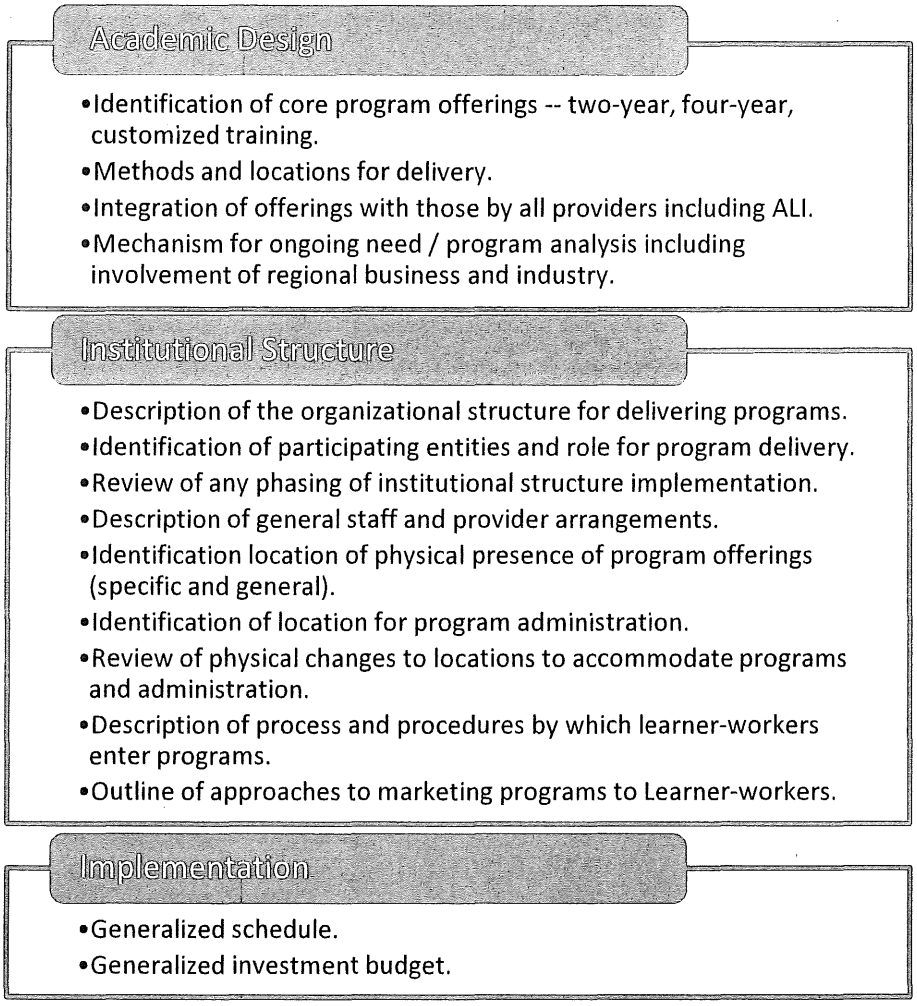
Figure 2. The Arrowhead Institute of Technology Approach to Learning



Comprehensive Plan Components

Figure 3 summarizes the three main components of the comprehensive plan for The Arrowhead Institute of Technology. Details of each component are provided in the following chapters.

Figure 3. Comprehensive Plan Outline



Academic Design

Need Oriented Design

AIT is grounded on the principle of working with regional industry and business and learner-works to identify, understand and respond to needs. In "Working Paper #1: Analysis of Gap between Customer Needs and Education Delivery" (Sertich Consulting, March 16, 2009) the difference between the combined needs of regional businesses and learner-workers and the education and training provided by regional educational institutions was identified. Identifying programs and approaches to crossing this gap was the basis for all subsequent actions in this project. As noted in the Institutional Structure plan component, ongoing Continuous Quality Improvement (CQI) will be utilized by AIT to remain current on needs and required programming.

The following statements summarize the existing gap between the needs of regional industry/business and learner-workers, and, regional educational programming.

Institutional / System (K-16)

- Disconnect from Regional Industry
  - Neither two- nor four-year providers recognize and interact sufficiently with regional business and industry as customers whose needs must be understood and met.
  - Little attention is given to innovation and presenting educational solutions that are "just ahead of time."
  - Lack of mechanisms to continually define needs of existing regional industry and business let alone explore potential incoming economic activity.
- Not a Seamless Institutional System
  - Arrowhead University Consortium (AUC), while probably the best platform for delivering four-year learning on the Range has low profile, is little known, and lacks sufficient inter-institutional authority.
  - Four-year institutions are not fully engaged to meet the educational needs of Range region students through programming on the Range.
  - Industry perceives higher education system as a monolith, but the system perceives itself and delivers its services as a confederacy of independent institutions.
- Not a Seamless Lifelong Learning System
  - Lack of emphasis on continuous quality improvement.
  - Limited availability of lifelong learning opportunities.
  - Although Applied Learning Institute (ALI) has made significant strides in this regard for certain students, insufficient attention is being given to preparing all students in secondary schools regarding regional career opportunities, workplace requirements, and early steps needed or desired to become ready for work.
- Not Oriented to Incoming Students
  - System is geared towards perspectives and type of social interactions of traditional students (who more closely align with the instructors) than with those of incoming learners.
  - High numbers of faculty and students both aversive to on-line learning.
  - Haphazard marketing to students.

Program Mix

- Programming Not Geared to Regional Business and Industry Needs
- Four-year programming provided on the Range is driven by what four-year institutions can easily deliver "off the shelf" rather than by customers' needs (i.e., regional industry).
- Too many two-year programs are driven by faculty knowledge and interest rather than representing real solutions needed and identified by students and industry.
- Work behavior is addressed implicitly, not directly.
- Insufficient utilization of regional industry / research sites as integral part of programs.

- Incomplete Soft Skill Programming
- Limited capacity to develop soft skills.
- Business clients expect workers to possess soft skills but are not willing to pay for them, say through customized training classes.
- Soft skills are neither uniformly defined nor uniformly addressed and taught across educational levels.

Skill Profiles

- There is inadequate articulation of skill training across educational levels in which previous education/training provides foundation for subsequent education/training.
- Skills taught are not well connected to emerging business models.
- Insufficient emphasis on "core skills" across program areas.
- Technical skill expectations versus technical skill funding: schools cannot afford to acquire the cutting edge technology required by industry and industry is unwilling to pay for this in the classroom.
- No educational offerings in critical areas (e.g., production systems, mining).

Delivery Systems

- Absence of 24/7 portal(s) providing easy access for businesses and students alike.
- On-line learning expectations versus on-line learning reality: people say they want it but there is low learner-side participation and steep drop off in participation once they are in.
- No evidence of shared learning model(s) among providers.
- Significant shortage of funding.
- While current student market is limited to the Iron Range area, the cost of new innovative systems will require a larger student base to make them work financially.

Initial Technology Programs

Two programs have already been initiated through this process. These are offered through Iron Range Engineering:

- Minnesota State University, Mankato: Innovative four-year cohort-based, job site oriented engineering program built upon Itasca Community College's program starting in FY2010.
- University of Minnesota - Duluth Masters of Engineering: provide better access to technology and engineering degree programs for Iron Range residents with an immediate purpose to provide graduate level opportunities to currently unemployed engineers. Program will start FY2010.

Five additional programs have been identified for implementation. These programs are detailed in subsequent subsections.

- Industrial Technology
- Process Automation
- Industrial Lab Technician
- Industrial Construction
- Information Management

AIT is intended to facilitate access by regional learner-workers to four-year and graduate level education and training. It will do this in three basic programmatic areas:

- Science and Technology
- Business
- Liberal Arts

The latter two areas specifically involve four-year degree, non-technology programs and are primarily extensions of the programming being offered through AIT's structural platform, the Arrowhead University Consortium.

The focus of this comprehensive plan is on Science and Technology programming.

Other technology programs are in the developmental stage including:

- Entrepreneurial Management: This would be a collaborative program with the University of North Dakota.
- Wind/Solar/Biofuels: This would be a joint venture with Lake Region Site College (Devils Lake, North Dakota) addressing renewable fuels.

On the following pages are short summaries of Iron Range Engineering's Bachelors and Masters Engineering programs, which have already been initiated, and longer detailed descriptions of the five proposed major programs.

Iron Range Engineering

The first Iron Range Engineering Program is a collaboration of faculty from the Northeastern Higher Education District (NHED) and Minnesota State University Mankato (MSUM) featuring a unique project-based curriculum through which graduates of Minnesota community colleges will earn a mechanical engineering degree two years after the program begins. These students will work on projects sponsored by external organizations (industry and not-for-profit) to develop their knowledge and skills with respect to the program learning outcomes specified by ABET (formerly known as Accreditation Board for Engineering and Technology), the organization that accredits engineering programs. Supervised by engineering faculty members, student teams will organize their learning and development around concurrent projects so that the Minnesota infrastructure becomes their classroom.

National reports have called for significant changes to engineering programs so that engineering graduates in 2020 will be significantly more prepared to address the socio-technical challenges in the future. The proposed program will implement many of the recommendations in these national reports. Many regional companies have demonstrated interest in new approaches to engineering education and their active participation is crucial to the program's success.

The proposed program builds upon the groundbreaking two-year engineering curriculum at Itasca Community College as well as other innovations throughout the country. With input from experts on engineering education from across the world and aggressive professional development programs by the participating faculty, the program will apply the latest research on how people learn with emphasis on guided, inquiry-based learning; systematic formative feedback, and learning in groups and communities.

The program has five key elements:

- Use industry as the classroom so students learn engineering in the same context they will practice it.
- Student learning outcomes based on externally sponsored projects so they connect their learning to applications.
- Ongoing assessment that provides data about the development of the students with respect to these learning outcomes.
- Emphasis by faculty members on reflection and self-assessment so that students develop their abilities to evaluate and improve on their learning.
- Students are organized in living, learning communities similar to Itasca Community College to promote learning and development.

Time schedule: Winter 2010

- 10/09 – curriculum development.
- 1/10 – first program delivery.
- 4/10 – recruit second student cohort.
- 9/10 – second semester cohort 1 / first semester cohort 2.

Masters of Engineering

There is an urgent current need for undergraduate and graduate educational programs in engineering and technology for displaced workers on the Iron Range. There is a continuing need for access to advanced course work for engineers employed on the Iron Range. Plant managers and personnel directors associated with regional mining operations are concerned with finding enough skilled workers to support expansion of mining operations and supporting industries and to replace an aging workforce.

The overarching purpose of this program, offered in partnership with the University of Minnesota – Duluth, is to provide better access to technology and engineering degree programs for people living and working on the Iron Range. An immediate purpose is to provide graduate level educational opportunities for currently unemployed engineers.

In phase one of this program, upper division / graduate engineering courses designed to meet the specific needs of unemployed engineers, and those engineers needing to maintain licensure, upgrade their engineering skills, or broaden their areas of employability will be offered. Courses would be part of UMD's Master of Science in Engineering Management and Master of Environmental Health and Safety degree programs. Specific course offerings will be developed following an assessment of needs.

In phase two, students would enroll in the new Masters of Engineering program. This will expand graduate opportunities for unemployed and employed engineers.

Notable features of this program include:

- Scheduling of courses to allow access by employed engineers.
- Credit for project work performed in work settings.
- Direct connections with undergraduate internships on the Iron Range.
- Courses to be offered at Mesabi Range C&TC.

Time schedule: Fall 2009

- 9/09 – phase 1 courses offered.
- 9/10 – continuation of phase 1 courses plus phase 2 Master courses offered

Program 1: Industrial Technology

Industrial Technology

Modern industry is dependent upon a wide range of technologies. Every sector makes use of electronics, hydraulics, automation, and similar rapidly evolving technologies. There is a resulting need for employees who are able to configure, operate, and repair equipment. Currently available programs range from those that emphasize mathematics and physics to others that address the wide ranges of technologies employed in today's industrial environment.

The proposed Industrial Technology Program strikes a middle ground. It offers a "core" perspective on contemporary technologies along with several pathways leading to studies of technology applications in specific industrial sectors. The program also provides for advanced study leading to three- and four-year certificates/degrees.

The proposed Industrial Technology Program embodies features that distinguish it from most competitive offerings. The program:

- Is based on "core studies" of the knowledge and skills that cut across all modern technologies.
- Engages local industries in on-going advisory relationships that ensure continuous quality improvement.
- Offers a "ladder" of certificates and degrees to meet the special needs of students and employers.

General Program Goals ► Students will learn to:

- Operate mobile and/or process equipment.
- Repair and maintain mechanical and electrical equipment.
- Operate and manage industrial plant.
- Maintain plant and equipment.
- Apply knowledge and skills across regional industrial sectors.

Industrial Technology	
	Lead College: Hibbing Community College, Mesabi Range CC, Itasca CC. Chief Academic Officers (CAO) at these colleges will design cores that meet program requirements.
	Program Location: Hibbing Community College, Mesabi Range CC, Itasca CC, Rainy River CC, Vermilion CC.
	Principal Design Manager: Mike Raich, Hibbing CC.

Industrial Technology: Learning Structure					
	Considerations: • Soft and work skills are incorporated. • Utilize student cohorts. • Learning experiences must mirror work place reality. Align with internships, including any existing apprenticeships. • Individualized instruction. • Tailor learning to cohort capacity/needs. • Provide for instructor learning in regional work places. • Promote "working language" for separate economic sectors.				
Instruction Approach	**Learning Structure**				
	Class	**Team**	**Cohort**	**Community**	**Network**
Lecture	50%				
Laboratory		20%			
On the Job		20%			
Mentor					
Self Directed					10%

Industrial Technology	
	Potential University (four-year/graduate) Partners: • Bemidji State University • University of North Dakota • North Dakota State University • South Dakota School of Mines • University of Wisconsin – Stout • Massachusetts Institute of Technology
	Career laddering opportunities: • Integrate Applied Learning Institute programming. • Science Technology Engineering Math (STEM) camps, College for Kids, job shadowing, concurrent enrollment, Perkins, Upward Bound, Talent Search.

Industrial Technology	
	Research or program benchmarking used to inform design process and align this program with better practices: • Alabama Southern • Kentucky • Northern Michigan University • Canberra Institute of Technology • East Down – Northern Ireland • University of Wisconsin – Stout • Fox Valley (Wisconsin)
	Alignment with NHED programs: • All industrial programs (e.g., mining, pulp and paper, maintenance, power generation, etc.). • Introductory courses will expose students to cross-cutting technologies for other college programs. • This program will open students' opportunities for career development.

Industrial Technology	
	Time schedule: Fall 2011 • 11/09 – curriculum development begins. • 8/10 – draft of core curricula defined. • 1/11 – program approved by MnSCU. • 8/11 – curriculum delivery initiated.
	Implementation strategies: • Customized training. • CAO leads program development. • Accelerate MnSCU processes for program development. • Utilize systems approach to development.
	Budget requirements: • $1.186 million: o Life Experience Counts Center: $86,000. o Program Development: $50,000. o Equipment: $500,000 (leveraging one-to-one industry match). o First year staffing at five colleges: $500,000.* o Marketing and Development: $50,000.

*For all five of the proposed programs there will be a concerted effort to avoid "cost shifting" in which IRHE Account funds replace provider funding for existing staff. IRHE funds will only be used for new staff required to implement the proposed programs.

Program 2: Process Automation

Process Automation

Process Automation (PA) refers to electronic control of industrial operations. PA training includes such elements as computer technology, industrial electronics, instrumentation, electrical machines, robotics, power electronics, and automated control systems. PA applications are found in all sectors of Iron Range industries and there is an increasing demand for trained employees.

The proposed PA Program is based upon existing offerings at Mesabi Range College. Content is continually modified to adapt to process automation in area industries by transforming advisory committees and focusing custom training on "corporate knowledge management." The proposed PA Program also offers opportunities for continuing studies at four-year institutions.

The proposed Process Automation Program features:

- Immediate start-up.
- Low implementation cost.
- Potential transformation of custom training from a marketing approach to "corporate knowledge management" in partnership with industry.
- Building on programs within the Applied Learning Institute.
- Utilizes the Emerging Technology Center at Mesabi Range College.

General Program Goals ► Students will learn to:

- Install, operate and troubleshoot automated equipment.
- Maintain Program Logic Control (PLC) and electro-hydraulic systems.
- Troubleshoot high level complex systems and processes in industry and the manufacturing environments.
- Incorporate core courses of engineering and science.

Process Automation	
	Lead College: Mesabi Range Community & Technical College.
	Program Location: Mesabi Range C&TC (Virginia and Eveleth campuses)
	Principal Design Manager: Jean Bailey, Mesabi Range C&TC.

Process Automation: Learning Structure									
	Considerations: • Potential for a three-year component, transferable to four-year engineering programs. • Field experience is a critical program feature. • Ensure core competency. • Redesign instructional resources for program delivery. • Create career/competency ladder. • Additional delivery through customized training and continuing education. • Close the learning loop between higher education and industry. • Utilize industry "schools" wherever possible.								
Instruction Approach	**Learning Structure***								
	Class		**Team**	**Cohort**	**Community**		**Network**		
Lecture	1)70%	3) 25%							
	2/ 50%	4) 10%							
Laboratory	1) 30%	3) 65%							
	2) 50%	4) 50%							
On the Job					1) 0%	2) 0%			
					2) 0%	4) 40%			
Mentor					1)0%	3) 10%			
					2) 0%	4) 0%			
Self Directed									

* Design Team divided process by four semesters to show change in approach.

Process Automation	
	Potential University (four-year/graduate) Partners: • Bemidji State University • University of Minnesota • Newcastle • MSU – Mankato • Georgia Tech • Massachusetts Institute of Technology • University of Alabama • Leeds University – United Kingdom • North Island College -- Canada
	Career laddering opportunities: • Integrate Applied Learning Institute programming. • STEM camps, College for Kids, job shadowing, concurrent enrollment, Perkins, Upward Bound, talent search.

Process Automation	
	Research or program benchmarking used to inform design process and align this program with better practices: • Visit campuses that demonstrate best practices. • Meet with industry experts. • Gather data and information on job outlook from DEED, Workforce Centers.
	Alignment with NHED programs: • Electrical and Industrial Automation Technology (EIAT) program – Mesabi Range C&TC • Electrical Maintenance – Hibbing CC • Engineering – Itasca CC

Process Automation	
	Time schedule: Fall 2010 • 9/09 – Current curriculum analysis begins. • 12/09 – Revisions sent to campus Academic Affairs & Standards Council (AASC). • 2/10 – Approved by MnSCU. • 8/10 – Curriculum delivery.
	Implementation strategies: • Potential for re-design of Mesabi Range's EIAT program.
	Budget requirements: • $887,000.

Program 3: Industrial Lab Technician

Industrial Lab Technician

Most laboratory technician training programs are specific to applied areas. Medical, biological, and similar fields all employ persons trained in a given field. There is, however, an emerging need for individuals skilled in laboratory practices in such sectors as mining, manufacturing, and construction. The resulting demand for training offers an opportunity for innovation in this important subject matter.

The proposed Industrial Laboratory Technician (ILT) Program is based upon statistical techniques required in all fields. Emphases on quality control, regulatory compliance, and process monitoring/management make this a highly-valued program.

The proposed Industrial Laboratory Technician Program will:

- Utilize systems approach to program development, approval, and implementation.
- Become a potential national model.
- Support "corporate knowledge management" approach to custom training.

General Program Goals ► Students will learn to:

- Demonstrate skills in environmental statistical methodology, sampling and research methods in the areas of water, paper, soil, air, pellets, and minerals.
- Conduct routine quality control (QC) testing.
- Complete recordkeeping, documentation of results, and assurance compliance.
- Perform calibrations and preventive maintenance of analytical equipment.
- Be skilled in wet chemical and instrumental analyses of samples for process control.
- Demonstrate skill in learning and applying hazard communication rules and regulations (federal, state, local, and international standards).

Industrial Lab Technician	
	Lead College: Vermilion Community College.
	Program Location: Vermilion Community College.
	Principal Design Manager: Mary DuBois, Vermilion CC.

Industrial Lab Technician: Learning Structure					
	Considerations: • Approach will combine lecture, laboratory, and on-the-job training as defined by industry partners. • Learning experiences must mirror work place reality. • Tailor learning to cohort capacity/needs. • Provide for instructor learning in work place. • Emphasize self-directed learning with open entry/open exit access.				
Instruction Approach	**Learning Structure**				
	Class	**Team**	**Cohort**	**Community**	**Network**
Lecture	40%				
Laboratory		30%			
On the Job		20%			
Mentor					
Self Directed					10%

Industrial Lab Technician	
	Potential University (four-year/graduate) Partners: • Bemidji State University (Environmental Studies major) • St. Cloud State University (Chemistry BS, Chemical Physics, BS)
	Career laddering opportunities: • Address seniority systems within the mining industry. • The chemistry and physics emphasis will give options for the four-year program. • The specific testing curriculum will be deliverable for custom training options.

Industrial Lab Technician	
	Research or program benchmarking used to inform design process and align this program with better practices: • Examination and consideration of curriculum, including Canadian model for ILT. • Raymond Walters College (University of Cincinnati)
	Alignment with NHED programs: • Water quality science and water shed science AS programs, Vermilion CC. • Hibbing CC Medical Laboratory Technician. • Some engineering or process classes from Itasca Community College.

Industrial Lab Technician	
	Time schedule: Fall 2011 • 11/09 – curriculum development begins. • 8/10 – draft of core curricula defined. • 1/11 – program approved by MnSCU. • 8/11 – curriculum delivery initiated.
	Implementation strategies: • Utilize existing Vermilion CC outdoor learning center. • Integrated with customized training. • CAO leads program development. • Accelerate MnSCU processes for program development. • Utilize systems approach to development.
	Budget requirements: • $250,000.

Program 4: Industrial Construction

Industrial Construction

Most industrial construction programs focus on management issues – site selection, supply chains, and work scheduling. While these skills are essential to any effective construction project, they limit the focus of managers to conventional inputs. Programs of study play little attention to "green and sustainable" approaches to industrial construction.

The proposed Industrial Construction Program builds on current offerings at NHED colleges to articulate "green/sustainable" content with training in up-to-date construction practices. It also takes advantage of the interest in "green/sustainable" construction among area industries.

The Industrial Construction Program embodies several features that make it a desirable investment:

- Two-year program for renewable energy technician provides foundation and expectation that learner-worker will seek four-year degree in design/build systems.
- Low cost.
- Immediate implementation.
- Connection to secondary schools.
- Federal emphasis and available resources in this field.

General Program Goals ► Students will learn to:

- Be all-around building trades professionals with the latest information and skills relating to green and sustainable construction methods, related products, and installation technologies for new and existing structures.
- Acquire competencies leading to a four-year degree.
- [potential] Learn energy auditing practices.

Industrial Construction	
	Lead College: Itasca Community College.
	Program Location: Itasca CC, Rainy River CC.
	Principal Design Manager: Barbara McDonald, Itasca CC

Industrial Construction: Learning Structure

Considerations:

- Need to adapt to new technologies as they are developed.
- Focus on apprenticeship delivery.
- Provide core learning that serve all apprenticeships.
- Project-based delivery will be prevalent throughout the program.

Instruction Approach	Learning Structure				
	Class	Team	Cohort	Community	Network
Lecture	30%				
Laboratory					
On the Job		25%			
Custom Training		25%			
Self Directed					20%

Industrial Construction

Potential University (four-year/graduate) Partners:

- Bemidji State University:
  - Industrial Technology -- Construction Technology, Manufacturing Management, Model Making, Manufacturing Technology
  - Master of Science in Industrial Technology
  - Construction Site Management
  - Prototype Engineering Technology

Career laddering opportunities:

- Program offers concurrent enrollment credits to International Falls High School Building Trades students. Potential to utilize Applied Learning Institute programming to extend to other regional schools.
- A program matures there is potential to provide customized training to local / regional professionals to earn continuing education credits related to green building methods and sustainable construction.

Industrial Construction

Research or program benchmarking used to inform design process and align this program with better practices:

- Instructors will be LEED (Leadership in Engineering and Environmental Design) Accredited Professionals and follow LEED and Minnesota GreenStar standards.

Alignment with NHED programs:

- Electrical Maintenance – Hibbing CC.
- Carpentry – Mesabi Range C&TC

Industrial Construction	
	Time schedule: Fall 2010 • 9/09 – curriculum delivery initiated. • 12/09 – core curriculum drafted. • 1/10 – program approval by MnSCU. • 8/10 – program articulation agreements in place and curriculum delivered.
	Implementation strategies: • Program uses Itasca CC engineering program as model for four-year articulation. • Concurrent enrollment of International Falls students via school's building trades program promotes K-14 opportunities.
	Budget requirements: • $250,000: o Equipment: $100,000. o Staff/faculty/coordination: $100,000. o Laboratory renovation and upgrade: $25,000. o Marketing: $25,000.

Program 5: Information Management

Information Management

Leading executives and managers depend upon an individual who collects, organizes and interprets the information and coordinates the processes that drive the organization. This person possesses the technical, analytical and communication skills needed to transform information into knowledge that informs executive and managerial decision making.

The Information Management Program is designed to replace conventional secretarial and office practice training. It is shaped by requirements articulated by members of the Design Team; extending the capacity of executives and managers in Iron Range businesses.

The proposed Information Management Program has such features as:

- Accessing a large potential market.
- Meeting immediate business needs.
- Connecting to the Applied Learning Institute.
- Foundation for four-year degree.
- Strategic investment.
- Articulating with knowledge-focused custom training.

General Program Goals ► Students will be proficient in:

- High levels of oral and written communication.
- Project management.
- Intercultural competence.
- Working independently.
- Current technologies and adaptable to emerging ones.
- Supportive leadership.

Information Management	
	Lead College: Hibbing CC, Mesabi Range C&TC.
	Program Location: Hibbing CC, Mesabi Range C&TC (Virginia and Eveleth campuses).
	Principal Design Managers: Mike Raich, Hibbing CC; Jean Bailey, Mesabi Range C&TC

Information Management: Learning Structure

Considerations:

- Use of virtual laboratory environment.
- Learning how to adapt to new technology.
- Use project-based learning delivery.
- Communication skills at a high level.
- Emphasize self-directed learning.

Instruction Approach	Learning Structure									
	Class		Team	Cohort	Community		Network	
Lecture	1) 50%	3) 20%						
	2) 20%	4) 0%						
Laboratory	1) 50%	3) 30%						
	2) 50%	4) 30%						
On the Job					1) 0%	3) 30%		
					2) 0%	4) 35%		
Mentor								
Self Directed							1) 0%	3) 20%
							2) 30%	4) 35%

* Design Team divided process by four semesters to show change in approach

Information Management	
	Potential University (four-year/graduate) Partners: • MnSCU Universities • University of Wisconsin – Stout • University of Wisconsin – Superior
	Career laddering opportunities: • Opportunity for "reverse transfers" whereby students with four-year degrees return to gain two-year degrees or certificates. • Integrate Applied Learning Institute programming. • STEM camps, College for Kids, job shadowing, concurrent enrollment, Perkins, Upward Bound, Talent Search.

Information Management	
	Research or program benchmarking used to inform design process and align this program with better practices: • Canberra Institute of Technology (Australia) • University of Wisconsin – Stout • Association of Northern Ireland Colleges "Women Mean Business"
	Alignment with NHED programs: • Administrative support -- Hibbing CC • Administrative support -- Mesabi Range C&TC

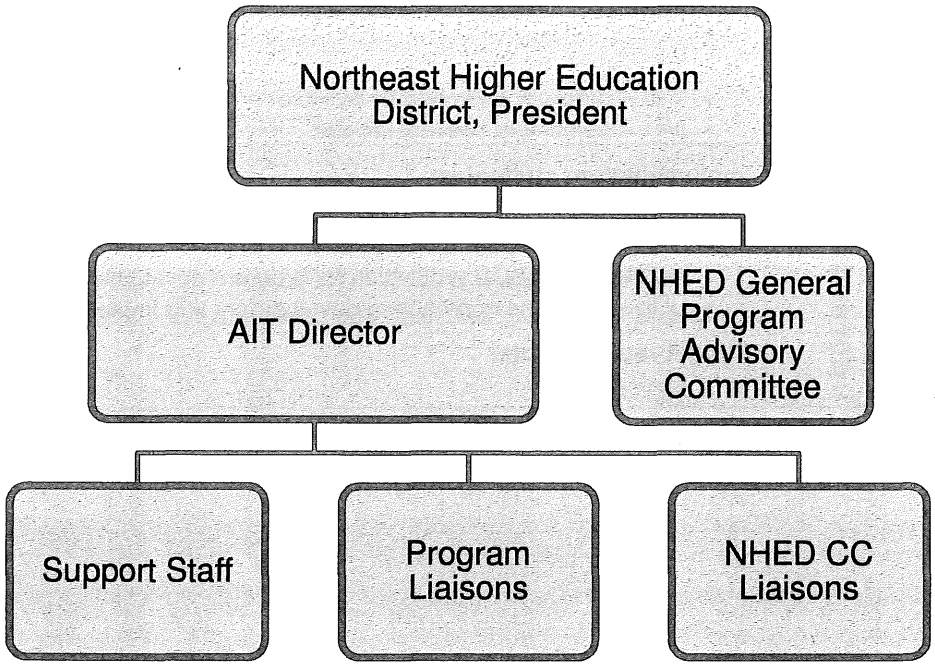
Information Management	
	Time schedule: Fall 2011 • 11/09 – curriculum development begins. • 8/10 – draft of core curricula defined. • 1/11 – program approved by MnSCU. • 8/11 – curriculum delivery initiated.
	Implementation strategies: • Integrate with customized training. • CAO leads program development. • Accelerate MnSCU processes for program development. • Utilizes systems approach to development and implementation.
	Budget requirements: • $500,000.

Institutional Structure

Organization

The Arrowhead Institute of Technology transforms the existing Arrowhead University Consortium structure into one with the capacity to deliver a more complex and evolving range of programs. AIT's basic structure is indicated in Figure 4.

Figure 4. Arrowhead Institute of Technology General Structure



The following offers brief descriptions of the organizational components:

- **NHED President**: provides administrative authority and direction and is direct connection with the MnSCU system.
- **NHED General Program Advisory Committee**: Led by NHED President, this body provides guidance, input, and policy direction regarding educational needs at two-year, four-year, graduate, and customized training levels. The Committee would have appropriately broad representation from the educational systems involved and regional industry and business. AIT would deal with findings and recommendations that apply to its areas of responsibility.
- **Director**: primary administrator and deliverer of AIT services. Director will be assisted, as needed, by support staff. The existing AUC director would become the AIT Director.

- **Community College Liaisons**: interact with students regarding program marketing, student services and support, and the like. These are existing AUC positions.
- **Program Liaisons**: each program offered through AIT would have a Program Liaison to offer direct contact and communication flow between the program and AIT.

AIT executes its mission by being a central coordinating body that facilitates the creation and/or use of programs to meet the ongoing needs of regional learner-workers. Memoranda of Agreement will be executed with partnering providers to deliver individual programs.

Within this arrangement **program providers and partnering institutions:**

- Enroll students.
- Provide instructional faculty and staff.
- Conduct program.
- Issue degrees / certify credits.
- Provide facilities, as appropriate, for program delivery.

General Program Advisory Committee

This committee is the heart of NHED's Continuous Quality Improvement (CQI) effort. It will be composed of representatives from regional industry, business, public schools, and others involved in economic activity and education. The committee will be led by NHED President and provide guidance to NHED Provosts and the AIT Director. This committee will complement advisory committees on the individual campuses.

The committee will meet on a regular basis with its primary mission being to continually update the needs and gap analysis that formed the foundation for this comprehensive plan.

The committee will operate in line with the best practices outlined in "Fifty Indices of Effectiveness Regarding the Program Advisory Committees in Minnesota's Technical Colleges: A Working Paper. Effective Advisory Committees Project" (Mercer, John and John W. Meunier, Minnesota State Council on Vocational Technical Education, St. Paul, 1991).

Sample AIT – Program Structural Relationship

Each program delivered via the AIT will be established through a Memorandum of Agreement (MOA) between NHED/AIT and the partnering entities that provide the instructional programming. Figure 5 identifies and generally describes the elements contained within a typical MOA.

Figure 5. Basic Components of MOA Establishing Educational Programming through AIT

Component	Description
Purpose	Generally describe terms and conditions to facilitate delivery of a specific program.
Partners	Identify entities involved in delivering the program. One party is always NHED/AIT.
Structure and Governance	Identify specific people for each partner who will be responsible for implementing the MOA. Method of resolution of differences. Establishment of specific program advisory group.

Figure 5. Basic Components of MOA Establishing Educational Programming through AIT		
Component		**Description**
		Role of AIT in providing support services for program.
Personnel Provisions	*Employment*	As appropriate to program, identify which partner will provide faculty and staff and the general role of such personnel. Identify time for staff to begin work.
	Bargaining Unit Representation	As appropriate to program and partners, identify the bargaining unit classification for faculty and staff.
Budget / Finance	*Fiscal Agent*	Identify the program's fiscal agent, which is most cases will be NHED through its Northeast Service Unit.
	Funding	Identify source and amount of funding to support program. Determine that a budget dictating revenues and expenses is to be prepared. Designate signatory authority for incurring costs, which in nearly all cases will be NHED.
	Financial Arrangements	Define the partner to receive state appropriation for enrollment, flow of tuition dollars, and the like.
	Tuition and Fees	Define the tuition rate to be paid by students and to which partner, determine student fee payments, and the like.
Student Services	*Recruitment*	Determine who will recruit learner-workers for program, when recruitment is to occur, and target level of enrollment.
	Admissions	Identify who will handle student applications, admissions, and registration. Identify the level of admissions and any prerequisite coursework and whether program enrollment is competitive or not.
	Financial Aid	Identify the availability of student aid and which staff will be responsible for assisting students.
	Other Services	Identify partner responsible for student advising and counseling, technology support, testing, vehicle use, etc.
	Residential Life	Identify any special arrangements for student housing.
Curriculum	*Accreditation*	Identify type of accreditation, number of credits, transcription, and related items.
	Matriculation	Identify the partner in which the learner-workers will be considered fully matriculated students.
Intellectual Property Rights / Ownership Rights		Identify which partner will hold rights to any intellectual property developed or acquired through the program.

"Life Experience Counts" Center

So as to generate a major strategic advantage over other educational institutions NHED will establish a "Life Experience Counts" Center to promote the value and application of Life Transcripts for credit towards certificates and degrees. As an example, through this process someone who has learned basic welding skills through on-the-job experience could "test out" or otherwise secure credit towards a degree or certificate, thereby reducing the cost and time to secure the degree or certificate. The Center will assist learner-workers to prepare Life Transcripts and secure appropriate credit.

Undertaking the establishment of this center is a serious and complex effort. It will take time but it will create a distinctive edge in favor of the system. Once fully underway, learner-workers will access the Center at each NHED campus.

The Center concept will be initiated through the Industrial Technology Program.

Location

AIT programming will occur at the five NHED colleges and on the six campuses. Existing facilities will be used to the degree possible. Improvements, including acquisition of new equipment, will be undertaken as required for specific programs.

AIT programs will make extensive use of workplace locations across the region for program delivery. This will include mills, mines, construction sites, and research and development facilities.

AIT administrative offices will be located at the Virginia campus of Mesabi Range Community and Technical College. In addition, the Iron Range Engineering Program will be headquartered at this campus; this will include laboratory/learning areas and student residences.

Learner-workers will be able to access AIT via the campus portals and program liaisons at each of the six NHED campuses.

Marketing

AIT's primary marketing focus will be on regional learner-workers. A variety of methods will be considered and employed including:

- Working with ALI to introduce secondary students to and prepare them for AIT programs.
- Coordinating with regional industries and businesses regarding all learning opportunities for their workforce.
- Use NHED campus liaisons to inform students of four-year degree opportunities through AIT.
- Work with program liaisons and providers to encourage students to participate in their programs.
- Coordinate with regional workforce and economic development programs.
- Various forms of advertising within regional schools, businesses and communities.

While AIT's focus is providing access to four-year and graduate level education for regional learner-workers, it will seek students from outside the region. One objective of this effort is to establish AIT with a national reputation for innovation in technology oriented learning and attract learner-workers to the region. Among the marketing initiatives that may be considered are:

- Establish an unique national brand for AIT and its learning programs.
- Seek a large federal Workforce Innovation in Regional Economic Development (WIRED) grant to help provide programming and to elevate AIT's national profile.
- Establish program provision partnerships with educational institutions across the country and internationally.

Implementation

Implementation of this comprehensive plan has several basic components to be undertaken concurrently.

- Establish AIT as an organization. On paper this involves transforming the Arrowhead University Consortium into the Arrowhead Institute of Technology. In reality this will involve a number of institutional actions within MnSCU and NHED. While these are being executed, AUC can operate under the AIT name and perform all functions of AIT (as it is currently doing for the Iron Range Engineering and UMD Masters of Engineering programs).
- Create and activate the NHED General Program Advisory Committee.
- Invest dedicated Iron Range Resources funds into the programs identified in this comprehensive plan. Figure 6 summarizes these investments.

Figure 6. Generalized Iron Range Resources Investment in Initial Arrowhead Institute of Technology Programming (program start year in red)

Program	FY10	FY11	FY12	Investment
Iron Range Engineering	$1,144,700	$800,000	$750,000	$ 2,694,700
Masters of Engineering	250,000	400,000	400,000	1,050,000
Industrial Technology	25,000	575,000	586,000	1,186,000
Process Automation	125,000	762,000		887,000
Industrial Lab Technician	40,000	186,000		226,000
Industrial Construction	105,000	105,000	60,000	270,000
Information Management	20,000	200,000	44,000	264,000
Entrepreneurial Management				TBD
Wind/Solar/Biofuels				TBD
Total	$1,709,700	$3,028,000	$1,840,000	$ 6,577,700

There will be separate IRHEC / IRR decisions to invest in each of the recommended (and subsequent) programs. In each instance, the partnering NHED campus is to submit a formal program proposal and funding request that contains, at a minimum, the following:

- Program description based upon the format and type of information provided in this comprehensive plan for the respective program.
- Degree to be conferred.
- Transferability of credits and degree.
- Detailed budget information.
- Benchmarked timeline for budget.
- Facility and equipment requiring Minnesota bonding support, the cost of such improvements, and timing (relative to bonding process and eventual use in program).

- Initiate actions centered on marketing, ongoing need analysis via NHED General Program Advisory Committee, and new program development.