INTERNATIONAL EDUCATION IN NATURAL RESOURCE ENGINEERING AND THE KSU / EI PURPAN AREM PARTNERSHIP

by

HALE C. SLOAN

A THESIS

submitted in partial fulfillment of the requirements for the degree

MASTER OF SCIENCE

Department of Biological and Agricultural Engineering
College of Engineering

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2010

Approved by:

Major Professor
Stacy Lewis Hutchinson

Abstract

The need for globally mobile and culturally intelligent engineers to address global natural resource issues is high. Current economic, political and environmental states demand that educational institutions equip engineers with diverse problem solving skill sets. International education experience is the best way for students from varied backgrounds to appreciate differences around the world, develop skill sets for global issues and operate in a multinational environment.

International education programs exist between many different educational institutions. A multidisciplinary program, Agricultural Resources and Environmental Management (AREM), currently exists between Kansas State University Manhattan, Kansas, USA and Ecole d'Ingénieurs Purpan Toulouse, France. AREM is a Master's level program designed to promote the exchange of ideas, faculty, and students in sustainable agricultural development. This program operates independently at each institution and features two courses, revolving around agro-ecological, economic, and social factors, which are co-taught via live video conference.

The main objectives of this research were to compare the structural education components of engineering institutes EI Purpan and KSU in order to evaluate the efficacy and importance of the AREM program in global terms, to create a mutual understanding of program obstacles, to highlight the benefits and strengths of each institution, and to provide a common plane for forward progress.

Comparisons of accreditation programs, pedagogy and curriculums at the Bachelor's and Master's level were conducted. The similarities and differences of the AREM program from both French and American perspectives were explored to develop recommendations for forward progress. Learning outcomes set by accreditation bodies were very similar, but the method of achieving those outcomes was dissimilar. Many differences were found in the amount of time spent on certain educational topics within the engineering curriculum. Engineering students at EI Purpan received a more rounded education, with an agricultural business management focus, enhanced with practical education through required internships. KSU engineering students received a much more technical and theoretical education based in math, physics and engineering design. Pedagogy contrasted most between schedule and on job training. Differences in Master's degree specialization were limited, but influential.

The AREM program is a specialized degree pathway at EI Purpan, while at KSU it is a graduate certificate program. At EI Purpan the AREM program is heavily advertised, while at KSU it is not. Departmental structure of American universities provides challenges to multidisciplinary programs like AREM. The strengths of each institution, practical or theoretical, should be integrated to enhance the AREM program outcomes.

Possibilities exist for the AREM program to maintain its current state with minor enhancements, develop into a short summer exchange program between KSU and EI Purpan, or evolve into a joint Master's degree. The AREM program exposes students to international collaboration, appreciation of different approaches to problems solving, and cultural eccentricities. Engineering students who participate in the AREM program are equipped to solve natural resource issues at the global scale. Improvements to the program will increase student ability and institutional reputability.

Table of Contents

List of Figures

List of Tables

Acknowledgements

The counsel given by Dr. Stacy Lewis Hutchinson, my major faculty advisor, was absolutely vital to the completion of this work. My committee members also provided crucial assistance. The assistance provided by Dr. Kyle Douglas-Mankin was important to the understanding of AREM at Kansas State University. The knowledge Dr. Michel Gay provided of the French and EI Purpan's education system was especially helpful. Also, the translation aid by Ms. Juliette Chaix of French documents made for much clearer understanding.

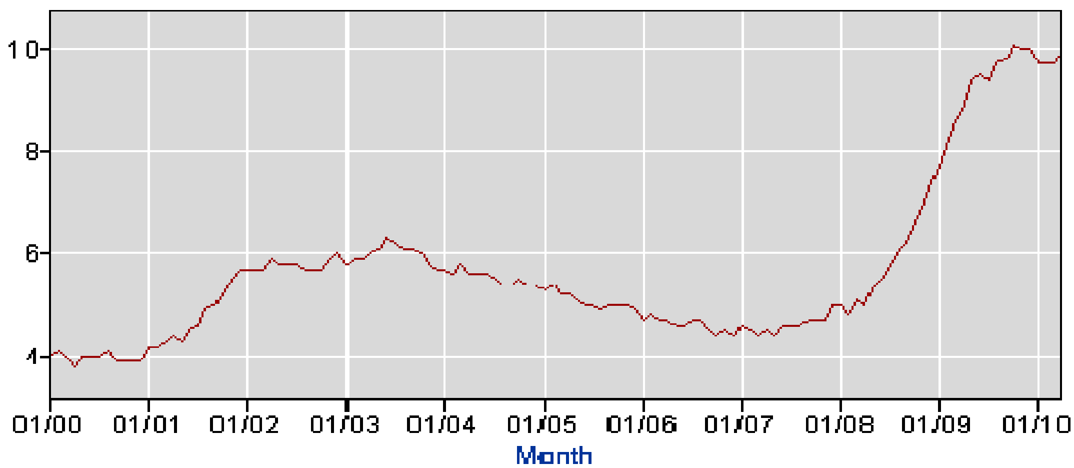
CHAPTER 1 - Introduction and Literary Review

Current World Challenges

The only constant is change, continuing change, inevitable change, that is the dominant factor in society today. No sensible decision can be made any longer without taking into account not only the world as it is, but the world as it will be.
— Isaac Asimov (Hartung, 2004)

We need to look at today and to tomorrow. Today the world is in economic limbo, some projections point up and some down. What is known is that the unemployment rate (Figure 1) indicates the absence of economic growth in the United States. The economic state drives how the entire world operates, we live in a world marketplace.

Figure 1.1 United State Bureau of Labor Statistics unemployment rate in percent for individuals 16 and older (Bureau of Labor Statistics, 2010).



Economics directly influence the decisions people make and scientific research. It is important to consider how economic status will influence the topics of this paper. Growth might not return next week, but it will return and those most prepared will be the best suited. Economic crisis is the immediate news of the day, but the state of the environment continues to be one of the most important issues the world must deal with. Popular media runs with the brightest torch and as the economic torch dims, the world will remember how bright the torch of environmental consciousness is.

In 2007, the Intergovernmental Panel on Climate Change (IPCC) concluded that it was “very likely” that humans are responsible for climate change (IPCC, 2007). The cause, excess carbon dioxide produced by internal combustion engines burning fossil fuel. Earth is a system. And this system is searching for homeostasis all the time. Whether it is the percent of one gas or another in the atmosphere, or the sea level, or the change in topography due to seismic activity, flux is constant.

From the IPCC findings, the global awareness of human impact on the earth is growing. Not all people agree with the IPCC’s research, but majorities agree that conserving available resources and limiting negative impacts on the earth is better for the longevity of the earth. Recently, emissions standards and air quality have become very important topics. In January 2010, President Barack Obama announced the Federal Government of the United States would reduce its greenhouse gas (GHG) pollution by 28 percent by 2020 (The White House, 2010).

There are many environmental systems operating around the world. The atmosphere (greenhouse gases) is only one of the systems that we must be concerned about. These systems of the earth share natural resources, supplied by nature and hold economic value. Today we rely on natural resources to live. We understand that some are renewable and some are non-renewable. It is the management of natural resources that offers dynamic challenges. How much should we use? How much should we save? How much do we need for tomorrow? Questions like these are very hard to approximate an answer. Thoughts about our current practices and the impact of those practices are beginning to enter the mainstream.

The United States has a division of government directly concerned with natural resources, the Natural Resource Conservation Service (NRCS). The NRCS currently has six goals which are the focus of the agency's effort (Table 1.1). These goals are similar, but not exactly congruent among developed countries of the world.

Table 1.1 Natural Resource Conservation Service Mission Goals / Outcomes established for 2005-2010 (NRCS, 2005).

NRCS Goals	**Outcomes**
High-quality, Productive Soils	Soil Quality. The quality of intensively used soils is maintained or enhanced to enable sustained production of a safe, healthy, and abundant food supply.
Clean and Abundant Water	Water Quality. The quality of surface waters and groundwater is improved and maintained to protect human health, support a healthy environment, and encourage a productive landscape.
	Water Management. Water is conserved and protected to ensure an abundant and reliable supply for the Nation.
Healthy Plant and Animal Communities	Grassland, Rangeland, and Forest Ecosystems. Grassland, rangeland, and forest ecosystems are productive, diverse, and resilient.
	Fish and Wildlife Habitat. Working lands and waters provide habitat for diverse and healthy wildlife, aquatic species, and plant communities.
	Wetlands. Wetlands provide quality habitat for migratory birds and other wildlife, protect water quality, and reduce flood damages.
Clean Air	Agriculture makes a positive contribution to local air quality and the Nation's efforts to sequester carbon.
Adequate Energy Supply	Agricultural activities conserve energy and agricultural lands are a source of environmentally sustainable bio-fuels and renewable energy.
Working Farm and Ranch Lands	Connected landscapes sustain a viable agriculture and natural resource quality.

These goals are broad and have no completion timeline, but they do provide a target area to work toward. As the population of the earth continues to grow, use and management of natural resources will also grow. The need to feed more people will necessitate the transition of natural ecosystems to agro-ecosystems and invigorate competition between the two. Management of these systems will become even more important if the supply of natural resources becomes lower than the demand. When countries have the opportunity to increase agricultural lands by converting forests to food production, the loss of resources may be equal or greater than the gain. For example, ecotourism, logging, hydrologic cycle implications, and potable water may be sacrificed for food production (MEA, 2003). Developing countries will continue to pass through phases of economic take-off, acceleration and stabilization that accompany development and in doing so will have great impact on the regional natural resources available. Developed nations have already passed through the grossly consumptive phase and because of this, the mistakes, or the mismanagement of earth's natural resources, when countries develop, can be prevented and improved. The implementation of conservation practices in already developed countries will exist indefinitely.

Engineers: Professional Problem Solvers

The world is full of change and from that change new problems and issues arise to be dealt with. We, as a world community, should be making real-time decisions to be able to keep up with the constantly changing dynamo that is the world we live in.

Who makes these decisions? Who analyzes this data? It is the professional that will lead forward to solution. Medical doctors solve problems with the human body. Lawyers solve problems with law/societal code. Scholars and scientists discover and test new and old problems. And engineers solve the physical world problems.

It is the engineer who will address the issues of natural resources. The engineer will analyze, design, and implement the practices and structures that will sustain earthly existence. Knowledge of the physical world and sciences that propel processes and interactions are basic qualities that engineers the world over possess. Understanding calculus and a broad range of physics, chemistry and life sciences enable the engineer to address natural resource issues. However, the earth is full of many different types of people and places. Will engineers operate around the world? From a technical point of view, yes, the effects of gravity are the same regardless of location. However, variety is the spice of life, and no two places are exactly the same. People further complicate things for engineers; people are very different. Engineers in one country may have strict guidelines based on societal and cultural practices, while other engineers have fewer regulations but are restricted due to lack of money.

The challenge for developed countries is to improve the problem solving ability of each engineer, as developing countries like India and China produce high level engineers due to sheer mass of population. Competitions between high population countries and high gross domestic product countries will create a need for an American engineer whose value must be significantly higher per capita. This must be done through broader intellect, innovation, entrepreneurship and an ability to address issues at the world scale (Duderstadt, 2008).

Yet even developed countries have many differences in engineering education and focus. The engineering educational experience shapes the analytical mind that will address world issues. Therefore, it is important to understand these differences when global teams of engineers are formed. For example, French students were learning that theoretical knowledge was the starting point for problem solving. However, in the United Kingdom, at all levels of education, practical knowledge was the base foundation when addressing issues. And in Germany, precision must be a key consideration if quality work was to be done (Downey and Lucena, 2004). Political, educational, and cultural issues influence the engineer depending on the country of origin. This is extremely important when considering how an engineer will approach an issue, such as natural resource management, especially depending on education.

The following problem definition process (Figure 1.2) is from Engineering Cultures course developed at the Colorado School of Mines and Virginia Tech (G.L. Downey *et al.*, 2006). As one reads through this problem definition, it begins to introduce a very interesting approach to problem solving that might be exactly how an engineer working in a world market would begin the problem solving process. This is what an engineer who will approach international natural resource issues should be thinking. Introducing engineers to international experience should aim to create a problem solver capable of approaching issues with this or a similar mindset.

Figure 1.2 Problem solving definition; part of Engineering Cultures course developed initially at Colorado School of Mines and Virginia Tech (Downey *et al.*, 2008).

Step 1	Identify each perspective that is involved in the decision you face. Remember that problems often mean different things in different perspectives. Relevant differences might include national expectations, organizational positions, disciplines, career trajectories, etc. Consider using the mnemonic device "Location, Knowledge, and Desire." *Location*: Who is defining the problem? Where are they located or how are they positioned? How do they get in their positions? Do you know anything about the history of their positions, and what led to the particular configuration of positions you have today on the job? Where are the key boundaries among different types of groups, and where are the alliances? *Knowledge*: What forms of knowledge do the representatives of each perspective have? How do they understand the problem at hand? What are their assumptions? From what sources did they gain their knowledge? How did their knowledge evolve? *Desire*: What do the proponents of each perspective want? What are their objectives? How do these desires develop? Where are they trying to go? Learn what you can about the history of the issue at hand. Who might have gained or lost ground in previous encounters? How does each perspective view itself at present in relation to those it envisions as relevant to its future?
Step 2	As formal problem definitions emerge, ask "Whose definition is this?" Remember that "defining the problem clearly" may very well assert one perspective at the expense of others. Once we think about problem solving in relation to people, we can begin to see that the very act of drawing a boundary around a problem has non-technical, or political dimensions, depending on who controls the definition, because someone gains a little power and someone loses a little power.
Step 3	Map what alternative problem definitions mean to different participants. More than likely you will best understand problem definitions that fit your perspective. But ask: does it fit other perspectives as well? Look at those who hold Perspective A. Does your definition fit their location, their knowledge, and their desires? Now turn to those who hold Perspective B. Does your definition fit their location, knowledge, and desires? Completing this step is difficult because it requires stepping outside of one's own perspective and attempting to understand the problem in terms of different perspectives.
Step 4	To the extent you encounter disagreement or conclude that the achievement of it is insufficient, begin asking yourself: How might I adapt my problem definition to take account of other perspectives out there? Is there some way of accommodating myself to other perspectives rather than just demanding that the others simply recognize the inherent value and rationality of mine? Is there room for compromise among contrasting perspectives?

For the majority of the world, the engineer is educated in the same subjects, but the pedagogy and focus may differ. For example, in France the engineer is respected as an upper level manager regardless of industry, think of an MBA graduate specialized for each engineering field. In the United States the engineer is a technically based problem solver, with less management, but more engineering design experience. Engineering design, in American terms, is a specific problem solving process. Whether it is bridge, artificial heart, grassed water way, silicon wafer, big block V-8, or improved shipping route functioning, this process is woven through every engineering field in the United States.

We know the scale: Worldwide. We know the issues: Natural Resource Management. We know the people who deal with these problems: Engineers. But how do we ensure the qualifications of these professionals? The answer is standardizing education with accreditation. Accreditation creates a standard for engineering educational regardless of institution.

Engineering Education Accreditation

To operate as an engineer in the global professional environment, a standard education must be completed. In the majority of countries, a legal body is responsible for accreditation. But, in the United States, non-governmental organizations, professional societies and educational associations, conduct accreditation by peer-review process (Prados *et al.*, 2005).

In the United States the standard education requirements are created and governed by the Accreditation Board for Engineering and Technology (ABET). In France, the equivalent is the Commission des Titres d'Ingénieur (CTI). Both institutions have missions of proliferating engineering in their respective countries and internationally. It is this vision that drives the accredited institutions (i.e. universities) to create international co-operations and programs. Although not formally in co-operation with each other, both CTI and ABET have established agreements with foreign engineering accreditation bodies. ABET has "substantial equivalency" programs that imply with reasonable confidence that foreign programs can prepare graduates for professional practice in multiple countries (ABET, 2010). CTI documentation suggests that the school is fully integrated into its local, national, European and international environment (CTI, 2009).

A majority of the regulatory publications produced by both ABET and CTI contain flexible verbal guidelines that accompany quantitative requirements. For example, ABET requires that program curriculum be maintained by the faculty to devote adequate attention and time to each component of education (ABET, 2010). CTI states that significant amount of academic training in disciplines not directly related to the specialty are required (CTI, 2009).

Differences in engineering education begin with accreditation. ABET requires a set amount of hours of the degree specifically dedicated to math, science and engineering. Based on the ABET definition of academic year, in terms of credit hours (CH), 80 CH of the math, science, engineering courses are required. CTI requires a CH level of 300 European Credit Transfer System (ECTS) to be met, topic selection is not defined. Another example; internships are not even mentioned in ABET criteria, while CTI requires they be included and determines the length.

ABET and CTI set the guidelines by which engineers are educated. Educational license, the space outside the set requirements, is given to each individual university. This space is where universities diversify and begin to compete for students. The goal is to differentiate enough from other universities to draw students for post secondary education. To attract students to an engineering program, who will live in a globalized world, international opportunities are vital.

International Education and Diverse Problem Solvers

Technology and mobility have created a world where people and problems cross national borders daily. "Put rather simply, the term 'internationalization' refers to the activities of higher education institutions, often supported or framed by multilateral agreements or programs, to expand their reach over national borders" (Van Damme, 2001). Educators must recognize this and be the first to introduce engineering students to this environment. Van Damme (2001) agrees that most progressive universities have some type of international activity with even a department to manage such affairs.

A common objective of international education is international student mobility (Downey *et al.*, 2008). International student mobility allows for easier navigation across cultural, language, and distance barriers. The student will be able to compete in a global market rather than just a regional or national market.

A wider breadth of knowledge and experience will increase engineering student value. Cultural intelligence, the ability to smoothly transition into a new cultural context, is a valuable trait that is developed with international experiences and relationships (Earley *et al.,* 2007; Thomas and Inkson, 2004). Thomas and Inskson (2004) suggested that international experience is "the most important means of increasing cultural intelligence". Even with low participation rates, international experiences are still promoted and valued because they can facilitate knowledge sharing and develop attributes that employing companies desire (Crossman and Clarke, 2010).

How can this benefit each participating university? Why should universities pursue these international co- operations? Between the years of 2008 and 2009 the state of Kansas netted $159,388,000 in revenue from international students and their families (NAFSA, 2009). Due to "tourist" status and non-resident tuition rates international students increase revenue for state universities as opposed to resident status enrolled students.

Another benefit of international cooperation is the development of different problem solving techniques. Traditionally, problem solving for engineers is a step by step process. In the United States, engineering problem solving is based on the design process. Khandani (2005) lists the following five steps for solving design problems.

1. Define the problem
2. Gather pertinent information
3. Generate multiple solutions
4. Analyze and select a solution
5. Test and implement the solution

Even from this simple list, conclusions can be drawn about the linear thought process of engineers. An engineer best suited for today's world must be able to step outside the box created during education.

Linear thinking can limit the view of the problem, creating fewer solutions. Creating a thought process that is systemic, disseminates the pieces of the whole and allows them to be examined. In rather colloquial terms, not just the entire picture, but the frame, wall, room, type of nail used for hanging and the temperature outside the room etc. should be considered. Engineering problem solving using a systemic approach can include issues on a grand scale and produce a solution that has less chance of failure (Wigal, 2009). It is this type of thinking that will propel individuals from the norm and into an upper level of problem solver.

The problem solving process in engineering is the challenge of accomplishing the intended goal without the spawn of unplanned consequences. The idea of holistic thinking in engineering is rarely encouraged. Connecting topics from one course to another and unifying the composition of knowledge will allow outward views. Every discipline will approach a problem from the “standard approach” of its teachings. A mathematician will approach a problem differently than would an economist or a natural resource engineer. Without the exposure to nonlinear problem solving techniques students will remain undervalued (Grasso and Martinelli, 2007).

Swinging back to the idea of differentiation, if an educational institution could instill global mobility in its graduates AND also enhance the problem solving base, such as systemic thought processes enhanced by international experience, a truly valuable engineer can be created. This enhanced problem solving base can easily be obtained by the exposure to different schools of thought. Even if the engineer continues to approach problems from a one-dimensional view point, educational background obtained in specific country, the knowledge of different problem solving methods can augment when the status quo fails.

International Education Cooperation

In 2005, the Continental automotive group along with eight universities from around the world, including Massachusetts Institute of Technology and Rheinisch-Westfälische Technische Hochschule Aachen, performed a study specifically focused on global engineering. The study generated four recommendations (Continental AG, 2005):

- Global competence needs to become a key qualification of engineering graduates.
- Transnational mobility for engineering students, researchers, and professionals needs to become a priority.
- Global engineering excellence depends critically on a mutual commitment to partnerships, especially those that link engineering education to professional practice.
- Research on engineering in a global context is urgently needed.

The recommendations were based on the following questions: Is tomorrow's engineering workforce prepared to meet these challenges? Are new skills required to be not only a good engineer but also a global engineer? Does engineering education need to change for the global age? Are foreign language skills and cross-cultural competence important for future engineers? Will globalization lead to a status gap between engineers who comfortably maneuver in an international environment and engineers who do not? (Continental AG, 2005). Following the motivating questions and resulting recommendations, a checklist for the global engineer was also compiled (Table 1.2).

Table 1.2 Attributes that describe the global engineer complied by the Continental global engineering study (Continental AG, 2005).

- **technically adept**
- **broadly knowledgeable**
- **innovative and entrepreneurial**
- **commercially savvy**
- **multilingual**
- **culturally aware**
- **knowledgeable about world markets**
- **professionally flexible and mobile**

The role of industry in engineering education is very influential, as seen from the Continental study. Funding drives action; companies large enough to establish economic partnerships with universities can effectively tailor programs that will produce engineering graduates specifically suited to a particular company's needs.

Another component of international cooperation is governance. Governance is an important part of establishing the base for international co-operation. Joint agreements and contracts cement common ideas and practices to a predetermined standard. If a set of rules exists then all participants can refer to the rules in times of conflict.

Bologna

In 1999, an agreement known as the Bologna Process, created by the European Higher Education Area, was developed to increase the mobility and employability of graduates in Europe (Bologna Declaration, 1999). The Bologna Process, described in the Bologna Declaration, aimed to increase the continent of Europe's development. The goals affirmed by the 29 original Ministers (Berlin Summit of Higher Education, 2003) were:

- adopt a system with two main cycles (undergraduate/graduate)
- establish a system of credits (ECTS)
- promote mobility by overcoming obstacles
- promote European co-operation in quality assurance
- promote European dimensions in higher education

Every two years, roughly, the countries involved with the process meet to continue improvement and address the ever changing challenges and needs of this co-operation (Bologna Declaration, 1999).

Erasmus Mundus

Furthering the international educational cooperation in Europe was the establishment of the ERASMUS MUNDUS program in 2001. ERASMUS MUNDUS is the governing body for European international cooperation at the Master's and Doctoral level. It provides organization and regulation for joint Master's and Doctoral programs in engineering and other fields among European universities and other countries. Not to be confused with the European student exchange program ERASMUS. From the ERASMUS MUNDUS commission (2010) three actions were established (Table 1.3).

Table 1.3 Actions of the ERASMUS MUNDUS (2010) commission.

• **Action 1**: Implementation of Joint Programs at Master's (Action 1A) and Doctorate (Action 1B) levels and award of individual scholarships/fellowships to participate in these programs; • **Action 2**: Erasmus Mundus Partnerships with Third Country higher education institutions; • **Action 3**: Promotion of European Higher Education.

Erasmus Mundus Master's Courses (EMMCs) are offered for most educational topics. Within this joint Master's framework and the cooperating third country institutions, universities such in the United States are able to contribute, provided that economic funding, grant monies, be applied for by only Eurozone participating universities. The joint Master's level programs are of specific interest to this study, as they allow engineers to be educated at different universities, but receive the same diploma, at the same level (Master's), upon completion.

Third Country

European Commission's ERASMUS MUNDUS Guide 2009-2013 allows for the inclusion of third countries, defined as: "a country which is not a Member State of the European Union and which does not participate in the program according to Article 9 of the Program Decision (ref). Article 9, as summarized by the Official Journal of the European Union – establishing the Erasmus Mundus 2009-2013 (2008), states that "participation is open to

European Free Trade Association members, who comply with European Economic Area, candidate countries, countries of the Western Balkans, and the Swiss Confederation". This type of cooperation, that of the Member State and the Third Country, is very congruent to the development of international degree programs between universities in the United States and Europe. A degree program such as the AGRIS MUNDUS could easily exist between the United States and Europe given proper desire and motivation.

AGRIS MUNDUS: Sustainable Development in Agriculture Master's Course

AGRIS MUNDUS is a two-year, 120ECTS, program focusing on sustainable development in agriculture. The program has six specialty fields available: agricultural systems research & development, horticultural crops management, livestock production & systems, land & water management, food, nutrition &health, and rural local development. The first year of the program is completed at one institution with the second year at a second institution within the European Union (Agris Mundus, 2010). The program is highly selective and requires a Bachelor of Sciences (180 ECTS) for eligibility. The six partner universities associated with AGRIS MUNDUS are: University College of Cork, University of Copenhagen, Wageningen University, Universita degli Studi di Catania, Universidad Politecnica de Madrid, Montpellier SupAgro. (Agris Mundus, 2010)

Undergraduate International Engineering Programs

Undergraduate international engineering programs aim for *global competence*, defined by National Association of State Universities and Land-Grant Colleges (NASULGC) as the ability "not only to contribute to knowledge, but also to comprehend, analyze and evaluate its meaning in the context of an increasingly globalized world" (NASULGC, 2004). At the undergraduate level, where the majority of degree holders in the United States end formal education, benefit and influence of international experience is very important. Some of the programs include summer study abroad programs, double degrees, and internships. Programs at the undergraduate level usually have a larger number of students who participate.

The University of Rhode Island offers international engineering programs that provide a Bachelor's of science and art. This is a double degree program that incorporates one language course in each semester as they pursue their BSc in engineering and BA degree in one of four languages, German, French, Spanish, or Chinese, at URI. During the fourth year of study the students spend eleven to twelve months abroad, in a country that speaks the language they have chosen for the BA degree. Following a semester of traditional university study, an internship in the chosen country is taken. Reports over the internship are written in the foreign language. Students then return for the final year of study at URI. (IEP, 2010)

The University of Pittsburgh awards a certificate in International Engineering Studies (IES) for completing a minimum set of requirements that include a study abroad experience and associated cultural enrichment and language studies. The certificate will indicate the country and language in which the IES program was completed (IES, 2010).

International Classroom

Utilizing technologies such as video conferencing equipment is a growing trend in international meetings, classrooms and personal communication. Video conferencing is not a standalone technology, but the combination of many that provides live interaction. This may range from very large auditorium audiences or to one-on-one desktop PC conferences (Coventry, 1995).

Video conferencing is particularly aimed at supporting dialogue as a form of interaction (Trajkovik and Caporali, 2009). The study by Trajkovik and Caporali (2009) also showed that video conferencing can lower costs for both the institution and the student at the university level. The gap that is created when students cannot afford actual physical study abroad programs can be bridged by the use of video conferencing. It is far from the immersive experience of living in another country, but it does provide a connecting experience between points spread over the globe (Figure 1.4).

Table 1.4 Advantages and disadvantages of video conferencing summary from (Grant and Cheon, 2007).

Advantages and Disadvantages of Video Conferencing	
Advantages	**Reference**
It can be used as collaboration tools for team works or team teaching	Alexander *et al.*, 1999 Coventry, 1994 Townsend *et al.*, 2001
It can provide active supports such as prompt feedback	Alexander *et al.*, 1999; Chan *et al.*, 2000; Pittman, 2003
It can make it possible for distant people to access expertise or specialists	Alexander *et al.*, 1999; Pittman, 2003
It can save travel time and cost	Chan *et al.*, 2000; Coventry, 1994; Wilkinson & Hemby, 2000
It can increase interactive communication with engaging discussion and enhancing social presence	Chan *et al.*, 2000; Coventry, 1994; Pittman, 2003; Smyth, 2005
Disadvantages	
In contrast, challenges to using synchronous conferencing include: Technical difficulties, such as time delay	Freeman, 1998; Pittman, 2003
Low quality of audio and video	Wilkinson and Hemby, 2000
Lack of training for utilizing new tools	MacIntosh, 2001; Pittman, 2003
Distractions and lack of real interaction	Freeman, 1998; Knipe and Lee, 2002

Educational Style and Structure

From a broad prospective, education in Europe and the United States is relatively similar. In increasing order by age, education in France and the United States is as follows: elementary education or l'école, middle school or collège, high school or lycée, and finally university. While these may look similar, deeper research yields many contrasts. National practices, cultural differences, and language are what begin to shape a specific style of education. To begin international, education cooperation, there are barriers that need to be addressed. This could include issues with location, language, culture, and pedagogical methods.

Language

Even more fundamental to problem solving is the act of communicating. Everyone who reads this understands the importance of communication. Communication comes in many forms. When communicating with others, all of the senses are used. When broken down into separate parts, language, speaking, listening, and seeing to read are the most vital for educational communication. As in mathematics, a common denominator must be found before people from different regions of the world can communicate. Through time, the language of science in the western world has migrated through the European languages and most recently to English. Salager-Meyer (1997) concluded that scientific production pre 20^{th} century was focused in France, the United Kingdom, and Germany, thus the resulting languages of science were those of the dominating countries. After the two great wars of the 20^{th} century, the countries of Europe suffered major disruption. The United States became the forerunner of the scientific community and the English language transitioned to the new major language of science.

Across all cultures and countries respect for how different people operate is required. No one can say that one language is better than the other, or more correct for use, but given the trends in science and academia the default language has become English.

Location

Due to the size of the Earth and the subsequent length of day, challenges arise when multi-continent cooperation is established. The earth is divided into 24 time zones, one for each hour of the day. This is evenly divisible by the typical 8 hour work day that has been developed in the modern professional world. If we break the world into three working time zones, cooperation is easiest the closer the cooperation countries are together. More of the working day overlaps. At the fringe of these zones we find that challenges occur due to the work schedule. For example, the time distance between Manhattan, Kansas in the United States of America, and Toulouse, France is seven hours. This allows for roughly 2-3 hours of overlap during the work day, due to the French day extending until 6 p.m. due to the length of the lunch period, which normally runs about one and a half to two hours. The overlap period occurs from 8 a.m.-11 a.m. in Manhattan and 3 p.m. - 6 p.m. in Toulouse. Being on the exact opposite side of the earth is an example of a distance that will not work. For example, at 8 a.m. in Manhattan, KS it is 8 p.m. in Thailand, Indonesia and Vietnam. This time zone difference does not allow for working day overlap, which prohibits real-time face to face interaction.

Another consideration is the circadian rhythms of human beings. The thoughts and functions of humans in the morning versus the late afternoon are quite different, regardless of geographic placement. Zaheer (1999) states that roughly 100 different circadian rhythms affect the daily operation of the human body. These are regulated by the brain and outside influences called zeitgebers, time givers, which operate on a 24 hour cycle. Daylight, meal time and social interaction initiate processes that inform the brain of patterns during the day (Zaheer, 1999).

Schedule

There are core differences and commonalities between an engineering education in France and the United States. However, the weekly format of classes is much different. EI Purpan in Toulouse, France and Kansas State University (KSU) in Manhattan, KS USA will be used to provide an example of differences that can occur. At KSU each weekly schedule is set based on the courses chosen during enrollment the previous semester. This schedule is exactly the same for 16 weeks, the length of a semester. At Purpan the schedule is much more fluid, monthly schedules are set for each promotion, a group of students recognized by the common year they began, and vary little until specialization in the fourth and fifth year. Each month a new schedule is produced sometimes continuing courses from the previous schedule or starting new courses. The daily structure of a student at Purpan is that of a typical professional eight hour work day. Broken into morning and afternoon blocks, this schedule requires much more in-class time for the students. However, this in-class time is a mix between lecture, identical to that at KSU, and student work time for homework and projects. The routine of the day is very important to the learning and working environment of students.

Agricultural Resources and Environmental Management (AREM) Partnership

In 2008 a joint program, Agricultural Resources and Environmental Management (AREM), was developed by faculty at Kansas State University, and EI PURPAN,. The program was created to train students on agricultural sustainable development with skills and tools from across the disciplines of economy, sociology, and agro-ecology.. The AREM program includes the following critical elements (Paradis *et al.*, 2010):

1) Exchange of knowledge and experience for both faculty and students, resulting in improved training of our students and a broader global perspective for our faculty;

2) Development and implementation of a new interdisciplinary AREM Certificate Program at K-State, and development of a new interdisciplinary environmental management specialty for EI Purpan;

3) Agro-Environmental and landscape problem analysis and solving, including prospective issues and participatory methods, through joint classroom discussion and project team work between US and French students; and

4) Joint teaching of selected courses through distance learning methods.

Objectives

Can we take students with very similar goals, educate them at two different institutions, using different educational structures and styles of pedagogy, and yet be able to look at graduates of this program as equals? The AREM partnership between EI Purpan and KSU provides an innovatively unique approach to international engineering education specializing in sustainable natural resources and agricultural development. The program encourages the development of systemic thought among accompanying issues in social, environmental, agricultural, and economic realms, and exposes students to global consciousness, mobility, and new engineering cultures. The current state of global behavior calls for educated professionals who can operate in any environment. International educational cooperation is becoming the norm for institutions to transcend international boundaries and extend these offerings to students.

The main objectives of this research were to compare the structural education components of engineering institutes EI Purpan and KSU in order to evaluate the efficacy and importance of the AREM program in global terms, to create a mutual understanding of program obstacles, to highlight the benefits and strengths of each institution, and to provide a common plane for forward progress.

CHAPTER 2 - EI Purpan and KSU Engineering Education Structure Data

French /American Education Terminology

It is important to understand the terminology used in the educational French system and the equivalent level in the United States.

- Lycée = High School
- Ecole d'Ingénieurs = Engineering University, can be private or public
- Université = University
- Grandes Écoles = Prestigious institutes of higher education
- ECTS (European Credit Transfer System) not equal to but similar to CH

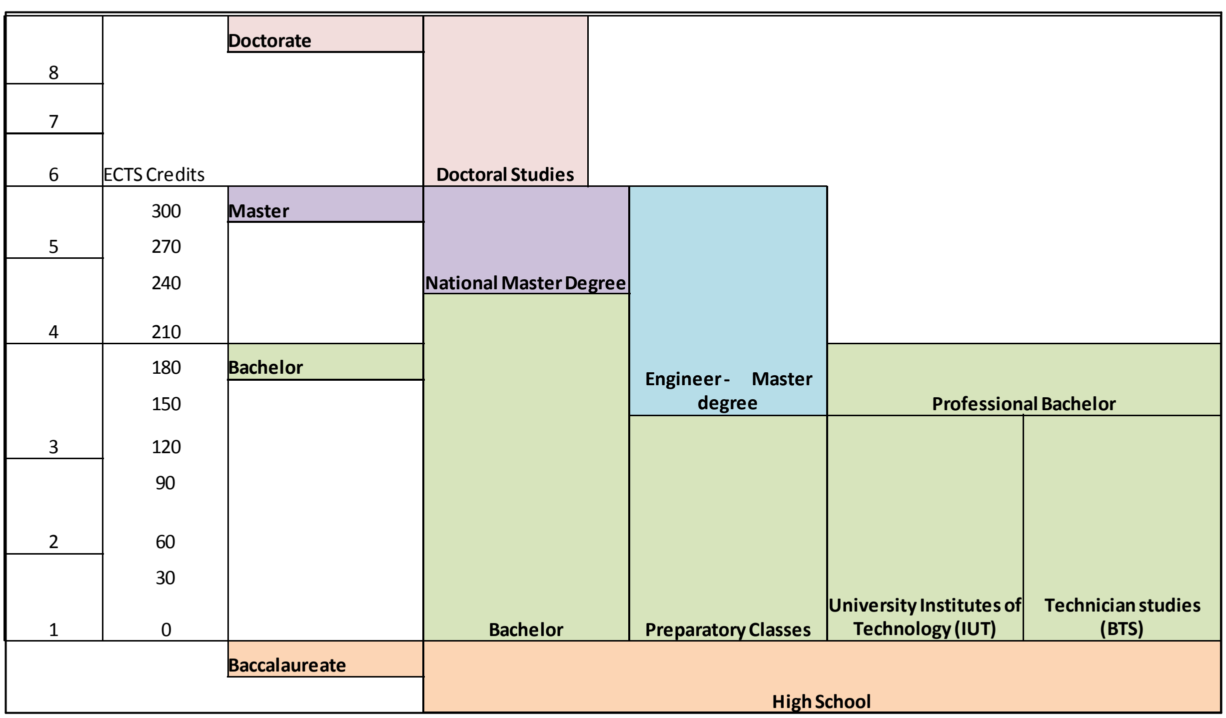
The grandes écoles are highly selective schools, public or private, that prepare students for specialized professional fields, eg the fields of engineering, architecture, commerce and management, or translation and journalism. Among higher education institutions, the grandes écoles are highly selective schools that have much lower admission rates than universities. The grandes écoles educate engineers and top managers, but also specialists in art, literature and humanities. Education in grandes écoles is typically completed in five years, including two years of preparation, either within the institution, or in secondary schools. These schools often provide a degree of BA + 5 awarding students with Master's degree upon completion (French Ministry of Education, 2010).

Admission

Ecole d'Ingénieurs Purpan (Grandes Écoles)

High school level graduates, lycee, who have completed the scientific, and sometimes the economic baccalaureate, are eligible to apply to engineering schools in France. Figure 2.1 displays French higher educational system. Following baccalaureate completion, there are different paths to prepare for the engineering degree: two years of grandes écoles preparatory classes and entrance exams, two years of engineering school preparatory courses, two years of technological university institute (IUT), or scientific university training with entrance exam. Each school has different entrance procedures, but most are open to all types of qualified applicants (CTI, 2009).

Figure 2.1 Specific routes through higher education in French education system (French Ministry of Education, 2010).



EI Purpan is a grandes écoles and a private engineering school. The application process for EI Purpan includes a standardized test via the Fédération des Ecoles Supérieures d'Ingénieurs et Cadres (FESIC), record of lycee performance, and personal interview. The FESIC standardized test covers the topics of math, chemistry, physics, earth and life sciences. Students wanting to attend EI Purpan must first apply through FESIC. After the FESIC application, prospective students apply to the Fédération des Ecoles d'Ingénieur en Agriculture (FESIA), the association of four agricultural Ecole d'Ingénieurs including EI Purpan; FESIA operates under FESIC. A large number of lycee graduates apply, but selection is very limited. Only 180-200 students are admitted to EI Purpan each year. Average annual tuition fees for FESIA schools is €3800 ~ $4848 (exchange rate 1.27$/€; FESIA, 2010). Tuition fees at Purpan in 2009-2010 were € 4,320 ~ $5512 annually, (exchange rate 1.27$/€; EI Purpan, 2010). Financial assistance is available based family income in the form of state scholarships, but living expenses are the responsibility of the student.

Kansas State University

Figure 2.2 displays the specific routes through higher education in the United States. High school graduates from any background can apply to Kansas State University as long as they meet precollege curriculum requirements (Figure 2.3). Either of two standardized tests, the SAT (Scholastic Aptitude Test) and the ACT (American College Testing), and high school performance records are considered when applicants apply. The SAT consists of reading, math and writing components; the ACT consists of english, math, reading and science. Family financial status consideration can result in government financial aid. Other scholarships are available based on academic merit, ethnicity, and various other criteria. A student must be admitted by Kansas State University and the College of Engineering at KSU. For 2009-2010 undergraduate tuition at Kansas State University was $5773 ~ €4524 annually (exchange rate 1.27$/€; Kansas State University, 2010) for Kansas residents (in-state students). Out-of-state undergraduate tuition, assessed to any student who is not a state of Kansas resident, was $15,776 ~ €12,422 annually (exchange rate 1.27$/€; Kansas State University, 2010). Graduate tuition is most accurately described by CH cost due to the variance in schedule at the graduate level. For in-state students this cost was $280 ~ €220 per CH, while out-of-state cost was $644 ~ €507(exchange rate 1.27$/€; Kansas State University, 2010).

Figure 2.2 Specific routes through higher education in the United States.

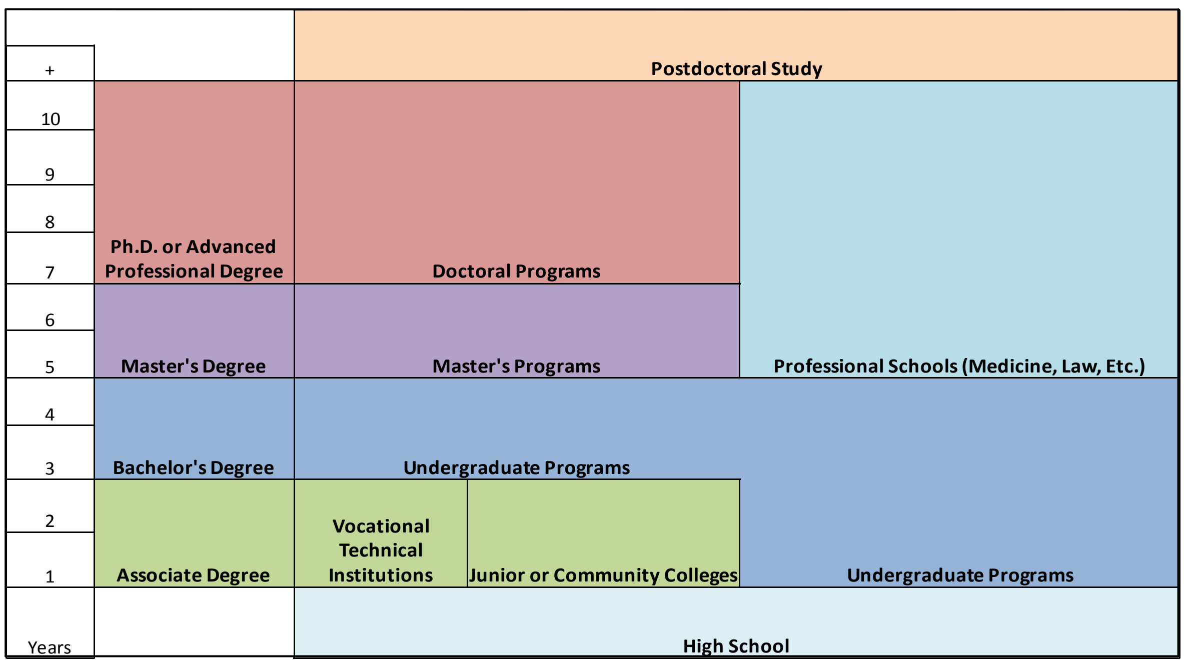


Figure 2.3 Precollege curriculum requirements for admission to Kansas State University. (KSU, 2010)

SUBJECT	UNITS REQUIRED	COURSES TO TAKE
English	4	One unit of English for each year of high school
Natural sciences	3	**Choose three units from:** Advanced Biology, Biology, Earth/space science, Chemistry, Physics (At least one unit must be chemistry or physics)
Math	3	Three units at or above the level of Algebra I If you graduated in 2006 and after, courses completed in middle school or junior high school don't count toward the math requirements.
Social sciences	3	**One unit of U.S. history** **One-half unit of U.S. government** **One unit selected from:** Psychology, Economics, Civics, History, Current social issues, Sociology, Anthropology, Race and ethnic group relations **One-half unit selected from:** World history, World geography, International relations
One unit = 1 year or 2 semesters		

Accreditation

EI PURPAN

Created in 1934, the Commission des Titres d'Ingénieur (CTI), the Engineering Degree Commission, is the accreditation body for engineering schools in France. It creates a standardized system of metrics for educational institutions. It can be seen as the equivalent to the United States' Accreditation Board of Engineering and Technology (ABET). Not only do French engineering schools report to their domestic accreditation board, CTI is a member of the European Network for Accreditation of Engineering Education (ENAEE) and must follow its regulations.

CTI defines specific work categories for engineers, which follow a timeline of experience and closely resemble that of an engineer's career progression in the United States (Table 2.1). Each of these work categories can be found within the most prevalent French engineering fields (Table 2.2). Typically, new engineering graduates start in disciplines 1-4 which include basic tasks of engineering in research, consulting, production and testing. This preliminary experience prepares engineers to move to disciplines 5 and 6, before moving to category 7, requiring a great amount of experience, in upper levels of industry and later in the career. Tasks in category 8 will be interspersed throughout an engineer's career (CTI, 2009).

Table 2.1 CTI Engineering disciplines (CTI, 2009).

1) Basic and applied research
2) Engineering studies, consulting and expertise,
3) Production, operation, maintenance, testing, quality, safety,
4) Information systems,
5) Project management
6) Customer relations (marketing, sales, customer support),
7) Management, human resources,
8) Training.

Table 2.2 CTI Main Engineering Fields (CTI, 2009).

1) Agriculture, Agronomy, Food industry.
2) Chemistry, Chemical.
3) Biological, Medical.
4) Earth sciences.
5) Materials.
6) Civil, Construction, Urbanism, Environment.
7) Mechanics, Energy.
8) Electricity, Electro-technical, Automatics.
9) Electronics, Telecoms and networks.
10) Information Technologies, Information systems, Mathematics, Modeling.
11) Industrial, Production, Logistics.

Program outcomes established by CTI provide the foundation for all engineering degrees in France (Table 2.3). Engineering training must included 1800-2000 hours of lecture over three years, at least 28 weeks of internship, preferably within industry, and certifiable level of English language competency certified with standardized tests. Throughout the education, a significant portion of training is delivered by corporate instructors and training in fields not directly related to the specialty. Additionally, a strong international component is required, primarily through international internships. Also, aspects of innovation, research experience, and inclusion academic projects must be addressed (CTI, 2009). If portions of the degree are completed outside the school, abroad or within France, agreements must be established based on individual institutions requirements. The internship portion is also required to be regulated by these agreements or following current employment regulations (CTI, 2009). Hands-on education through internship is a pillar of French engineering education.

Table 2.3 Program outcomes required of engineering graduates (CTI, 2009).

Program Outcomes	Detailed Description
1. **Knowledge and understanding of a broad range of basic sciences and the related capacity to summarize and perform analysis**	
2. **Aptitude to use the scientific and technical resources related to a specialty**	
3. **Understanding of engineering methods and tools**	identification and resolution of problems, the collection and interpretation of data, the use of computing tools, the analysis and design of systems
4. **Capacity to join an organization, to lead it and drive it forward**	self-awareness, team spirit, commitment and leadership, project management, project coordination, communication with specialists and non-specialists alike
5. **Aptitude to take on board professional issues**	corporate spirit, competitiveness and productivity, innovation, intellectual and industrial property, respect for quality procedures, security, health and safety in the workplace
6. **Aptitude to work in an international context**	command of one or more foreign languages, cultural open-mindedness, international experience, business intelligence
7. **Aptitude to put sustainable development principles into practice**	environment, economy, labor and corporate governance
8. **Aptitude to consider and foster societal values**	endorsing social values, responsibility, ethics, health and safety
9. **Capacity to follow through on their professional choices and fit into a professional context**	

KSU

ABET accreditation requires engineering programs in the United States to meet eleven program outcomes for accreditation (Table 2.4). Outcomes (a) through (k) are basic and can be complemented with ancillary requirements intrinsic to the specific engineering program. Over the course of the degree, checkpoints and documentation that program outcomes are being met must be completed by the accredited institution (ABET, 2010).

Table 2.4 ABET Engineering Program Outcomes 2010-2011 (ABET, 2010)

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Program outcomes define the qualitative aspects of the engineering education requirements, while curriculum requirements broach the quantitative side. A minimum of one year, defined as 30 CH, of college level math and sciences, including lab experimentation is required. A minimum of one and one-half years, 45 CH, of engineering sciences and design courses are required. "These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other" (ABET, 2010). ABET (2010) requires that biological and similarly named engineering programs maintain curriculum demonstrating graduate proficiency in mathematics, chemistry and biology. Math knowledge must included topics through differential equations, and a practical background of advanced biological sciences must be established. Students must be able to apply engineering concepts to biological systems. To complete the requirements set by ABET and the Kansas State University College of Engineering, students must complete 130 CH, which include the ABET time requirements for math, science and engineering topics, to be awarded the Bachelor's of engineering. The additional CH above the 75 credits of science, technology, engineering and math (STEM) courses include general educational and engineering electives.

Engineering Bachelor's Degree Requirements

EI Purpan

The equivalent of an engineering Bachelor's degree at EI Purpan requires 180 ECTS. An engineering degree, in France, can only be obtained by completing a Master's degree. But, the equivalent level is used for comparison in this case. Opposed to the Bachelor's degree in the United States, three years are required for completion. This includes roughly 140 ECTS of class work and 40 ECTS of internship. Three internships are required, one at the end of each school year. Internships typically last for 3 months, June to August.

Beginning in the first year, students are exposed to the foundations of STEM courses. Math, chemistry, and much biology are accompanied by foreign language, basic communication and general education. Courses in agriculture and a two week farm work period are also integrated in the first year. Year two enhances scientific learning with more specific classes in agricultural and biology. The second year at Purpan also requires the first internship report, from the internship following the first year, valued at 4 ECTS. By the end of year two, most math and science courses are completed. The third year completes the bachelor's of engineering with preparations for the Test of English for International Communication (TOEIC) exam, choices of specialized classes in agriculture (e.g viticulture), courses of statistics and data analysis, and agricultural systems.

Professionalization is a goal of EI Purpan for the bachelor's degree, as is seen from the amount of time spent on the required internships (Table 2.5) and the emphasis on communication. By the end of year three, students have submitted three major reports based on their internship experience: Internship report, Agricultural Case Study, and Bibliographical Report. These reports hold ECTS credit value and are exogenous to other courses. Students are also proficient in English, gauged by TOEIC scores, and have experience with another foreign language, usually Spanish or German.

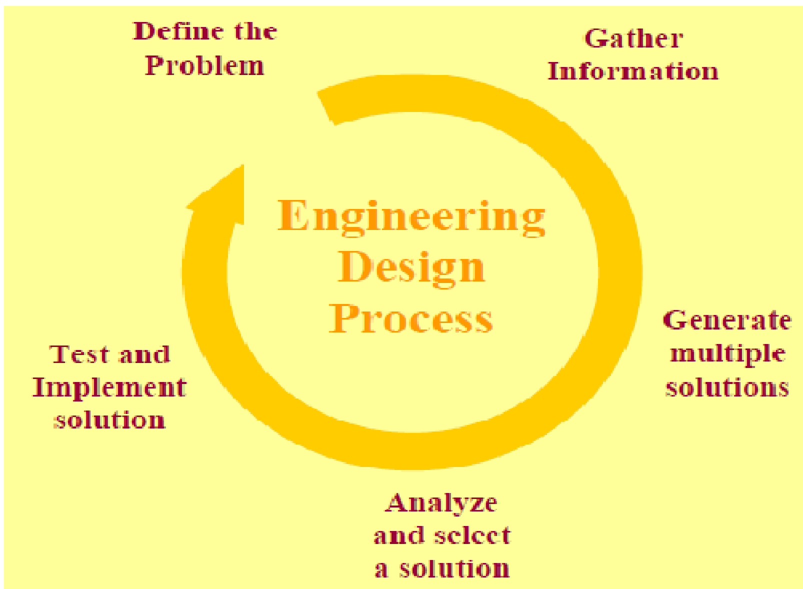
Table 2.5 Bachelor degree equivalent internship requirements of EI Purpan. (EI Purpan, 2010)

1st year (15 weeks)	Internship on a farm, aims to develop observational skills and further discover farm life and social/professional environments, as well as experience living in a different family.
2nd year abroad (11 weeks)	Internship in an agricultural firm offers an opportunity to practice language skills, gain international experience, develop analytical capacities and prepare for the technical-economical at a higher level of study.
3rd year (11 weeks)	Internship brings the students into contact with economical or social organizations working in the agricultural fields. The internship can be done abroad and is often the opportunity to gain work experience developing countries. The student has projects and studies they must carry out including the capacity to analyze information in the aim of creating solutions.

KSU

Kansas State University (KSU) Biological and Agricultural Engineering (BAE) offers three degree options. For the purpose of this study, comparisons will be made using the biological option curriculum because it is the most similar to EI Purpan. The full curriculum with course requirements is attached (appendix A). Engineering students begin the first year with core requirements of math and science, speech and writing, general engineering courses and discipline specific design courses. Beginning design courses expose the first year student to the *design process* that is centric in United States engineering. The second year is a continuation and building year with advanced math, chemistry, physics, professionalism, introductory Biological and Agricultural engineering courses, and humanities/social sciences. The third year begins the engineering specific courses, but still basic regardless of discipline, such as thermodynamics, fluid dynamics, statics, and mechanics of materials. The fourth year includes many elective courses, which allow students to tailor their education based on individual interests. The fourth year also includes the design courses that implement professionalism, project development, design and management. Design is a very integral part in the final year(s) of engineering education at KSU. Figure 2.4 displays the components of the design process in graphical form.

Figure 2.4 Graphical representation of USA engineering design process (IISME, 2005).



It is of interest to note that internships are not required for the KSU BAE engineering degree, but are encouraged as extracurricular activities. Internship experience is solely the student's responsibility and choice. Agricultural classes are not required for degree completion but students may incorporate these as electives depending on personal preference.

Engineering Master's Degree Requirements

EI Purpan

The Master's degree program is integrated to the engineering degree program at EI Purpan. To receive "diplôme d'ingénieur" (engineering diploma), students must meet the requirements to the level of a Master's degree. This is the characteristic of engineering education in France. Other discipline programs end at the bachelor's level and a student may or may not choose to complete a Master's degree. However, approximately 10.7% of the French population hold a Master's degree (INSEE, 2010), and if a student desires an engineering degree in France, they must complete educational requirements at the Master's degree level.

The first year of Master's degree work, year four, ramps up and reinforces professionalism and industry expectations. Agricultural business practices, sector specific law, continuation of foreign language skills, a largely weighted ECTS business case study, and internship, are the focal points of the fourth year. The internship during the fourth year builds on the undergraduate experience and some students of the AREM program choose to spend this time in developing countries.

Year five strives to meet four objectives. First, assemble the theoretical and practical knowledge from the previous four years by completing the dissertation. Second, have the ability to understand the intricacy of the business world. Third, students are prepared to enter careers with a deep personal understanding. Four, be competent in one of the specific study areas.

Specialization of the engineer within a specific field is also the target of EI Purpan. Students may also choose between specialized pathways of Banking – Finance - Insurance, Agricultural Resources and Environmental Management (AREM), European Animal

Management (EURAMA), Cheng International Master in Agribusiness, or Master's in Agribusiness (AgroEcos).

KSU

The last United States census (2000) reported that 5.9% of the population 25 years and over attained a Master's degree; a total of all Master's degree, not only engineering. People who complete a Master's degree in the U.S. can continue on toward a doctoral degree or pursue higher level jobs in industry.

An engineering Master's degree at KSU, designated as a Master's of science, is typically a two year, 30 CH program concluding with a research thesis or report. Because fewer courses are required for the Master's degree, 24 CH of course work over the two year time period, a very large portion of time is spent on research and completion of the thesis. The thesis option requires 6-8 research CHs within the program of study. A report can be substituted for a thesis, but only 2 research CHs can be counted, the difference must be obtained through class work. If a student is compensated for work time via a Graduate Assistanceship they must complete a thesis (KSU BAE, 2010). KSU graduate students completing a thesis spend on average 20 hours per week over the course of the Master's program working on research, resulting in a total of 2000 work hours (KSU BAE, 2010). The main objective of a Master's degree at KSU is to develop specialty within one of the areas of the KSU BAE department (Table 2.6).

Table 2.6 KSU BAE Graduate specialization areas (KSU BAE, 2010).

Environmental Engineering
Bio-processing Engineering
Information and Electrical Technology
Machinery Systems.
Natural Resource Engineering
Structures and Environment

After selecting an area of specialty and identifying a major advisor to supervise the Master's student education, students develop individual programs of study. The program of study includes course work in the topic area of the Master's thesis and provides the educational background needed to complete the research. Natural resource engineering students may take similar courses, but it would not be uncommon for two students in the same specialty area to take different courses to complete their requirements. An example program of study is attached in appendix B.

BAE Master's degree in engineering requires six CHs at or above 600 course level, 18 CHs at or above 700, and depending on preference six CHs of thesis research. Following the sample program of study in appendix B, analyses of time and topic area have been made. Graduate degree certificates may also be obtained, which are completed with a certain course focus during the Master's degree. There are 8 student learning outcomes for the Master's degree program (Table 2.7).

Table 2.7 BAE Master's Student Learning Outcomes (SLOs). (KSU BAE, 2010)

1. Ability to solve advanced biological and agricultural engineering problems using math, science, computation, and analysis skills.
2. Ability to critically synthesize and evaluate information.
3. Advanced knowledge in the area of specialization.
4. Ability to plan and conduct scholarly activities.
5. Effectiveness in collaboration and leadership.
6. Ability to communicate effectively both in written and oral forms.
7. Understanding of professional and ethical responsibility.
8. Recognition of the need for and ability to engage in life-long learning and professional service.

The combined bachelor - Master's degree program, which was recently adopted in BAE, gives students the opportunity to combine BS and MS degrees, using 9 credits that overlap both degree programs. The total CHs for the individual degrees is 130 and 30, respectively. In the combined program, a total of 151 CHs complete both degree requirements. This incents students to complete the Master's degree program in a condensed time period. Courses must still be selected to fulfill requirement in both programs. A comparison of the KSU courses most closely related the EI Purpan curriculum is detailed in Appendix C (Table C.4). Note that with this class selection the ABET required engineering courses have not been completed. Additional analysis of ABET requirements and the breadth of topics covered at EI Purpan is required to develop an accredited engineering Master's program at KSU that more closely matches EI Purpan.

AREM Partnership

The AREM program was developed with grants from the French-American Cultural Exchange (FACE) Program, and the Partner University Fund (PUF). For the past three years, KSU and EI Purpan have intertwined two individually standing structures. Each engineering education institution operates the program independently, but a portion of course requirements are co-taught. Classes are held simultaneously in France and Kansas, and are connected with the aid of live video conferencing equipment. The AREM Introductory course was offered jointly with EI Purpan 3 times (Spring 2008, Spring 2009, Spring 2010), and the AREM Capstone course was offered 2 times (Fall 2008, Fall 2009) (KSU Graduate Council, 2010).

EI Purpan

The focus is the concept of sustainable development in three areas of ecology, economics and sociology. Congruency defines the path of the AREM program engineering students at EI

Purpan follow, each completes the same curriculum. While specialization (e.g. AREM) begins at the start of the fourth year at EI Purpan, the formal AREM training does not start until the second semester of the fourth year.

Kansas State University

KSU's AREM program revolves around the same three focus areas of economics, agro-ecology, and sociology. Knowledge of the main components of sustainability in natural resources, impacts of the three focus areas, governance and regulation structure ,and the analysis and interpretation of tools to meet issues are the primary student learning objectives. These objectives apply to "land and water management, rural economic development, watershed assessment and planning, participatory planning and development, economic evaluation of environmental protection, and optimization of landscape/lifescape processes and interactions" (KSU Graduate Council, 2010). The AREM requires 12 CHs in predetermine course categories to be completed (Table 2.8).

Table 2.8 KSU AREM Certificate requirements. (KSU Graduate Council, 2010)

AREM Structure	Courses
Required Courses – 3 Credit Hours	
GENAG 670: Introduction to AREM (2 cr).	
GENAG 870: Capstone for AREM (1 cr)	
Elective Courses – 9 Credit Hours *	
Platform A: *Agro-Ecological Sciences and Engineering*	AGRON 615/935. Climate Change and Agriculture. AGRON 635. Soil Conservation and Management. AGRON 835. Nutrient Sources, Uptake and Cycling. ATM 661. Watershed Management. BAE 560. Natural Resources Engineering I. BAE 665 (865). Ecological Engineering Design. BAE 669 (869). Watershed Modeling.
Platform B: *Social Sciences, Economics, and Policy*	AGEC 525. Natural Resource and Environmental Economics AGEC 610. Current Agricultural and Natural Resource Policy Issues AGEC 825. Natural Resource Policy. AGEC 925. Advanced Resource and Environmental Economics. ECON 527. Environmental Economics. GEOG 730. World Agricultural Systems. GEOG 760. Human Impact on the Environment. GEOG 770. Perception of the Environment. SOCIO 533. Rural Sociology SOCIO 536. Environmental Sociology SOCIO 831. Sociology of Agriculture SOCIO 835. Environment and Society SOCIO 934. Sociology of Rural Development.

*Students must take 3 credit hours from each of platforms A and B, the remaining 3 credits can be from either platform. Only one course can be taken from the student's major department

CHAPTER 3 - Comparison and Discussion

Accreditation

When the United States' accreditation program, ABET, and the French program, CTI, were compared, direct correlation was found for many of the program outcomes. Outcomes were listed previously in Tables 2.3 and 2.4. Common ground was first found with the knowledge and understating of basic sciences and mathematics and the resulting capacity to analyze data in CTI outcomes 1 and 2 (Table 2.3) and ABET outcomes (a), (b), and (j) (Table 2.4).

The aptitude for implementing sustainable practices to meet solutions that have many constraints including environmental, economic, social and governmental was also a common program outcome, CTI 7 and 8 (Table 2.3) and ABET (c) (Table 2.4). These outcomes are relatively the same, but ABET uses verbiage to indicate the importance of design capabilities, which is a noted difference between the problem solving approaches from the beginning. Understanding engineering methods and utilization for problem solving CTI 3 (Table 2.3) and ABET (e) (Table 2.4), as well as ethical responsibilities CTI 9 (Table 2.3) and ABET (f) (Table 2.4) were also congruent outcomes.

Differences occur when comparing the team or group aspect. CTI outcome 4 (Table 2.3) states "the capacity to join an organization, to lead it and drive it forward". This is in contrast to ABET outcome (d) (Table 2.4) "an ability to function on multidisciplinary teams". Clearly, the education of engineers at EI Purpan follows this outcome, as they are prepared to immediately assume positions of leadership. Team work is very evident at KSU BAE throughout undergraduate education; graduate education was much more independent.

Almost all of the outcomes from the different accrediting bodies are similar. But, the ability to work in an international context, CTI outcome 6 (Table 2.3), was not included in ABET program outcomes. Only ABET includes the outcome of "recognition of the need for, and ability to engage in life-long learning" (ABET, 2010), a very important quality that increases the value of an engineer over time.

Even though the goals of the programs, as defined by the accreditation boards, were very similar, their product is markedly different. This can be attributed to the different styles of pedagogy, culture, and industry expectations. Examples of different pedagogy are evident in the schedule, inclusion of engineering professionals in lecture at EI Purpan, focus on the design process at Kansas State, and required internships in French engineering education.

Comparison of individual structure provides a clear understand of the strengths of each university. Utilizing the focus of common accreditation goals, programs that offer international education experience can be included in either institution's curriculum easily, and already is in some cases. Trends in higher education have developed objectives of global student mobility (Downey *et al*., 2008, Continental AG, 2005) through international experience. International experience also increases cultural intelligence (Earley *et al.,* 2007; Thomas and Inkson, 2004). Programs such as AREM must be maintained and developed to keep EI Purpan and KSU BAE at the forefront of engineering education.

Credit Hour and ECTS

Before moving forward the equivalency between ECTS and CH must be established because time units for educational credit are not equal when comparing France and the United States. ABET standards are based on the CH unit, defined by Lorimer (1962) as three time hours of work done by student per week. Sixteen weeks is the standard length of one semester in the

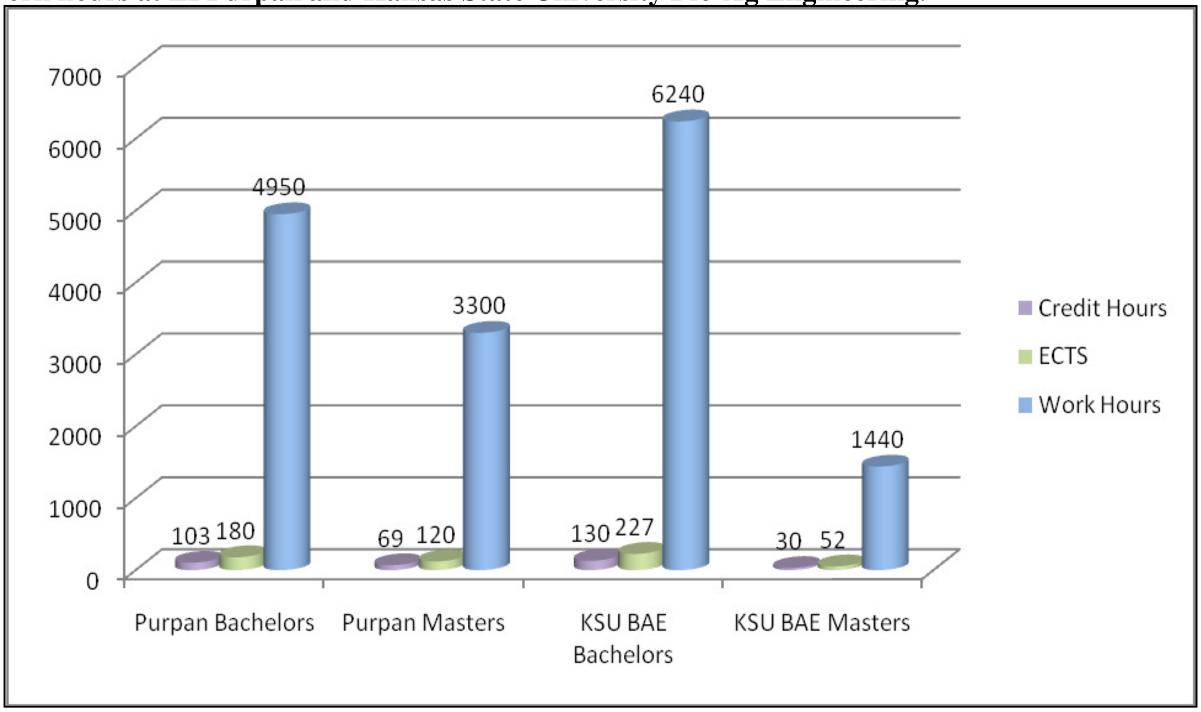
USA. Using ABET guidelines for CH per year, 32, the result of one semester is 16 CH per semester * 16 weeks semester length * 3 hours of work per week for each CH equaling 768 hrs of educational work hours per semester (1536 hrs per academic year). Figure 3.1 introduces the number of ECTS and CH required for Bachelor's' and Master's' degrees, as well as the total work hours required for each degree.

CTI uses ECTS. One ECTS is defined by the European Commission to be 25-30 work hours. EI Purpan (2010) states that 60 ECTS comprise one academic year, thus 60 ECTS *27.5 hrs (average work time hours) results in 1650 educational work hours per academic year. With 114 more work hours at EI Purpan, this difference is mainly attributed to the continued study during the summer months, be it internship or lecture.

One ECTS credit equals an average of 27.5 time hours and one US CH equals 48 time hours. Therefore, one CH is equal to 1.75 ECTS credits or one ECTS credit is equal to 0.57 CH. This was a very important conversion factor when comparing curriculum in the overall engineering degree. Direct comparison between specific topics was established with actual work hours required for completion.

During the analysis of the AREM program, data was found to indicate that 1 CH was equal to 3 ECTS (Paradis *et al.*, 2010). Based on comparison of work hours required to complete one credit in the respective systems, it was found that the 3 ECTS to 1 CH ratio overvalues the CH. Forty-eight work hours for 1 CH would indicate 1 ECTS only required 16 work hours. This was much lower than the definition by the European Commission (2010) of 27.5 work hours. The ratio of 1.75 ECTS to 1 CH was more accurate to the definitions of the European Commission (2010) and Lorimer (1962). This new ratio may enable students from either university to increase the time value of their education abroad, and should be applied to already existing cooperations between KSU and EI Purpan.

Figure 3.1 The amount of credits required for Bachelor's and Master's degrees and corresponding work hours at EI Purpan and Kansas State University Bio-Ag Engineering.



***Thesis research at the KSU Master's level is disproportionately weighted because only 6 CH of thesis can be applied toward the degree, while an additional 2000 work hours is typically required to complete the research project.**

Bachelor's Degree Comparison

The KSU BAE degree option used for this comparison was the Biological option. This option allows the widest breadth of topics, more chemistry and biology, utilized in elective course selection among BAE degree paths. The attempt was to find the most congruent educational path at KSU BAE to that of EI Purpan. EI Purpan provides a singular pathway for all students through the Bachelor's degree. Specialized pathways at EI Purpan are available in the fourth year, equivalent to the first year of Master's' study.

Bachelor degrees at EI Purpan and KSU have strikingly different weighting of educational topics. Roughly 60% of the BS engineering degree at KSU is composed of math, physics, and engineering courses that emphasis technical knowledge (Figure 3.2). The engineering topic area is defined as those courses based in math and science that provided exposure to the American design process for general engineering and specific to Biological and Agricultural engineering. This is compared to EI Purpan, which only required ~14% of the total education to be in math and physics. Conversely, EI Purpan includes a business and management portion to the engineer's repertoire that is about 5% of the program.

Communication is relatively similar in percent of total work at both institutions, 384 work hours KSU BAE and 440 work hours EI Purpan, but the type of communication is vastly different. Fluency in English and exposure to another foreign language are mandatory at EI Purpan. This is a definite strength with no comparable requirement at KSU. Written communication is enforced with many reports on internship experience and case studies at EI Purpan. Due to the magnitude of reports in terms of education percent and ECTS value, ~6.5% and 11.8, report writing warranted a separate category at EI Purpan. KSU BAE incorporated written communication with two major courses, one of general writing in the first year and one of engineering report writing in the third or fourth year. These courses are included in the communication portion of the KSU BAE engineering Bachelor's assessment. In addition, many engineering courses at KSU BAE require written reports as end of semester projects.

After compilation and breakdown of the curriculum at EI Purpan by topic, it is apparent that the BS degree offered by EI Purpan is something of hybrid when viewed from an American perspective. To develop a better understanding of how the educational topics are weighted, the agricultural, biology and business, including courses in business, management, and accounting, components of EI Purpan BS degree were compared to the agronomy, biology and business degree minors at KSU. While not exactly equivalent in all three areas, a common trend is apparent, time values are relatively similar, but scope of topics covered at EI Purpan is always greater in each area.

Chemistry and biology work hours at KSU BAE equal 768 and 672 respectively, while at EI Purpan the ratio heavily favors biology at 165 and 784, respectively (Table 3.1). Attached (Appendix C) are full comparisons of the Biology minor at KSU and the biology courses required for EI Purpan engineering Bachelor's, as well as the time required for completion (Table C.1). Courses such as animal and plant physiology, genetics, and microbiology are included in both curricula. A biology minor requires 21 CH at KSU, and the entire biology portion of EI Purpan is 16.33. These comparisons lead to the realization that engineers at EI Purpan and those at KSU BAE have quite a different educational foundation.

One of the most marked differences between the programs came from the agricultural portion of the engineering education. No agricultural courses are required for an engineering degree in KSU BAE. However, if a student chooses to incorporate agricultural courses within their undergraduate degree, a small portion can be included using electives. Agricultural topics are included within the introductory engineering courses and can have influence in the design courses toward the end of the degree. That is in stark comparison to the ~17%, 853 work hours, in agriculture that are required by EI Purpan (Table 3.1). A very wide breadth of topics is covered under the agricultural portion of curriculum at EI Purpan including soil science, animal feeding, aquaculture, Ag mechanization and Ag policy and marketing. The complete range of topics with the amount of time spent on the agricultural portion of education can be found in Appendix C (Table C.3). The agronomy minor at KSU is almost a direct match to the agriculture portion of education at EI Purpan in terms of hours for completion. Yet again differences arise in that the range of topics covered during that time is much greater at EI Purpan.

The business and management portion of EI Purpan is hard to compare to the Bachelor's engineering degree in KSU BAE. Some engineering classes in KSU BAE incorporated business and management topics at a basic level, such as DEN 350 Personal and Professional Development and BAE 536 Ag Engineering Design I (Appendix B, Figure B.1). EI Purpan includes a very comprehensive business and management portion, including courses such as Commercial Negotiations, Quality Assurance, Optimization, and Quantitative Methods in Management (Appendix B, Figure B.5). This difference in emphasis is what prompted the comparison of the Minor in Business at KSU to the business and management portion of EI Purpan's engineering Bachelor's. Appendix C (Table C.2) shows the time spent on business related topics at EI Purpan is lower than that of a Business minor at KSU, but the range of topics covered during this time is far greater at EI Purpan. Complete comparison is shown in Appendix C (Table C.2)

Humanities, social science and economics round out the degrees at both universities, with EI Purpan including a few hours of accounting. The totals of these combined courses are 672 KSU BAE and 413 EI Purpan, but the overall percent is much closer with 10.8% and 8.3%, respectively (Table 3.1).

Possibly the biggest differentiating factor at EI Purpan is the edict from accreditation for internship, which consumed 21.5% of the engineering Bachelor's degree (Figure 3.3). This accounts for with 1066 work hours; when divided over a 40 hour work week, resulted in roughly 27 weeks of internship experience over the three year Bachelor's degree.

A summary of total hours provides interesting comparisons (Figure 3.1). Based on defined amounts of work hours per credit system, either ECTS or CH, the total hours of work required to complete degrees at KSU BAE and EI Purpan were established:

- EI Purpan = 4950 total work hours for BS engineering degree
- KSU BAE = 6240 total work hours for BS engineering degree

At the BS level KSU BAE require 1300 more work hours to complete the degree. Keep this in mind for the next section which compares the Master's degree programs at each institution. As the hour level of the EI Purpan Master's is much higher than that of KSU BAE Master's.

Due to the differences in educational topic focuses that have been shown by the preceding comparisons, undergraduate cooperation between EI Purpan and KSU BAE would not be productive in the current framework of the AREM program. But, the current Summer Study Program at EI Purpan (KSU, 2010) offers cultural and internship experience that would greatly value undergraduate engineers of KSU BAE. This information is currently available through the College of Agriculture and it should be made available to the students of KSU BAE.

Table 3.1 Breakdown of Bachelor's degree requirements for Kansas State and EI Purpan by Credit hours, ECTS, percent of total education and work hours.

Bachelors	Kansas State				EI Purpan			
	Credit Hours	ECTS	Percent	Work Hours	Credit Hours	ECTS	Percent	Work Hours
Discipline								
Agriculture	0.0	0.0	0.0%	0	17.8	31.0	17.2%	853
Biology	14.0	24.4	10.8%	672	16.3	28.5	15.8%	784
Business Management	0.0	0.0	0.0%	0	4.9	8.5	4.7%	234
Chemistry	16.0	27.9	12.3%	768	3.4	6.0	3.3%	165
Communication	8.0	14.0	6.2%	384	9.2	16.0	8.9%	440
Economics / Accounting	5.0	8.7	3.8%	240	4.9	8.5	4.7%	234
Engineering	36.0	62.8	27.7%	1728	0.0	0.0	0.0%	0
Humanities / Social Science	9.0	15.7	6.9%	432	3.7	6.5	3.6%	179
Internship	0.0	0.0	0.0%	0	22.2	38.8	21.5%	1066
Math	19.0	33.2	14.6%	912	8.0	14.0	7.8%	385
Physics	23.0	40.1	17.7%	1104	6.0	10.5	5.8%	289
Reports / Projects	0.0	0.0	0.0%	0	6.7	11.8	6.5%	323
Totals	130	227	100%	6240	103	180	100%	4950

Figure 3.2 Pie chart of KSU BAE Bachelor's degree time allocation to each topic area.

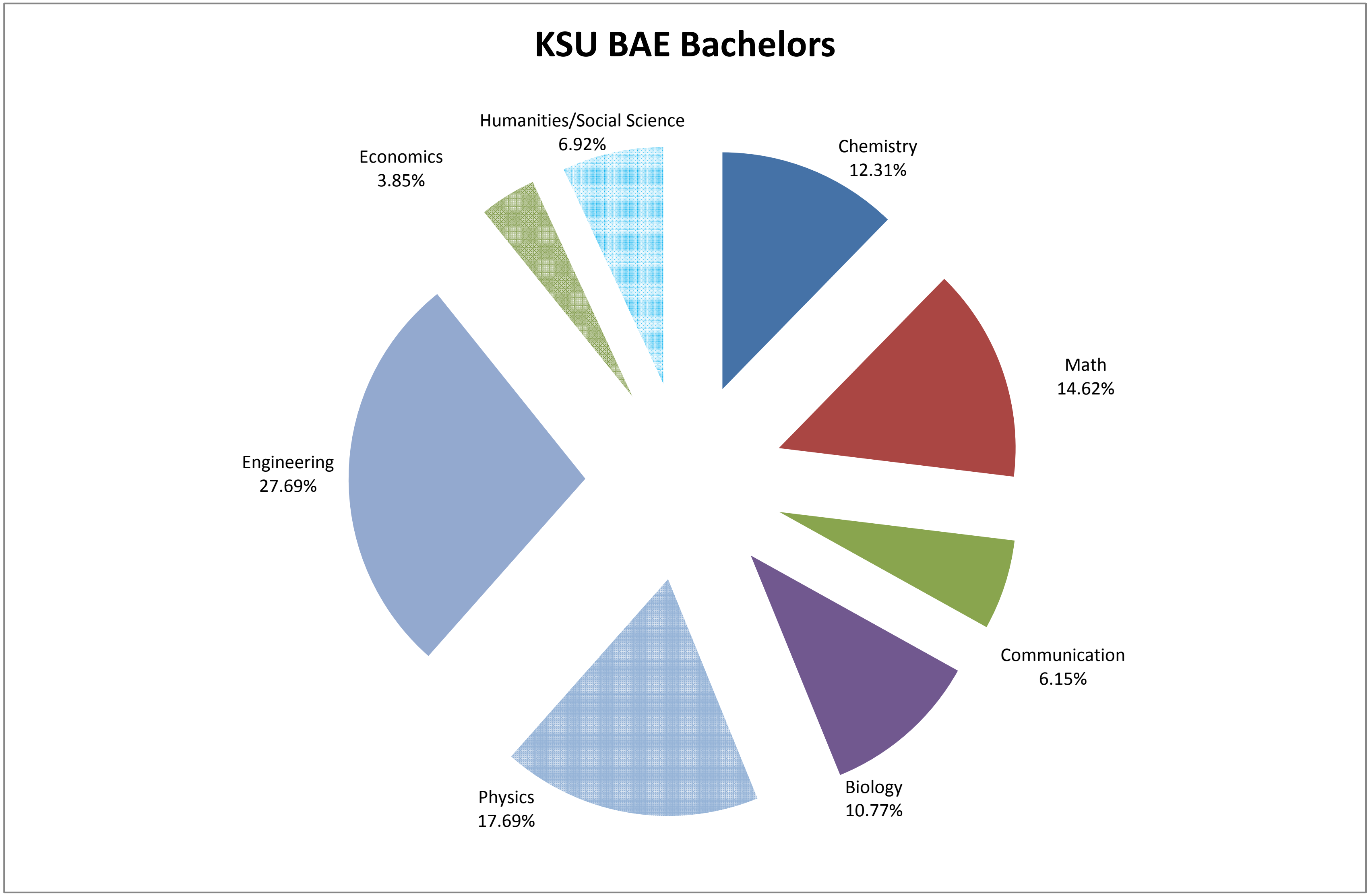
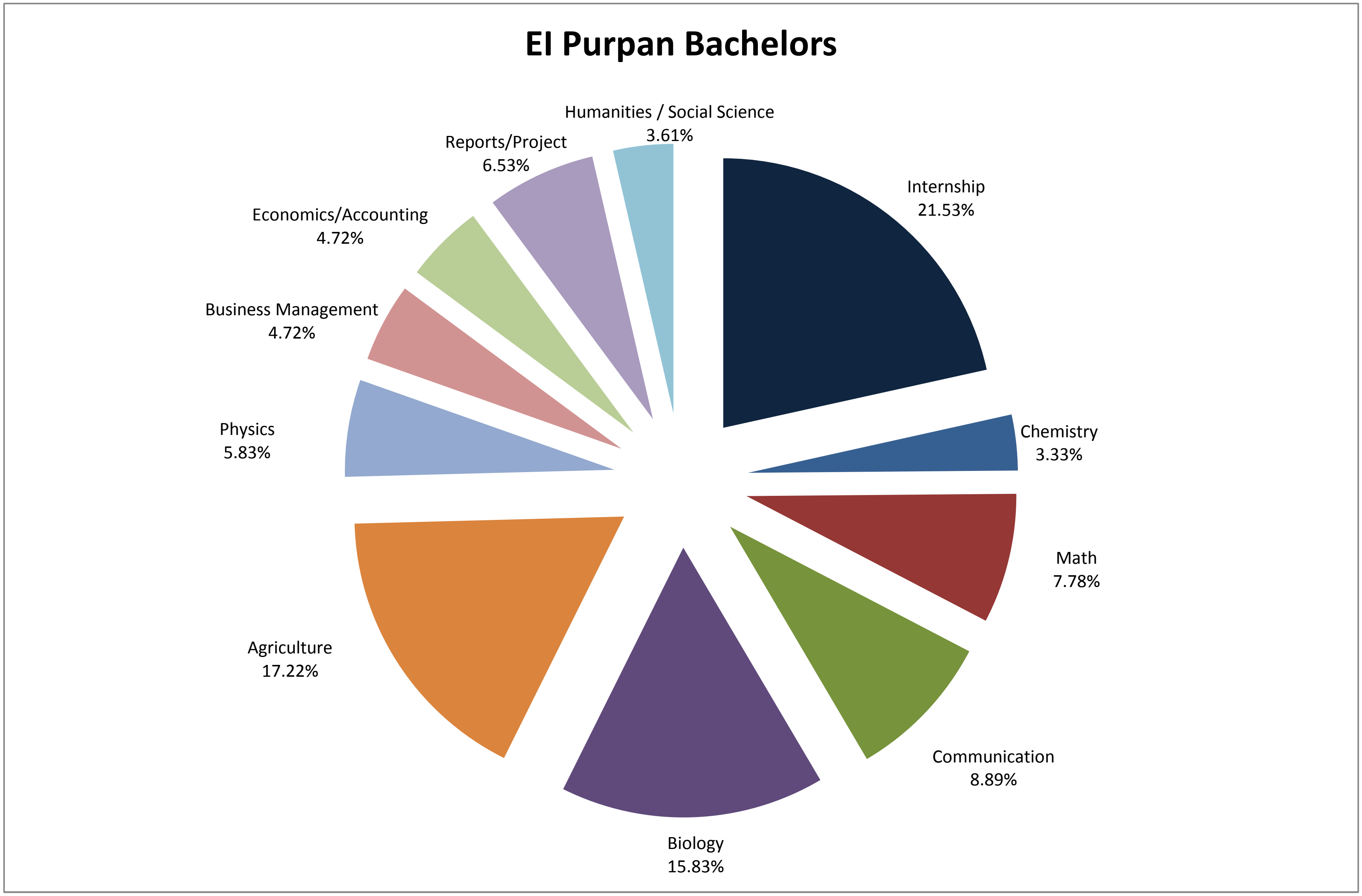


Figure 3.3 Pie chart of EI Purpan Bachelor's degree time allocation to each topic area.



Master's Degree Comparison

The Master's degree programs at EI Purpan and KSU BAE were compared using the AREM specialization pathway, EI Purpan, and a program of study, which incorporates the AREM graduate certificate, KSU BAE. The program of study at KSU BAE is a very individual process. No basic educational format exists, when compared to the EI Purpan specialized, each program of study is tailored to individually develop specialty focused around each student's specific research area. At EI Purpan students follow preset structure in terms of course selection, but individual specialization is represented by internship experience.

Attached (Appendix B, Figures B.5-7) are examples of 4th and 5th year curriculum of EI Purpan, which correlate to Master's study, and KSU BAE sample program of study. The attached program of study is centered around international engineering education, and the AREM graduate certificate at KSU. It may not necessarily be as specialized as other programs of study at KSU BAE.

At the Master's level at KSU BAE, technical education and the design process have been previously instilled during undergraduate education, and each course in the Master's program of study adds complimentary attributes to these core qualities. While specialization was a common goal of the two master programs, the manner which each institution achieved this was quite different. Thesis research CH were very disproportionate at KSU BAE to actual work hours, creating an underweighted value of 20% of the total degree (Figure 3.4), opposed to the EI Purpan thesis/report portion at roughly 37% (Figure 3.5).

Internships become even more of an emphasis at EI Purpan, up from 21.5% (Table 3.1) to 30% (Table 3.2) and a new facet of thesis research was added at KSU BAE, accounting for 20% of the degree (Figure 3.4). Courses designed to broaden the foundation on which specialization comprise the rest of the degrees at both institutions. The process of specialization is realized by combining the new theoretical knowledge from courses and through the research experience of the thesis.

Half of an engineer's final year at EI Purpan was spent on an internship. In coordination with a tutor, the student focused on a specific topic that became the subject matter for the thesis. This on-job training that is incorporated into the Master's education of EI Purpan prepares the engineering graduate to enter an engineering job much easier than the counterpart in the United States. EI Purpan has the goal of creating a project manager or team leader immediately following graduation.

By the end of the Master's program at KSU, the knowledge of the graduate is not in question, but the application of this knowledge and integration into the work force has not been addressed in full. This is the trend of most engineering degree programs in the United States; employers expect graduates to be a novice business person and some companies even have initial training programs to address this. However, most students understand this and seek to compensate what the curriculum lacks with internships and extracurricular activities, during the undergraduate education, to prepare them for assimilation.

International cooperation must be achieved to educate engineers who appreciate different cultures, communicate effectively with other nationalities, and approach problems with a diverse set of solving skills. The educational institutions of KSU and EI Purpan have taken great steps in this direction. The development of the AREM program at the graduate level is exactly the first step toward an environment at both institutions that develops an engineer with global mobility and cultural intelligence.

With the increase of international joint educations like ERASMUS MUNDUS, the stage is set for EI Purpan and KSU BAE to take the next step and develop a joint Master's program focused around AREM. Similar programs such as the AGRIS MUNDUS exist and can provide templates for cooperation and the aforementioned ratios of academic credit value from each system will allow for more efficient student study time within a joint Master's program. Program strengths such as the technical design and research base at KSU BAE and practical on-job training gained from internship and the business leadership education of EI Purpan must be highlighted in all cooperation, current and future.

Table 3.2 Breakdown of Master's degree requirements for Kansas State and EI Purpan by Credit hours, ECTS, percent of total education and work hours.

Masters	Kansas State				El Purpan			
	Credit Hours	ECTS	Percent	Work Hours	Credit Hours	ECTS	Percent	Work Hours
Discipline								
Agriculture	4.0	7.0	13.3%	192	2.0	3.5	2.9%	96
Biology	0.0	0.0	0.0%	0	1.1	2.0	1.7%	55
Business Management	0.0	0.0	0.0%	0	9.5	16.5	13.8%	454
Chemistry	0.0	0.0	0.0%	0	0.0	0.0	0.0%	0
Communication	0.0	0.0	0.0%	0	2.9	5.0	4.2%	138
Economics / Accounting	3.0	5.2	10.0%	144	2.6	4.5	3.8%	124
Engineering	10.0	17.5	33.3%	480	0.0	0.0	0.0%	0
Humanities / Social Science	3.0	5.2	10.0%	144	4.0	7.0	5.8%	193
Internship	0.0	0.0	0.0%	0	20.9	36.5	30.4%	1004
Math	4.0	7.0	13.3%	192	0.6	1.0	0.8%	28
Physics	0.0	0.0	0.0%	0	0.0	0.0	0.0%	0
Reports / Projects / Thesis	6.0	10.5	20.0%	288	25.2	44.0	36.7%	1210
Totals	30	52	100%	1440	69	120	100%	3300

Figure 3.4 Pie chart of KSU BAE Master's degree time allocation to each topic area.

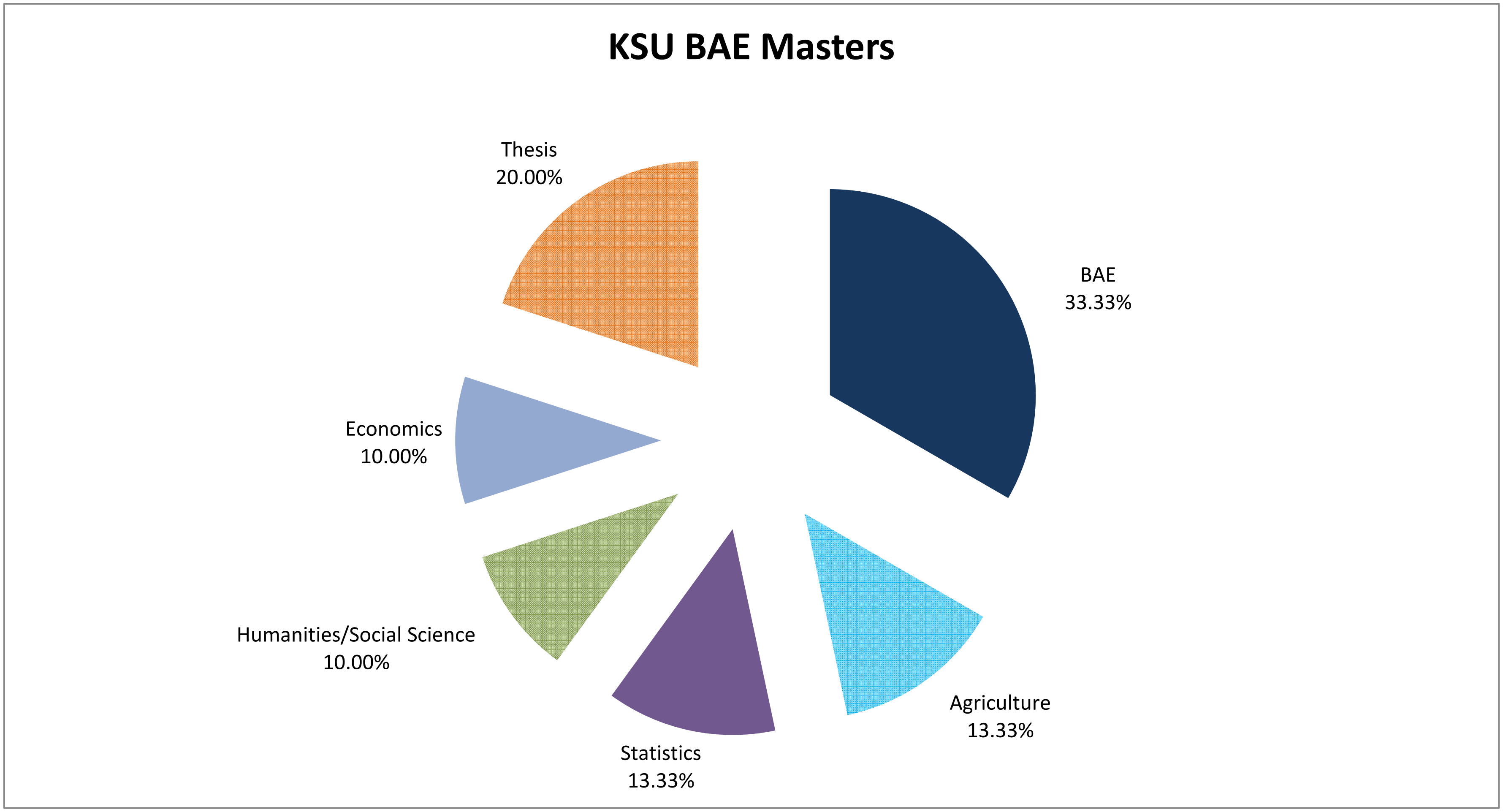
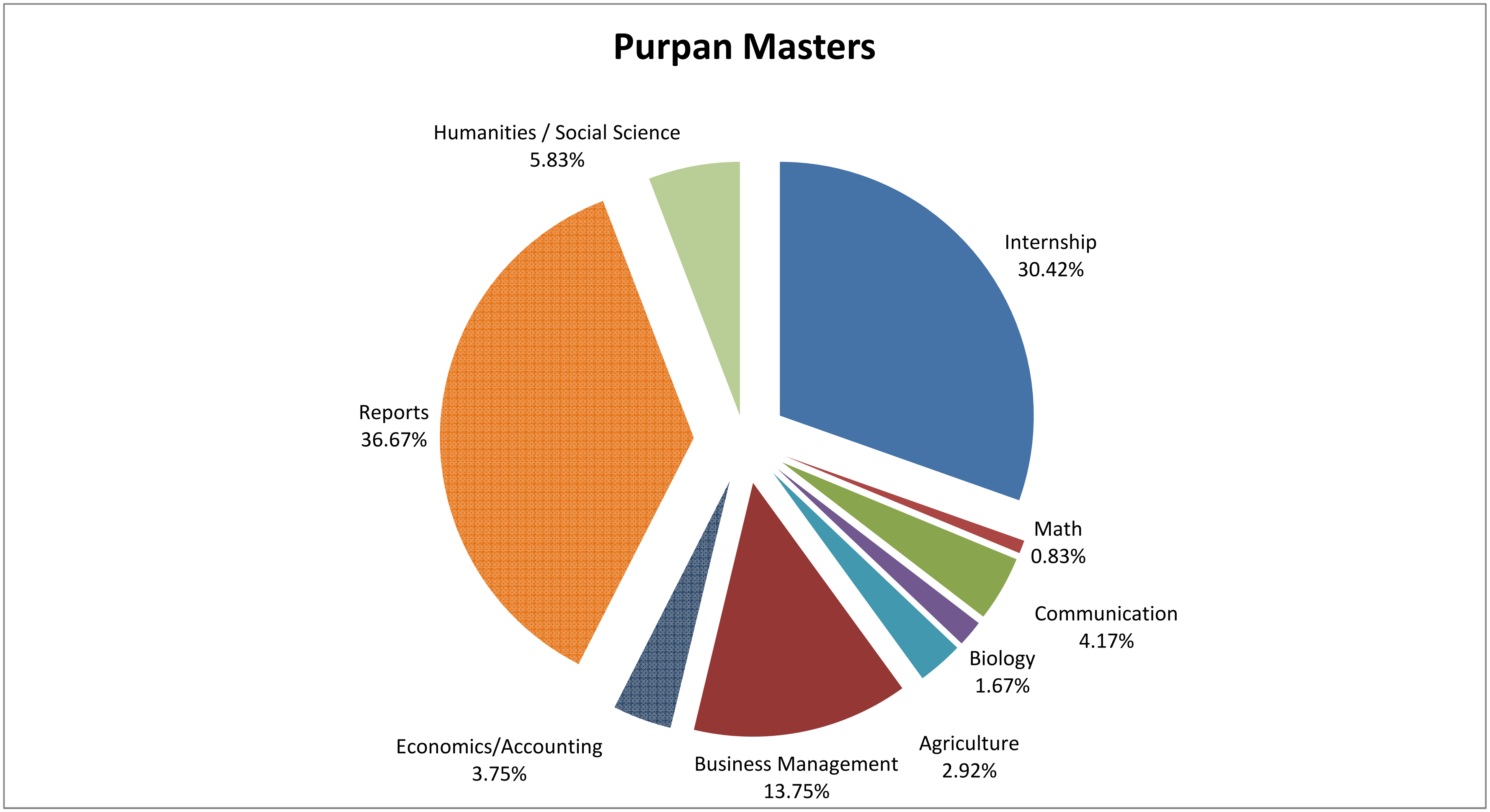


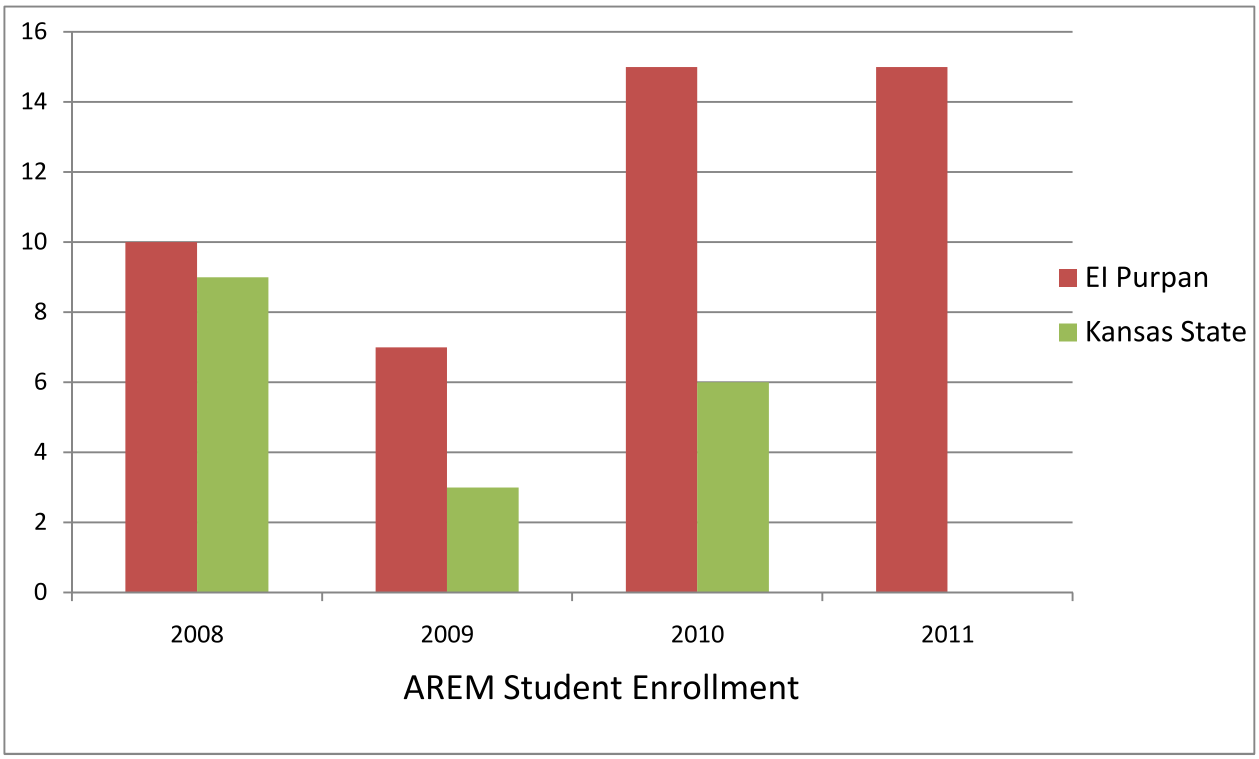
Figure 3.5 Pie chart of EI Purpan Master's degree time allocation to each topic area.



AREM Comparison

AREM is very prevalent in the descriptive literature of EI Purpan. This is not the case at KSU BAE. The stage of development has either prevented KSU from advertising this program or oversight has occurred. A student entering KSU BAE's master program would not be able to find information of AREM on the KSU website or in BAE departmental literature. With this in mind, the enrollment sizes were compiled to show the differences in the AREM program at both universities (Figure 3.6).

Figure 3.6 AREM Student enrollments since program inauguration.



The student enrollment in 2008 began with very comparable numbers but the following two years, 2009 and 2010, have shown drastically unequal enrollment between the two schools. This is in part due to the lack of information about the AREM graduate certificate available on websites and in promotional literature at KSU. AREM must be prevalent within KSU literature, it must be posted on all department websites affiliated with the program and within informational publications.

Immediately highlighted in EI Purpan's description of AREM, is the international component. This is also the case of the AREM graduate certificate at KSU. International experience is paramount to increasing global mobility and cultural intelligence of engineering graduates. Both universities understand that to compete with other institutions for students international programs must be available.

Table 3.3 was compiled from student data by instructors of the AREM program. This course was conducted in the English language. Data suggests that the French students had difficulty with the lectures when video conferencing equipment was used.

Table 3.3 Student assessment from the Introductory Class. Scale from 1 to 5, with 5 being the best. (Paradis *et al.*, 2010)

ASSESSMENT QUESTIONS	K-State		Purpan	
	ave	std	ave	std
The distance technology did not hinder my learning in the course.	4.6	0.5	3.4	0.7
The opportunity to interact with students and teachers from the other institution enhanced my learning	4.3	0.7	4.2	0.7
The course enhanced my understanding of the perspectives in other countries	4.8	0.4	4.0	1.0
The case study assignment was a valuable exercise	4.6	0.5	4.3	0.9
The lectures were easily understood across cultures and disciplines	4.2	0.6	3.6	1.0

AREM Current State

Through my experience, participating as a student in AREM classes at KSU and EI Purpan, I have developed a unique perspective of the current program and feel comfortable with my knowledge level of the workings and intricacies of both sides. The following section is my personal analysis of the current operations of the AREM program.

Utilizing broad band internet connections, the schools of EI Purpan and KSU connect on a regular schedule throughout the spring and fall semesters, depending on which course is in session. The video conferencing equipment enables real-time audio and visual interaction. Many different companies offer this type of technological equipment; KSU uses Polycom brand equipment, while EI Purpan uses Sony brands. These systems connect via individual internet protocol (IP) address assigned to each system. Figure 3.7 displays the hardware required for video conferencing interactions.

Figure 3.7 Polycom HDX 7000. Utilized by KSU for video conferencing, including the AREM courses.

The two courses of the AREM program at both institutions that utilized video conferencing for co-teaching are, via KSU description, GENAG 670 Introduction to AREM and GENAG 870 AREM Capstone (KSU Graduate Council, 2010). GENAG 670 introduces students to the concept of sustainability, exposes students to interdisciplinary perspectives, combines the three main topic areas (agro-ecological, economic, and social), and provides international collaboration and viewpoints. GENAG 870 builds on the introductory course in all areas and incorporates team work with a large portion of the class being a group case study of related natural resource issue.

Continuing the AREM program as it is now adds technologic appreciation, international view points, and understanding of different pedagogy and practice to both institutions curriculum. These courses are a step in the direction of engineer global mobility and cultural intelligence. The benefit of the video conference in the classroom allows students from opposite sides of the world to have a hybrid international educational experience from week to week. However, an appreciation of societal functions, the eccentricities of daily life, and true face-to-face interaction cannot be delivered to students with only video conferencing; students immediately return to their separate worlds as soon as the connection ends. Being in the same room, eating the same food, developing rapport, and living a schedule specific to that corner of the world is what a culturally educated engineer gains from time abroad. Definitely, this experience can only be realized when a student actually lives in a different place for an extended period of time.

As the program exists now at EI Purpan, only the courses coordinated with KSU use English as the teaching language. This adds to the difficulties with communication at times during the semester. The French students are very proficient in English, but complete mastery of nuances and colloquial terms is impossible without immersion, and when a person speaks via video conference information can be misinterpreted. For example, a single word, usually an English word sharing French roots, can be closely related or something vastly different. This can throw an entire conversation off, but with patience and very specific questions this can be overcome. However, the technological buffer that video conferencing equipment creates between physical human communications can spawn an attitude of going through the motions, and not truly interacting.

This timid attitude, created by the technological buffer, is most easily squelched with feelings of camaraderie, which comes with personal interaction. Either before the course begins or during the early stages, implementation of a video conference, specifically created to introduce students, would help this. A 30 min meeting would suffice with activities that introduce and explain a few personal details about each student, an ice breaking session. This would establish individual identity as well as promote group mindset, encouraging students toward more engaging interactions and discussion.

During the Spring of 2010, the possible extension of the AREM program to a university in India provides interesting ideas for forward progress. This extension is one initiated and motivated by EI Purpan. If this becomes a reality, students from the Indian university will travel to France and spend 1.5 years participating in the AREM program alongside French students. Due to language differences, the entire EI Purpan AREM course set will be presented in English. This would create an environment for students from KSU, most have little or no foreign language skills, to more readily participate.

Another complexity of AREM is that professors at KSU are not directly compensated for their participation in the program, in part due to the fact AREM does not fall directly within a specific university department's definition, but encompasses many and has topic areas in-between. It is my opinion that due to the research and teaching duties required of KSU faculty, the extra time required for participation as a faculty member of AREM demands a mindset motivated by group progress rather than individual achievement and recognition.

Also, the economic category that EI Purpan serves deserves recognition. EI Purpan is not a public university education, which in France is provided close to gratis, but rather a private education that requires tuition. One could conclude that due to the requirements of tuition, many internship programs, some with income, some not, and the requirement of study in an English speaking country, the economic position of students attending this school are in the upper levels of economic class for France as a whole. With that in mind, students from EI Purpan might not scoff at extra costs to the base tuition, those required by international programs or study periods. At KSU, the affordance of the base education, for some students, can be a financial burden that will be carried for many years. Channeling students to existing international scholarship programs would greatly benefit AREM students at both universities, depending if time abroad is required for AREM program completion in the future.

CHAPTER 4 - Summary and Conclusion

It is evident that the current steps taken by KSU BAE and EI Purpan to develop international programs to increase student global mobility and cultural intelligence through the jointly taught video conferencing courses of AREM are parallel to current trends in international graduate education to a degree. The courses that currently exist provide a sample to students of what international collaboration entails. Further development, such as a joint Master's program, would increase both institutions value by attracting the globally minded engineering students of each respective region.

Immediately, the implementation of an "ice breaker" session should be added to each cooperative AREM Course. This should include a video conference that introduces each student from KSU and EI Purpan and identifies personal information, such as location of home, interests, hobbies, and perceptions about the other country. Whether this incorporates additional connectivity via online media should be considered. As it currently stands, the economic impact of the current practice of AREM is not great to either institution, and it benefits students, at the minimum, by exposing them to different ideas, considerations, and collaborations.

The 1-2 year goal of an AREM summer study program should be considered. A three month program in the summer, incorporating the technical design and research aspects of KSU, and the internship and business management qualities of EI Purpan. This program would have equal time spent at both institutions, programs would be conducted in English, but while in France the KSU students would be introduced to the French language. Further research should be done to determine if this program would qualify as CTI defined internship/study abroad period, so that French students would not have to make up time to complete their degree.

Within 3 -5 years the development of a joint Master's degree should be developed. This would be a two year program that incorporates a year at each institution. Various models of this type of program exist within Europe that provide example framework. This is the largest and most complex goal, but would provide the most enriching experience for a globally mobile and culturally educated engineer ready to face the challenges and solve the natural resource problems of the world today.

Analysis of the respective curriculum revealed large differences in educational topic focus. Engineers at EI Purpan spend more time on internship, agriculture and biology. KSU BAE engineers focus heavily on math, physics, and engineering design. The strengths of both programs must be incorporated in future cooperative ventures. Graduate level cooperation provides the most level plain for interaction of students due to the breadth of education covered previously.

Accreditation bodies, CTI and ABET, have very similar program outcomes that encourage the cooperation of these institutions. Pedagogical, geographical, cultural, and language differences provide challenges to this type of international educational cooperation. If the flexible and inflexible characteristics of each of the challenges can be established by decision making parties at both institutions, forward progress will come at a much more rapid pace.

These international graduate programs will create globally mobile and culturally educated engineers, who are specialized in natural resource engineering topics, consider multiple disciplinary aspects, approach issues with systemic problem solving processes, and understand the differences and appreciate the strengths when working with engineers of diverse nationality.

References

ABET. 2010. Engineering Accreditation Criteria 2010-2011. Baltimore, MD: Accreditation Board for Engineering and Technology.

AGRIS MUNDUS. 2010. Agris Mundus Master's Course in Agricultural Development and Management of Natural Resources. Available at: http://www.agrismundus.eu/agris-mundus/?id=56. Accessed 12 March 2010.

Berlin Summit of Higher Education. 2003. Realising the European Higher Education Area. Available at: http://www.bologna-berlin2003.de. Accessed 8 May 2010.

BLS. 2010. Labor Force Statistics from the Current Population Survey: 2000-2010. Bureau of Labor Statistics Databases and Tables. Available at: http://www.bls.gov. Accessed 20 May 2010.

Bologna Declaration. 1999.. The European Higher Education Area. Available at: http://www.aic.lv/ace/ace_disk/Bologna/about_bol.htm. Accessed 29 April 2010.

Crossman, J.E. and M. Clarke. 2010. International experience and graduate employability: stakeholder perceptions on the connection. Higher Education. 59(5): 599-613.

CTI. 2009. Adapted English version of "References et Orientations" (2009) References and Guidelines 2010. Paris, France: Commission des Titres d'Ingenieur.

Continental AG. 2005. Continental Global Engineering Excellence Study. Hanover, Germany: Continental Automotive Group Global Engineering Study.

Coventry. L. 1995. Video Conferencing in Higher Education. Supportive Initiative for Multimedia Applications. Edinburgh, Scotland: Heriot Watt University.

Downey, G.L., and J.C. Lucena. 2008. Knowledge and Professional Identity in Engineering: Code-Switching and the Metrics of Progress. *History and Technology*. 20(4): 393–420.

Downey, G.L., J.C. Lucena, B.M. Moskal, R. Parkhurst, T. Bigley, C. Hays, B.K. Jesiek, L. Kelly, J. Miller, S. Ruff, J. Lehr, A. Nichols-Belo. 2006. The Globally Competent Engineer: Working Effectively with People Who Define Problems Differently. *Journal of Engineering Education*. 95(2): 107-122.

Duderstadt,J J. 2008. *Engineering for a Changing World: A Roadmap to the Future of Engineering Practice*. Manchester University Press, Manchester, England

Earley, P.C., C. Murnieks, E. Mosakowski. 2007. Cultural Intelligence and the Global Mindset. *Advances in International Management*. 19. 75-103.

EI Purpan. 2010. Ecole d'Ingenieurs Purpan. Available at: www.purpan.fr. Accessed 19 May 2010.

ERASMUS MUNDUS. 2010. Erasmus Mundus 2009-2013. Available at: http://eacea.ec.europa.eu/erasmus_mundus/programme/about_erasmus_mundus_en.php. Accessed 9 May 2010.

ERASMUS MUNDUS. 2010. Official Journal of the European Union. Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:340:0083:0098:EN:PDF. Accessed 17 April 2010.

European Commission. 2010. European Credit Transfer and Accumulation System. Avaliable at http://ec.europa.eu/education/lifelong-learning-policy/doc48_en.htm. Accessed 25 May 2010.

FESIA. 2010. Agricultural engineering school association. Available at: http://www.fesia.org/en/fesia/identity-card/. Accessed 19 May 2010.

FESIC. 2010. Association of Grandes Ecoles of ingenieurs and management. Available at: http://www.fesic.org/. Accessed 10 March 2010.

French Embassy of Ireland. 2010. French educational structure. Available at: http://www.ambafrance.ie/. Accessed 15 April 2010.

French Ministry of Education. 2010. Educational terminology. Available at: http://www.enseignementsup-recherche.gouv.fr/pid20002/ministere.html. Accessed 15 April 2010.

Gay, M. 2010. Unpublished data from AREM meeting presentation. Manhattan, KS: Kansas State University

Grasso, D. and D. Martinelli. 2007. Holistic Engineering. *The Chronicle Review*. 53(28): B8

Hartung, A. 2004. Quotes: pithy sayings for the new world of work. Available at: www.thephoenixprinciple.com/quotes/. Accessed 30 April 2010.

IEP. 2010. University of Rhode Island International Engineering Program. Available at: http://www.uri.edu/iep/programs_french.html. Accessed 27 April 2010.

IES. 2010. University of Pittsburgh International Engineering Studies Certificate Program. Available at: http://www.engr.pitt.edu/International/internationalengrcertificate.html. Accessed 9 May 2010.

IISME. 2005. Engineering Design Process, Educational Transfer Plan, Seyyed Khandani. Santa Clara, CA: Industrial Initiatives for Science and Math Education.

INSEE. 2010. Institut national de la statistique et des études économiques. Available at : http://www.insee.fr/fr/themes/theme.asp?theme=7&nivgeo=0&type=2. Accessed 17 June, 2010.

IPCC. 2007. Fourth Assessment Report: Climate Change 2007 (AR4). Geneva, Switzerland: Intergovernmental Panel on Climate Change.

KSU. 2010. Kansas State University. Available at: www.ksu.edu. Accessed 9 January 2010.

KSU BAE. 2010. Kansas State University College of Engineering Biological and Agricultural Engineering. Available at: www.bae.ksu.edu. Accessed 22 May 2010.

KSU Graduate Council. 2010. Minutes of the Graduate Council at KSU. Available at: http://www.k-state.edu/grad/gspeopleorg/council/minagen/2010_04%20agen.pdf. Accessed May 23 2010.

Lorimer, M.F. 1962. How much is a credit hour?: A Plea for Clarification. *The Journal of Higher Education.* 33(6):302-306.

MEA. 2003. Millennium Ecosystem Assessment, Ecosystems and Human Well-being. Washington, D.C.: Millennium Ecosystem Assessment.

NAFSA. 2009. Economic Benefit of International Education to the United States 2008-2009, Kansas. Washington, DC. NAFSA: Association of International Educators.

NASULGC. 2004. A call to leadership: The presidential role in internationalizing the university. Washington, DC: NASULGC Task Force on International Education.

NRCS. 2005. Productive Lands Healthy Environment Natural Resource Conservation Service Strategic Plan: 2005-2010. Washington, D.C.: Natural Resource Conservation Service.

Paradis. S., K. Douglas-Mankin, S. Hutchinson, M. Gay, T. Selfa. 2010. AREM: An original joint educational program to improve the sustainability of agricultural natural resources and environmental management. 9th IFSA Symposium. Vienna, Austria: Workshop 5.4

Prados, J.W., G.D. Peterson, L.R. Lattuca. 2005. Quality assurance of engineering education through accreditation: The impact of Engineering Criteria 2000 and its global influence. Journal of Engineering Education. 94(1):165-183.

Polycom. 2010. Polycom HDX 7000. Available at: www.polycom.com. Accessed 25 May 2010.

Salger-Meyer, F. 1997. Scientific Multilingualism and “Lesser Languages”. Interciencia. 22(4): 197-201.

The White House. 2010. President Obama Sets Greenhouse Gas Emissions Reduction Target for Federal Operations. Office of the Press Secretary. Washingtion, D.C: The White House

Thomas, D.C., and K. Inkson. 2004. *Cultural Intelligence: People skills for global business*. Berrett-Koehler Publishers, Inc, San Francisco, CA.

Trajkovik,V., and E. Caporali. 2010. *Videoconferencing as Tool of Higher Education*. ICT Innovations 2009. Part 2.

US Census. 2000. United States Census educational statistics. Available at: www.census.gov. Accessed 15 May 2010.

Van Damme, D. 2001. Quality issues in the internationalization of higher education. *Higher Education*. 41(4): 415-441.

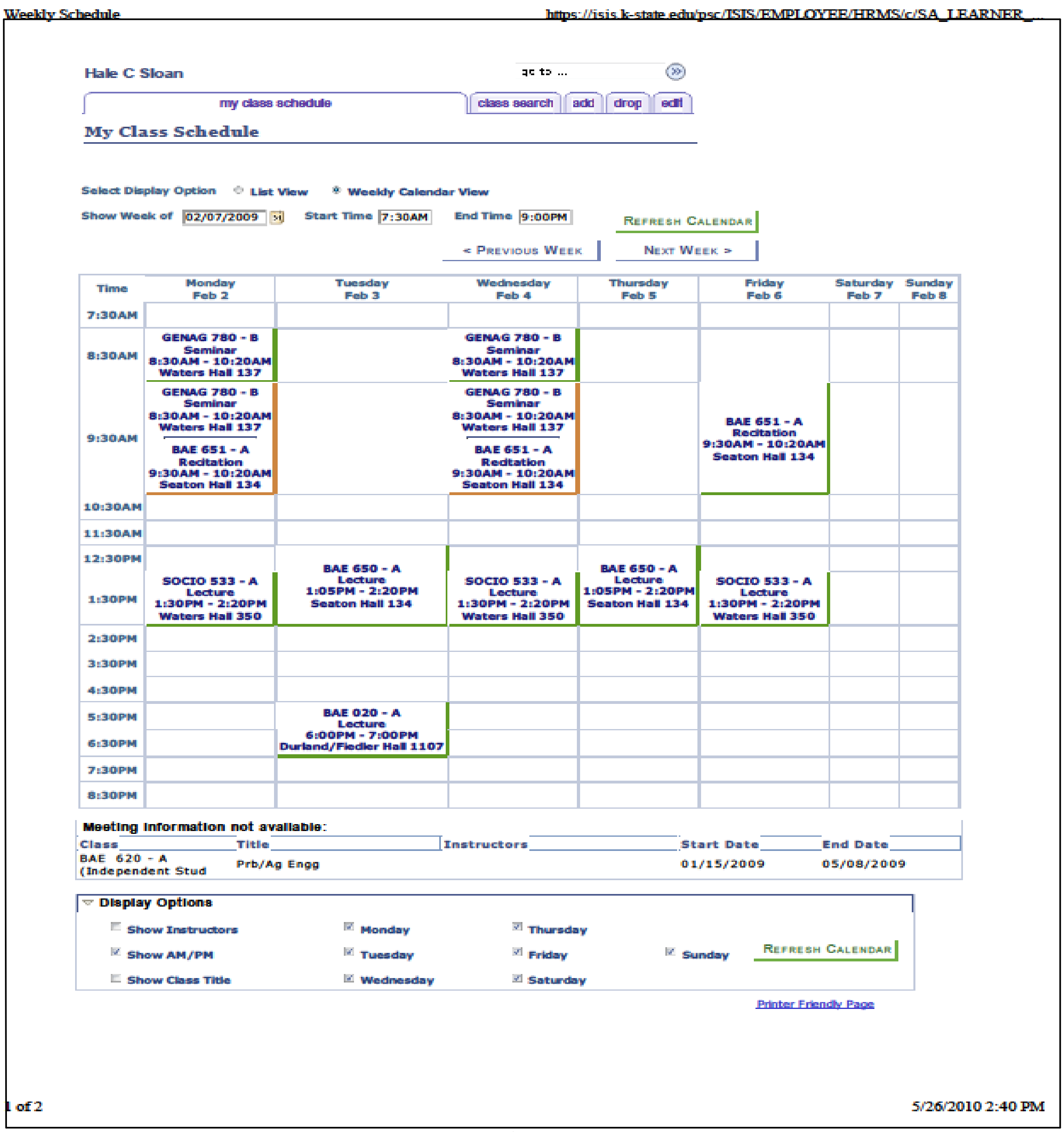
Wigal, C. 2009. Using Rich Pictures to Improve Systemic Thinking. 39th ASEE/IEEE Frontiers in Education Conference. Session: T2B. San Antonio, Texas.

Zaheer, S. 1999. Time-zone Economies and Managerial Work in a Global World. University of Minnesota. Minneapolis, MN: Carlson School of Management. 9th IFSA Geneva, Switerland

Appendix A - Course Schedules

The following figures display the schedules of a typical semester, in the case of engineering at KSU BAE, and of two typical monthly schedules, for EI Purpan.

Figure A.1 Example weekly schedule for students of Kansas State University, this schedule repeats every week for the 16 weeks that comprise a semester of study.



Weekly Schedule https://isis.k-state.edu/psc/ISIS/EMPLOYEE/HRMS/c/SA_LEARNER_...

Hale C Sloan

my class schedule | class search | add | drop | edit

My Class Schedule

Select Display Option ○ List View ◉ Weekly Calendar View

Show Week of 02/07/2009 Start Time 7:30AM End Time 9:00PM REFRESH CALENDAR

< PREVIOUS WEEK NEXT WEEK >

Time	Monday Feb 2	Tuesday Feb 3	Wednesday Feb 4	Thursday Feb 5	Friday Feb 6	Saturday Feb 7	Sunday Feb 8
7:30AM							
8:30AM	GENAG 780 - B Seminar 8:30AM - 10:20AM Waters Hall 137		GENAG 780 - B Seminar 8:30AM - 10:20AM Waters Hall 137				
9:30AM	GENAG 780 - B Seminar 8:30AM - 10:20AM Waters Hall 137 BAE 651 - A Recitation 9:30AM - 10:20AM Seaton Hall 134		GENAG 780 - B Seminar 8:30AM - 10:20AM Waters Hall 137 BAE 651 - A Recitation 9:30AM - 10:20AM Seaton Hall 134		BAE 651 - A Recitation 9:30AM - 10:20AM Seaton Hall 134		
10:30AM							
11:30AM							
12:30PM		BAE 650 - A Lecture 1:05PM - 2:20PM Seaton Hall 134		BAE 650 - A Lecture 1:05PM - 2:20PM Seaton Hall 134			
1:30PM	SOCIO 533 - A Lecture 1:30PM - 2:20PM Waters Hall 350		SOCIO 533 - A Lecture 1:30PM - 2:20PM Waters Hall 350		SOCIO 533 - A Lecture 1:30PM - 2:20PM Waters Hall 350		
2:30PM							
3:30PM							
4:30PM							
5:30PM		BAE 020 - A Lecture 6:00PM - 7:00PM Durland/Fiedler Hall 1107					
6:30PM							
7:30PM							
8:30PM							

Meeting Information not available:

Class	Title	Instructors	Start Date	End Date
BAE 620 - A (Independent Stud	Prb/Ag Engg		01/15/2009	05/08/2009

▽ Display Options

☐ Show Instructors ☑ Monday ☑ Thursday

☑ Show AM/PM ☑ Tuesday ☑ Friday ☑ Sunday REFRESH CALENDAR

☐ Show Class Title ☑ Wednesday ☑ Saturday

Printer Friendly Page

1 of 2 5/26/2010 2:40 PM

Figure A.2 Example monthly schedule for students of EI Purpan, this schedule is created on a month by month basis. Green – specific AREM lecture; Red – Core curriculum of all engineering studies; Yellow - Core curriculum of all engineering studies; Blue – Video conference room in use.

JANVIER

Mois / Jours		du 28 Déc. au 02 Janv - Semaine 18	du 04 au 09 - Semaine 19	du 11 au 16 - Semaine 20	du 18 au 23 - Semaine 21	du 25 au 30 - Semaine 22
LUNDI		28	4	11	18	25
	8h00 - 9h10				DROIT DES SOCIETES 1/2	DROIT DES SOCIETES 5/6
	9h20 - 10h30		9H: RENTREE A4			
	11h00 - 12h10				Intervention Michel Roux	
	13h45 - 15h30		PHOTO PROMO	Solagro - Vidéo - 14h00-17h00; MO TD 2 Gr2	14AAE12 - AgroEcology - salle 20 - 13h45/17h30 - Etudiants	AREM Intro Course 2 - 15h15/17h30
	15h45 - 17h30					
			Rentrée pour tous			
MARDI		29	5	12	19	26
	8h00 - 9h10			MAP 1 (Laure Bertrand) Gr2		DROIT DES SOCIETES 5/6
	9h20 - 10h30		METHODES D'OPTIMISATION 1/2		ANALYSE DE DONNEES 1/2	ANALYSE DE DONNEES 3/4 (Monique Berger)
	11h00 - 12h10					
	13h45 - 15h30		METHODES D'ENQUETE 1/2 (Monique Berger)	14AAE12 - AgroEcology - salle 20 - 13h45/17h30 - Etudiants	VideoConf - FB- 13h00-16h25; AD TD 1 Gr2; SH - Watershed - 20 - 16h30/18h00	SH - Watershed - 20 - 16:30/17:4; MAP 2 Gr2
	15h45 - 17h30					
				Galette		
MERCREDI		30	6	13	20	27
	8h00 - 9h10		Présentation AREM - 8h10h - Salle 22 - MG, SP, LA, SH, CP	MO 6/7		
	9h20 - 10h30				DROIT DES SOCIETES 3/4 (KRAJESKI)	
	11h00 - 12h10		METHODES D'OPTIMISATION 3			
	13h45 - 15h30		MO TD 1 Gr2	VideoConf - FB- 13h00-16h25; Gestion de projet 1	AREM Intro Course 1 - 15h15/17h30	AREM Intro Course 3 - 15h15/17h30
	15h45 - 17h30					
JEUDI		31	7	14	21	28
	8h00 - 9h10			MO TD 3 Gr2	GESTION DE PROJET TD 2 Gr2	METHODES D'ENQUETE TD 1 gr2
	9h20 - 10h30					
	11h00 - 12h10					
	13h45 - 15h30		14AAE12 - AgroEcology - salle 20 - 13h45/17h30 - M Gay	SH - Watershed - 20 - 16:30/17:45		
	15h45 - 17h30					
			Soirée Gala avec repas			Soirée Promo A4
VENDREDI		1	8	15	22	29
	8h00 - 9h10		MO 4/5	Gestion de projet 2	1/2 Journée recherche	
	9h20 - 10h30					
	11h00 - 12h10					
	13h45 - 15h30		Projet Professionnel ?	14AAE12 - Agroecology - salle 20 - 13h45/17h30 - M Gay	14AAE12 - AgroEcology - salle 20 - 13h45/17h30 - Etudiants	14AAE12 - Agroecology - salle 20 - 13:45/17h30 - L Alletto
	15h45 - 17h30					
SAMEDI		2	9	16	23	30
	8h00 - 9h10					
	9h20 - 10h30					
	11h00 - 12h10					

Figure A.3 Example monthly schedule for students of EI Purpan. Note the difference of course times from January, except for the jointly taught course: AREM Intro Course. Green –specific AREM lecture; Red – Core curriculum of all engineering studies; Yellow - Core curriculum of all engineering studies; Blue – Video conference room in use.

FEVRIER

Mois / Jours			du 01 au 06- Semaine 23		du 08 au 13 - Semaine 24		du 15 au 20 - Semaine 25		du 22 au 27- Semaine 26
LUNDI	8h00 - 9h10	1		8	INITIATION DEMARCHE QUALITE 4/5/6	15		22	
	9h20 - 10h30		DROIT DES SOCIETES 9/10				MACRO 8/9		
	11h00 - 12h10								
	13h45 - 15h30		AREM Intro Course 4 - 15h15/17H30		AREM Intro Course 6 - 15h15/17H30		AGRICULTURE/ENVIRONNEMENT 1/2/3 (GAY) ? En double! / AREM Intro Course 8 - 15h15/17H30		AREM Intro Course ? US only 10
	15h45 - 17h30								
			Démarrage des DA						
MARDI	8h00 - 9h10	2	INITIATION DEMARCHE QUALITE 1/2/3 (tormo - surel)	9		16		23	
	9h20 - 10h30				DROIT DU TRAVAIL 1/2 (C. Privat)		DROIT DU TRAVAIL 3/4		
	11h00 - 12h10								
	14h30 - 16h15		SH - Watershed - 20 -16:30/17:4 / RESTITUTION PVD 1 (Dayde - Teste) Gr2		Solagro - 13:30/16h15 / MACRO TD 1 Gr2 / SH - Watershed - 20 -16:30/17:45		RESTITUTION PVD 2 Gr2		
	16h30 - 18h15								
MERCREDI	8h00 - 9h10	3		10	14AAE12 - AgroEcology - salle 20 - 13h45/17h30 - Etudiants	17		24	
	9h20 - 10h30		MACRO 1/2 (PELTIER)				DROIT DU TRAVAIL 5/6		
	11h00 - 12h10								
	13h45 - 15h30		AREM Intro Course 5 - 15h15/17H30		AREM Intro Course 7 - 15h15/17H30		AREM Intro Course 9 - 15h15/17H30		AREM Intro Course ? US only 11
	15h45 - 17h30								
JEUDI	8h00 - 9h10	4	MACRO 3/4/5	11		18	DROIT DES SOCIETES 10/11/12	25	
	9h20 - 10h30								
	11h00 - 12h10								
	13h45 - 15h30		Solagro - 14h-18h				RESTITUTION PVD 3 Gr2		
	15h45 - 17h30								
			Apéro Téléthon						
VENDREDI	8h00 - 9h10	5		12		19	Analyse de données TD2	26	
	9h20 - 10h30		MACRO 6/7						
	11h00 - 12h10								
	13h45 - 15h30		INITIATION DEMARCHE QUALITE 1				MACRO TD 2 Gr3		
	15h45 - 17h30								
SAMEDI	8h00 - 9h10	6		13		20		27	
	9h20 - 10h30								
	11h00 - 12h10								

Appendix B - Course Curricula

The following figures are of the course curricula for Kansas State University and EI Purpan. Kansas State University separates graduate and undergraduate curricula while EI Purpan combines.

Figure B.1 Biological option curriculum of KSU BAE engineering Bachelor's degree.

BIOLOGICAL & AGRICULTURAL ENGINEERING
KANSAS STATE UNIVERSITY
Bachelor of Science in Biological and Agricultural Engineering
130 hours required for graduation

BIOLOGICAL OPTION

Freshman Fall Semester	COURSE	Sem. hrs.
DEN 015	New Student Orientation	0
CHM 210	Chemistry I	4
MATH 220	Analytic Geometry and Calculus I	4
ECON 110	Principles of Macroeconomics	3
BAE 200	Intro. to Biol. and Agric. Engg. Tech	2
BAE 020	Engineering Assembly	0
SPCH 105	Public Speaking IA	2
		15

Freshman Spring Semester	COURSE	Sem. hrs.
ENGL 100	Expository Writing I[d]	3
MATH 221	Analytic Geometry and Calculus II	4
CHM 230	Chemistry II	4
BIOL 198	Principles of Biology	4
ME 212	Engineering Graphics	2
BAE 020	Engineering Assembly	0
		17

Sophomore Fall Semester	COURSE	Sem. hrs.
MATH 222	Analytic Geometry and Calculus III	4
PHYS 213	Engineering Physics I	5
CHM 350	General Organic Chemistry	3
CHM 351	General Organic Chemistry Lab	2
	Humanities or Social Science Elective[a]	3
BAE 020	Engineering Assembly	0
		17

Sophomore Spring Semester	COURSE	Sem. hrs.
MATH 240	Elementary Differential Equations	4
PHYS 214	Engineering Physics II	5
BAE 560	Properties of Biological Materials	2
DEN 275	Personal/Professional Development	1
BIOL 455	General Microbiology	4
BAE 020	Engineering Assembly	0
		16

Junior Fall Semester	COURSE	Sem. hrs.
CE 530	Statics and Dynamics	3
ME 513	Thermodynamics I	3
EECE 519	Electric Circuits and Control	4
	Biology / Biochemistry / Chemistry Elective[b]	3
	Humanities or Social Science Elective[a]	3
BAE 020	Engineering Assembly	0
		16

Junior Spring Semester	COURSE	Sem. hrs.
ME 571	Fluid Mechanics	3
	Biology / Biochemistry / Chemistry Elective[b]	3
	College of Engineering Elective[c]	4
STAT 510	Introduction to Statistics I	3
	Humanities or Social Science Elective[a]	3
BAE 020	Engineering Assembly	0
		16

Senior Fall Semester	COURSE	Sem. hrs.
BAE 536	Agricultural Engineering Design I	2
	BAE Elective	3
	College of Engineering Elective[c]	6
ENGL 415	Written Communication for Engineers[d]	3
	Biology / Biochemistry / Chemistry Elective[b]	3
BAE 020	Engineering Assembly	0
		17

Senior Spring Semester	COURSE	Sem. hrs.
BAE 640	Instrumentation and Control for Bio Sys.	3
BAE 636	Agricultural Engineering Design II (or approved capstone course)	2
	BAE Elective	3
	College of Engineering Elective[c]	3
IMSE 530	Engineering Economic Analysis	2
	Biology / Biochemistry / Chemistry Elective[b]	3
BAE 020	Engineering Assembly	0
		16

[a]Humanities & social science electives are to be selected from the approved list and need not be taken in order listed in the curriculum (2 courses must be 300 level or above).

[b]Biology, Biochemistry, and Chemistry electives are to be chosen from an approved departmental list of courses with the advice and approval of the faculty advisor and department head. Six of the 12 hours must be 400 level or higher.

[c]College of Engineering electives are to be chosen from an approved departmental list of courses with the advice and approval of the faculty advisor and department head.

[d] Prerequisites for Written Communication for Engineers (ENGL 415) must be met from Expository Writing I or II. If both ENGL 100 and ENGL 200 must be taken, the additional 3 hours do not count towards the 130 hours required for graduation.

Effective Fall 2004

9/23/03

Figure B.2 Curriculum of EI Purpan engineering diplome.

PURPAN

fésia

III. PROGRAMME OVERVIEW – PREVISIONAL – 2009-2010

Course code	Matières	Courses	Professor	ECTS credits	Bimesters
		YEAR 1			
11AAE01	Géologie	Geology	Javier Scheiner	1,5	3
11AAE03	Techniques Agricoles	Agricultural Techniques	Françoise Neron	2	1-2-3
11AAE04	Visite d'Exploitation	Farm Visit	Pierre Sabalcagaray	2,5	1-2-3
11AAE06	TP Ferme	Farm practices	Pierre Sabalcagaray	1	1
11FHC01	Anglais - Grammaire	English I - Grammar	Evelyne Francal	3	1-2-3
11FHC03	Seconde Langue	Second Foreign Language I	Evelyne Francal	2	1-2-3-4-5
11FHC05	Formation Humaine	Personal Development I	Pascale Rigaud	1	1
11FHC09	Communication Orale	Oral Communication	Danielle Daubisse	1	2
11FHC10	Français	French	Danielle Daubisse		1-2-3
11GME01	Approche Chiffrée de l'Exploitation Agricole	Accounting I	André Coulombel	2	1-2-3
11GME03	Introduction au Droit Privé et Droit de la Famille	Law	Christophe Privat	2	3
11SCB01	Biochimie Structurale	Structural Biochemistry	Roland Cazalis	1,5	1
11SCB02	Biologie Cellulaire	Cell Biology	Roland Cazalis	1,5	1-2
11SCB03	Embryologie	Embryology	Djamila Lekhal	1	1-2-3
11SCB04	Histologie	Histology	Djamila Lekhal	1	2
11SCB05	Anatomie	Anatomy	Vassilia Theodorou	1	2
11SCB06	Botanique	Botany	Jean-Marie Savoie	4	1-2
11SCB07	Génétique	Genetics I	Monique Berger	2	3
11SCB09	Microbiologie	Microbiology	Hélène Eutamene	2	3
11SCB11	Zoologie	Zoology	Hervé Brustel	1	3
11SCB12	Découverte des espèces cultivées		Lionel Alletto		1-2
11SCI01	Mathématiques - Calcul vectoriel et calcul matriciel	Mathematics I - Module 1	Karim Chaib	3	1-2
11SCI02	Mathématiques - Algèbre linéaire et analyse	Mathematics I - Module 2	Karim Chaib	3	3
11SCI03	Physique - Statique des solides	Physics I - Module 1	Fabienne Bessac	2	1
11SCI04	Physique - Statique des fluides	Physics I - Module 2	Fabienne Bessac	2	3
11SCI05	Chimie générale : Constitution de la matière	Chemistry I - Module 1	Anne Calmon	2	1-2
11SCI07	Chimie Organique	Organic Chemistry	Anne Calmon	1	1
11SCI08	Chimie Analytique 1	Analytical Chemistry I	Anne Calmon	1	1
11SCI09	Informatique et Bureautique	Computing Sciences	Jean-Louis Monlon-Borrel	1	1-2-3
		YEAR 2			
12AAE01	Pédologie	Soil Science - Module 1	Javier Scheiner	2,5	2-3
12AAE03	Agronomie	Agronomy	Christine Claudon-Duplan	2	3-4
12AAE04	Oral de Terrain	On farm technical training - Oral assessment	Thierry Lagravere	2	5
12AAE05	Machinisme**	Agricultural Mechanization II**	Thierry Lagravere	0,5	1-2-3-4-5
12FHC01	Anglais	English II	Evelyne Francal	3	1-2-3-4-5
12FHC03	Seconde Langue	Second Foreign Language II	Evelyne Francal	2	1-2-3-4-5
12FHC04	Communication	Communication	Danielle Daubisse		1-2
12FHC05	Formation Humaine : S'interroger	Personal Development II	Pascale Rigaud	1	3-4

14 / 26

Figure B.3 Curriculum of EI Purpan engineering diplome.

Course code	Matières	Courses	Professor	ECTS credits	Bimesters
12FHC06	Histoire des Cultures et des Religions	Cultures and Religion History	Evelyne Francal	1	5
12GME03	Droit des Obligations et Droit Rural	Law of Obligations and Rural Law	Christophe Privat	2	4
12GME04	Gestion Comptable et Financière	Accounting	André Coulombel		1-2-3-4-5
12MOS01	Suivi d'Exploitation**	On farm technical training**	Pierre Sabalcagaray	3,5	1-2-3-4-5
12MOS02	Rapport de Stage en exploitation	Internship Report	Thierry Lagravere	4	1-2
12SCB01	Biochimie Métabolique	Biochemistry	Vassilia Theodorou	1,5	1-2
12SCB02	Physiologie Animale - Endocrinologie	Animal Physiology - Endocrinology	Vassilia Theodorou	1	4
12SCB03	Physiologie Animale - Physiologie Digestive	Animal Physiology - Digestive Physiology	Hélène Eutamene	1	2-3
12SCB04	Physiologie Végétale	Plant Physiology	Roland Cazalis	2,5	3-4
12SCB06	Systématique Végétale	Plant Systematics	Jean-Marie Savoie	1	5
12SCB07	Génétique	Genetics II	Jean Dayde	2	2
12SCB08	Ecologie	Ecology	Véronique Cheret	1,5	4-5
12SCI01	Probabilités	Mathematics / Probabilities	Karim Chaib	2	3-4
12SCI02	Bases de la Statistique	Probabilities and Statistics	Karim Chaib	2	4-5
12SCI03	Physique - Dynamique des fluides	Physics - Fluid Mechanics	Fabienne Bessac	1	3
12SCI04	Physique - Hydraulique	Physics - Hydraulic	Fabienne Bessac	2	4-5
12SCI05	Thermodynamique	Thermodynamic	Anne Calmon	2	2-3
12SCI07	Chimie Organique	Organic Chemistry	Anne Calmon	1	4-5
12SCI08	Chimie Analytique II	Analytical Chemistry	Frédéric Violleau	1	1-2-3
12SCI09	Informatique - Créations d'applications	Computing Sciences	Jean-Louis Monlon-Borrel	2	3-4
12SCI11	Analyse matricielle		Karim Chaib		2
12SPA01	Alimentation Animale	Animal Feeding	Djamila Lekhal	1,5	3-4
12SPV01	Protection des Cultures	Crop Protection	Marie-Hélène Bonneme	2,5	4-5
12STA01	Sciences des Aliments	Basics in Food Science	Olivier Surel	1	4-5
		YEAR 3			
13AAE02	Biodiversité - Option 1		Antoine Brin	1,5	4-5
13AAE05	Machinisme - Option 1	Agricultural Mechanization III	Régis Vezian	1,5	4-5
13AAE06	Production Agricole et Sécurité Alimentaire - Option 2	Agriculture Production and Food Safety	Michel Gay	1,5	4-5
13ECM01	Micro-Economie	Micro-Economics	Céline Peltier	1	3
13ECM03	Politiques Agricoles	Agriculture Policies and Grain Market	Françoise Goulard	1	2
13FHC01	Anglais	English III	Evelyne Francal	2	1-2-3-4-5
13FHC02	TOEIC	TOEIC	Evelyne Francal	1	1-2-3
13FHC03	Seconde Langue	Second Foreign Language III	Evelyne Francal	2	1-2-3-4-5
13FHC04	Projet Professionnel - MBTI		Pascale Rigaud	0,25	3
13FHC05	Bioéthique	Personal Development III - Bioethic	Pascale Rigaud	0,25	4
13FHC06	Engagement et responsabilité	Personal Development III - Commitment and Responsibility	Pascale Rigaud	0,25	4
13FHC08	Interculturalité	Personal Development III - Inter culture	Jean-Louis Monlon-Borrel	1	4-5
13GME01	Gestion Comptable et Fiscale	Accounting and Management	André Coulombel	2	3
13GME02	Gestion de l'Exploitation Agricole	Management	Aline Dumont	1	1-2

15 / 26

Figure B.4 Curriculum of EI Purpan engineering diplome.

Course code	Matières	Courses	Professor	ECTS credits	Bimesters
13GME03	Droit des Sociétés Agricoles	Agriculture Company Law	Christophe Privat	1,5	2-3
13GME04	Marketing	Marketing	Sébastien Bral	1,5	4-5
13GME09	Conseil de Gestion – Option 1	Management Consultancy	André Coulombel	1,5	4-5
13MOS01	Mémoire Bibliographique	Bibliographical Synthesis and Report	Jean-Louis Monlon-Borrel	4,5	1-2-3-4
13MOS02	Cas Concret**	Agricultural Case Study**	Jean-Louis Monlon-Borrel	3	4-5
13SCB01	Génétique des Populations	Population Genetics	Jean Dayde	1	2-3
13SCI01	Statistiques descriptive et inférentielle	Inferential Statistics	Josiane Lacombe	2	3
13SCI03	Analyse de Données 2	Data Analysis 2	Monique Berger	1	3-4
13SCI04	Recherche Documentaire et Analyse de texte	Information Research / Document Summary	Danielle Daubisse	0,5	2
13SCI05	Cartographie Numérique – Option 2	Digital Mapping	Michel Gay	1,5	4-5
13SCI06	Analyse de données 1	Data Analysis 1	Josiane Lacombe		2-3
13SCI11	Conception et réalisation de Bases de Données	Computer Analysis - Data Bases and Prototyping	Jean-Louis Monlon-Borrel	1	4
13SDT01	Histoire des Organismes Professionnels Agricoles	History of the Professional Agricultural Organizations in Fr	Jean-Louis Monlon-Borrel	0,5	2
13SPA01	Elaboration Produits Animaux	Basics of Animal Science	Djamila Lekhal	1	1-2
13SPA04	Amélioration génétique des animaux	Animal Breeding	Christine Claudon-Duplan	1,5	3-4
13SPA05	Elevages Alternatifs – Option 1	Particular Animal Husbandry	Fabien Alleman	1,5	4-5
13SPA06	Aquaculture	Aquaculture	Vassilia Theodorou	1,5	4-5
13SPA07	Bien être animal - Bâtiment d'élevage – Option 1	Animal Welfare	Djamila Lekhal	1,5	4-5
13SPV01	Gestion de Production en Grande Culture	Field Crops	Françoise Goulard	2	3-4
13SPV02	Gestion du Système Fourrager	Forage Systems	Christine Claudon-Duplan	1	2-3
13SPV04	Physiologie Plantes Perennes	Perennial Plant Physiology	Didier Kleiber	1	3
13SPV05	Arboriculture	Arboriculture	Didier Kleiber	1	3
13SPV06	Ecologie des Plantes Perennes	Perennial Plant Ecology	Michel Gay	1	3
13SPV07	Viticulture	Viticulture	Nathalie Mailhac	1	3
13SPV08	Maraîchage – Option 2	Horticulture and Vegetable Cropping	Didier Kleiber	1,5	4-5
13SPV09	Viticulture et Œnologie appliquées – Option 1	Applied Viticulture & Enology	Nathalie Mailhac	1,5	4-5
13SPV10	Stratégies de protection des cultures à bas niveau intrants – Option 2		Antoine Brin	1,5	4-5
13SPV11	Amélioration des Plantes	Plant Breeding	Jean Dayde	1,5	3-4
13STA01	Sciences et Technologies Agro-Alimentaires	Food Science and Technology	Olivier Surel	5	1-2-3
13STA02	Œnologie	Wine-making	Nathalie Mailhac	1	2
13STA04	Cultures Industrielles Alternatives – Option 1	Alternative Industrial Crops	Françoise Goulard	1,5	4-5
13STA05	Qualité Agro-Alimentaire – Option 2	Farm-produce Quality	Olivier Surel	1,5	4-5

16 / 26

Figure B.5 Curriculum of EI Purpan engineering diplome.

PURPAN
Ecole d'ingénieurs

fésia

YEAR 4					
14AAE02	Agriculture et Environnement	Agriculture and Environment	Françoise Goulard	2	3
14AAE03	Agricultures Alternatives – Option 2	Particular Agriculture	Javier Scheiner	1,5	4
14AAE05	Agriculture Comparée	Comparative Production Systems	Christine Claudon-Duplan	1,5	4
14ECM01	Economie des productions animales - Option 1	Animal Production Economics	Fabien Alleman	2	3
14ECM03	Marché du Vin - Option 1	Wine Market	Jean-Louis Dejean	2	3
14ECM04	Marché des Fruits et Légumes - Option 1	Fruit and Vegetable Market	Didier Kleiber	2	3
14ECM05	Economie internationale	International Economics	Céline Peltier	1,5	3-4
14ECM07	Grande distribution - Option 2	Mass Marketing	Olivier Surel	2	4
14ECM10	Négociation Commerciale	Commercial Negociation	Mélise Bouroullec	1	4
14ECM11	Macro-Economie	Macro-Economics	Céline Peltier	2	3
14FHC02	Seconde Langue	Second Foreign Language IV	Evelyne Francal	1	3
14FHC03	Français Langue Etrangère	French Foreign Language	Sarah Prince	3	1-2-3-4
14FHC07	TOEIC	TOEIC	Bernadette Flannery		3
14FHC08	Construire son projet professionnel		Pascale Rigaud	0,5	3
14GME01	Finance	Finance	Catherine Tocquer	1	3
14GME03	Politique Générale d'Entreprise	General Company Policy	Céline Peltier	2	3-4
14GME04	Droit Fiscal	Tax Law	Christophe Privat	1,5	3
14GME05	Droit des Sociétés Commerciales	Compagny Trade Law	Christophe Privat	1,5	3-4
14GME06	Droit du Travail	Social Law	Christophe Privat	2	5
14GME08	Méthodes Quantitatives de Gestion	Quantitative Methods in Management	Céline Peltier	1,5	5
14MOS01	Grand oral	BSc oral	Christophe Privat	6	2
14MOS02	Projet	Professional Case Study	Christophe Privat	6	3-4-5
14MOS04	Méthode d'Accompagnement de Projet	Project Management Methodology	Christine Claudon-Duplan	1	3
14MOS05	Formation à l'Ecriture de Documents Professionnels		Pascale Rigaud	0,5	3
14SCB01	Biotechnologie et Ethique	Biotechnology and Ethic	Jean Dayde	2	5
14SCI01	Méthodes d'Enquête	Survey Methodology	Cécile Levasseur	0,5	3
14SCI02	Analyses de Données	Data Analysis	Monique Berger	1	3-4
14SCI03	Initiation Démarche Qualité	Quality Assurance Survey	Hélène Tormo	1	3
14SCI04	Méthode d'optimisation	Optimization model	Karim Chaib	1,5	4
14SCI11	Modélisation des systèmes d'information	Information system modelling	Jean-Louis Monlon-Borrel	1	5
14SDT01	Sociologie	Agricultural Sociology	Christophe Privat	2	3-4-5
14SDT05	Filière et Territoire	Production network strategy / Networds and Land	Christine Claudon-Duplan	2	3
14SPV01	Valorisation non alimentaire des prod. agricoles - Option 3	Valorization of Non-food Agricultural Productions	Anne Calmon	2	5
14STA01	Industries des aliments du bétail - Option 3	Feed Industries	Fabien Alleman	2	5
14STA02	Industries Alimentaires - Option 3	Food Industries	Olivier Surel	2	5

17 / 26

Figure B.6 Curriculum of EI Purpan engineering diplome.

YEAR 5					
15ECM01	L'entreprise agricole dans son environnement en évolution	The Enterprise Environment	Jean-Marie Savoie	3	3
15FHC01	Accompagnement pour la recherche d'emploi	Entering the Job Market	Jean-Marie Savoie	1	3
15GME01	Stratégie d'entreprise et management	Firm Strategy & Management	Jean-Marie Savoie	2	3
15MOS01	Mémoire de Fin d'Etudes	Master's Thesis	Didier Kleiber	30	
16AAE01	Forêt agriculture et environnement*	Agriculture, Forest and Environment*	Véronique Cheret	23	3-4
16GME01	Création et gestion de l'entreprise*	Business set-up and Management*	Céline Peltier	23	3-4
16GME02	Management des entreprises viti-vinicoles*	Viticulture/Wine Business Management*	Jean-Louis Dejean	23	3-4
16GME03	Export et management international*	Exports and International Management*	Sébastien Brel	23	3-4
16GME04	Stratégie des systèmes d'information*	Information Systems Strategy*	Jean-Louis Monlon-Borrel	23	3-4
16GME05	Management des entreprises de la filière Equine en Europe*	Equine Management in Europe*	Michel de Rancourt	23	3-4
16SDT01	Stratégie territoriale et action locale*	Land Strategy & Local Policies*	Sylvie Paradis	23	3-4
16SPA01	Programme intensif Filière Equine en Europe	IP Equine Management in Europe	Michel de Rancourt	4	3
16STA01	Qualité et sécurité des aliments*	Food Safety and Quality*	Olivier Surel	23	3-4

Bimesters :	September / October: 1	January / February: 3	May / June: 5
	November / December: 2	March / April : 4	July / August : 6

** Enrolment subject to prior acceptance / Inscription soumise à approbation préalable*
*** Not open to exchange students / Non ouvert aux étudiants étrangers*
Courses/Options by colour and by year: choose one course among each / Même couleur et/ou option : un seul choix possible

18 / 26

Figure B.7 Example Program of Study for KSU BAE Engineering Master's.

The Graduate School

Kansas State University

PROGRAM OF STUDY: MASTER'S

Name:
K-State eID:
Student Number:
Program:

Master's Thesis ☒
Master's Report ☐
Non Thesis/Report ☐

Course Number	Course Title	Credit Hours	Semester Taken
Example: AGRON101	Example: Basic Introduction	Example: 3	Example: S05
Review instructions on page 2 prior to completing. Submit original and 4 copies of both pages.			
GENAG780	Ag Resources and Environmental Management	2	SP09
BAE650	Energy and Biofuel Engineering	3	SP09
BAE651	Air Pollution Engineering	3	SP09
SOCIO533	Rural Sociology	3	SP09
EECE772	Theory of Bioinstrumentation	2	F08
AP773	Bioinstrumentation Lab	1	F08
STAT704	Analysis of Variance	2	S09
STAT705	Regression and Correlation Analysis	2	S09
BAE899	Thesis	6	Variable
BAE820	Topics in Ag Engg (AREM Purpan Toulouse France)	1	F09
GEOG795	Topics in Geographic Information Science	1	F09
ECON681	International Economics	3	SP10
BAE815	Graduate Seminar in Agricultural Engineering	1	SP10

Total KSU credits 30

Appendix C - KSU Minor and EI Purpan Curriculum

The tables C.1 – C.3 compare selected minor's that students may pursue at KSU, and the corresponding portion of EI Purpan engineering Bachelor's education.

Table C.1 Comparison of Biology Minor at KSU and EI Purpan Bachelor biology curriculum.

Biology Minor at KSU	Credit Hours	**ECTS**	
Totals	21	36.65	
Principles of Biology	4	6.98	
Organismic Biology	5	8.73	
Modern Genetics	4	6.98	
Physiology of Animals	3	5.24	
Phsy of Anmls Lab	1	1.75	
Plant Physiology	4	6.98	
Purpan Year Color Code	1st Year	2nd Year	3rd Year
Purpan Bachelor Biology Requirements	Credit Hours	**ECTS**	
Totals	16.33	**28.5**	
Biochem Structures	0.86	1.5	
Cell Bio	0.86	1.5	
Embryology	0.57	1	
Histology	0.57	1	
Anatomy	0.57	1	
Botany	2.29	4	
Genetics	1.15	2	
Microbiology	1.15	2	
Zoology	0.57	1	
Metabolic Biochem	0.86	1.5	
Animal Physiology/Endocrine	0.57	1	
Animal Physiology/Physiology	0.57	1	
Plant Physiology	1.43	2.5	
Plant Systematics	0.57	1	
Genetics II	1.15	2	
Ecology	0.86	1.5	
Population Genetics	0.57	1	
Perennial Plant Physiology	0.57	1	
Perennial Plant Ecology	0.57	1	

Table C.2 Comparison of Business Minor at KSU and EI Purpan Bachelor business related curriculum.

Business Minor at KSU	Credit Hours	**ECTS**
Totals	15	26.18
Business Operations Accounting	3	5.24
Investment and Financing Accounting	3	5.24
Principles of Finance	3	5.24
Management Concepts	3	5.24
Introduction to Marketing	3	5.24
Purpan Bachelor Business/Management/Accounting/Economics	Credit Hours	**ECTS**
Totals	9.74	17
Computing Sciences	0.57	1
Personal Development	0.57	1
Personal Development II	0.57	1
Computer Programming	1.15	2
Bioethics	0.14	0.25
Commitment and Responsibility	0.14	0.25
Interculture	0.57	1
Management	0.57	1
Data Bases and Prototyping	0.57	1
Accounting I	1.15	2
Account and Finance Management	1.15	2
Micro-economics	0.57	1
Account and Finance Management	1.15	2
Marketing	0.86	1.5

Table C.3 Comparison of Agronomy Minor at KSU and EI Purpan Bachelor agriculture curriculum.

Agronomy Minor at KSU	Credit Hours	**ECTS**
Totals	17	29.67
Soils	4	6.98
Crop Science	4	6.98
Forage Management	3	5.24
Crop Growth and Development	3	5.24
Weed Science	3	5.24
Agriculture	Credit Hours	**ECTS**
Totals	17.76	31.00
Ag Techniques	0.86	1.5
Farm Practices	0.57	1
Soil Science I	1.43	2.5
Agronomy	1.15	2
On Farm technical training	1.15	2
Ag Mechanization	0.29	0.5
On Farm technical training	2.01	3.5
Animal Feeding	0.86	1.5
Crop Protection	1.43	2.5
Food Science	0.57	1
Ag policy and marketing	0.57	1
History of French Ag Organizations	0.29	0.5
Animal Science	0.57	1
Aqauculture	0.86	1.5
Field Crops	1.15	2
Forage Systems	0.57	1
Food Science and Technology	2.86	5
Wine-making	0.57	1

Table C.4 Proposed BS/MS program for KSU BAE as compared to EI Purpan.

	KSU		EI Purpan	
	Bio/Biochem/Chem	CH	*Bio/Biochem/Chem*	ECTS
BIOL 198	Principles of Biology	4	Biochem Structures	1.5
BIOL 201	Organismic Biology	5	Cell Bio	1.5
BIOL 450	Modern Genetics	4	Embryology	1
BIOL 513	Physiology of Animals	3	Histology	1
BIOL 514	Phsy of Anmls Lab	1	Anatomy	1
BIOL 500	Plant Physiology	4	Botany	4
BIOCH 521	General Biochemistry	3	Genetics	2
CHM 210	Chemisty 1	4	Microbiology	2
CHM 350	General Organic	3	General Chem	2
CHM 351	General Organic Lab	2	Organic Chem	1
	Elective	3	Chem Analytic	1
			Zoology	1
			Metabolic Biochem	1.5
			Animal Physiology/Endocrine	1
			Animal Physiology/Physiology	1
			Plant Physiology	2.5
			Plant Systematics	1
			Genetics II	2
			Ecology	1.5
			Organic Chem	1
			Chem Analytic II	1
			Population Genetics	1
			Perennial Plant Physiology	1
			Perennial Plant Ecology	1
			Biotechnology and Ethics	2

	Humanities / Social Science	CH	*Humanities / Social Science*	ECTS
POLSC 110	Intro to Political Science	3	Law	2
AGEC 410	Agricultural Policy	3	History of Culture and Religion	1
	Elective	3	Rural and Obligation Law	2
	Elective	3	Ag Company Law	1.5
			Tax Law	1.5
			Company Trade Law	1.5
			Social Law	2
			Agricultural Sociology	2

	Business Management	CH
ACCTG 231	Business Operations Accounting	3
ACCTG 241	Investment and Financing Accounting	3
FINAN 450	Principles of Finance	3
MANGT 420	Management Concepts	3
MKTG 400	Introduction to Marketing	3
ECON 110	Priciples of Macroeconomic	3
ECON 120	Principles of Microeconomics	3
	Elective	3
	Elective	3

Business Management	ECTS
Computing Sciences	1
Personal Development	1
Personal Development II	1
Computer Programming	2
Bioethics	0.25
Commitment and Responsibility	0.25
Interculture	1
Management	1
Data Bases and Prototyping	1
Commercial Negociations	1
General Company Policy	2
Quantitative Methods in Management	1.5
Survey Methodology (investigation)	0.5
Quality Assurance	1
Optimization	1.5
Information Systems	1
Production Network Strategy	2
Enterprise Environment	3
Entering the Job Market	1
Firm Strategy and Management	2
Accounting I	2
Account and Finance Management	2
Micro-economics	1
Account and Finance Management	2
Marketing	1.5
International Economics	1.5
Macro Economics	2
Finance	1

	Math	CH
MATH 220	Analytic Geometry and Calculus I	4
STAT 510	Intro to Probablities and Statistics	3

Math	ECTS
Calc I	3
Linear Algebra	3
Probabilities	2
Statistics	2
Inferential Statistics	2
Data Analysis	1
Data Analysis II	1
Data Analysis III	1

	Physics	CH
PHYS 213	Engineering Physics I	5
PHYS 214	Engineering Physics 2	5
ME 571	Fluid Mechanics	3
ME 513	Thermodynamics	3

Physics	ECTS
Solid Statics	2
Fluid Statics	2
Geology	1.5
Fluid Mechanics	1
Hydraulics	2
Thermodynamics	2

	Communication	CH
COMM 106	Public Speaking I	3
ENGL 100	Expository Writing	3
FREN 113	Accelerated Beginning French	5
FREN 215	Elementary French Conversation	2
SPAN 165	Accelerated Beginning Spanish	5

Communication	ECTS
English Grammer	3
Second Foreign Language	2
Oral Communication	1
French	
English II	3
Second Foreign Language II	2
Communication	
TOEIC	1
English III	2
Second Foreign Language III	2
Second Foreign Language IV	1
French Foreign Language	3
TOEIC	1

	Agriculture	CH
AGRON 305	Soils	4
AGRON 220	Crop Science	4
AGRON 550	Forage Management	3
AGRON 360	Crop Growth and Development	3
ASI 102	Principles of Animal Science	3
ATM 160	Engineered Systems and Technology in Ag	3
	Elective	3
	Elective	3

Agriculture	ECTS
Ag Techniques	1.5
Farm Practices	1
Soil Science I	2.5
Agronomy	2
On Farm technical training	2
Ag Mechanization	0.5
On Farm technical training	3.5
Animal Feeding	1.5
Crop Protection	2.5
Food Science	1
Ag policy and marketing	1
History of French Ag Organizations	0.5
Animal Science	1
Aqaauculture	1.5
Field Crops	2
Forage Systems	1
Food Science and Technology	5
Wine-making	1
Agriculture and Environment	2
Comparative Production Systems	1.5

	Reports/Project	CH
ENGL 415	Written Communication for Engineers	3
ENGL 516	Written Communication for the Sciences	3
BAE 536	Biological Systems Senior Design	3
BAE 636	Biological Systems Design Project	3
BAE 899	Masters Thesis	6

Reports/Project	ECTS
Internship Report	4
Agricultural Case Study	3
Bibliographical Report	4.5
Professional Project	0.25
BSc Oral	6
Professional Case Study	6
Professional Document Writing	0.5
Information Research	0.5
Project Management	1
Master's Thesis	30

	CH	ECTS
Total	160	188.3