

EMPLOYERS PERCEPTIONS OF AGRICULTURAL SYSTEMS MANAGEMENT
(ASM) GRADUATES COMPETENCIES AND SKILL LEVEL IN THE WORK
ENVIRONMENT

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MANAGEMENT (ASM) GRADUATES COMPETENCIES AND
SKILL LEVEL IN THE WORK ENVIRONMENT

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DEDICATION

I would like to dedicate this work to my parents Carl and Rebecca Martens. Dad - thanks for teaching me how to work hard and providing me guidance throughout my life. Mom - thanks for all of your support, encouragement and making sure I always had everything that I needed to survive.

To the love of my life, Natalie, thank you for all of your support and encouraging me when I did not want to go any farther.

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LIST OF ABBREVIATIONS

ASM: Agricultural Systems Management

MU: University of Missouri

IRB: Institutional Review Board

ABET: Accreditation Board for Engineering and Technology, Inc.

MWDS: Mean Weight Discrepancy Score

WDS: Weighed Discrepancy Score

SAS: Statistical Analysis System

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ABSTRACT

The University of Missouri Agricultural Systems Management and Agricultural Engineering Extension program is undergoing a six year review in order to evaluate whether or not the department is satisfying the needs of the community and student population. In order to increase the usefulness of this review a survey was sent to 100 employers of ASM graduates and self-employed ASM graduates asking for their perception of the skill level of the ASM graduate they employ and the importance of that skill to their industry for 11 general competencies and 29 ASM competencies that the ASM program is currently teaching in its curriculum. The data generated by this survey was used to calculate a Mean Weight Discrepancy Score (MWDS) for each of the 40 competencies in order to see which skills needed to be emphasized/de-emphasized in the ASM program. Respondents suggested that general skills such as effective use of financial management skills (MWDS = 1.90), skills associated with marketing of a product (MWDS = 1.81), and ability to motivate employees or co-workers (MWDS = 1.07) should be emphasized more in the ASM program curriculum and ability to show

more desirable employability skills compared to graduates of other universities (MWDS = -1.89) should be de-emphasized. Survey participants suggested that ASM competencies such as ability to install, calibrate, and demonstrate precision agriculture systems (MWDS = 1.14) should be emphasized more in the ASM program and skills such as ability to understand and operate grain storage systems (MWDS = -1.01), knowledge required to construct agricultural structures (MWDS = -1.02), knowledge of safe handling and storage of pesticides (MWDS = -1.02), knowledge to plan appropriate layout of farmstead buildings (MWDS = -1.11), ability to select appropriate equipment for pesticide/fertilizer application (MWDS = -1.16), understanding of challenges associated with logistics of biofuels (MWDS = -1.61), and knowledge of renewable energy and sustainable energy sources (MWDS = -1.74) should be de-emphasized.

CHAPTER 1

INTRODUCTION

Innovations in agricultural technology and production methods have allowed producers to increase their level of production which has led to a growth in the economy of the entire world. Agriculture production has become a very important topic of discussion among professionals because the United Nation has projected that the world population is expected to increase to 9.1 billion people by the year 2050 (Gilland 2002). To meet the demands of a growing population it has been estimated that agriculture production needs to increase by at least 50% (Horlings and Marsden 2011). This creates a unique challenge for the agriculture industry because of limited resources and competition for agricultural land due to urbanization and the expansion of the population. Factors such as an increase in global food demand and supply due to growing populations, changes in diets due to developing economies, demand for renewable energy sources, and changes in land use and resources such as water all affect crop productivity and demand for food (Spiertz and Ewert 2009). Not only is the population of the world increasing, the expectation for quality of lifestyle for many developing countries is improving which increases the demand for food and increases the overall amount of food that needs to be produced.

The solution to increasing world agricultural production is maximizing yields by efficiently growing crops and expanding the amount of land used for agricultural production (Wolf et al. 2003). Producers must look for technological innovations that

increase the efficiency in which they produce crops because farmers need to produce more food with fewer available resources (Schneider et al. 2011). Along with an increase in the population comes an increase in the demand for limited resources such as water which is essential for agricultural production and this competition could become a serious issue in the future.

Technological innovations have assisted producers in increasing their yields. It has been estimated that without “agricultural intensification” and “technical progress” there would need to be 50-65% more land for agricultural production to meet the needs of a growing population; technical innovation is needed to offset the demand for more food (Schneider et al. 2011). In the past, the food demand was met through the green revolution. Factors such as improved crop varieties through breeding, application of inexpensive fertilizers, application of pesticides for weed, insect, and disease control, and improved irrigation practices increase agricultural production to meet the demands of the world population (Gregory and George 2011). Agricultural mechanics has also been a major influence in the development of the agriculture industry because it has increased the efficiency of crop production (Herren 2006). Many of the new production technologies and methods would not have been possible without the mechanization of agriculture. These types of technical revolutions will still need to take place in the future but they will need to be optimized with proper management strategies and training to reach maximum efficiency. Management strategies that producers need to be competitive in the future, include adapting to technology quickly, utilizing information technology and atomization, and developing systemic procedures for operating tasks (Lamp 2008).

As the agricultural industry is challenged with increasing production levels to satisfy the demand for food for a growing population it is apparent that the demand for people that have knowledge of the technical skills required for agricultural production will also increase. As many developing countries adopt new technologies they will have to be properly trained to use the technologies to ensure that they reach the maximum production efficiency possible. Many of these trained professionals will be supplied through agriculture technology programs. The Agricultural Systems Management (ASM) Program at the University of Missouri “is nationally recognized for its integration of agriculture technology with the physical sciences using a systems approach that incorporates management skill development” because of the “Systems approach in teaching curricula” that provides necessary technical skills for the agriculture industry that incorporates economic and management principals while developing communication and problem solving skills (Strickland et al. 2006). These skills are essential to the agriculture industry and they will provide valuable assistance in helping meet the needs of a changing industry.

It has been stated that the placement of graduates in the industry is a measure of success for a university and if they are not adequately prepared with the necessary skills to be successful in the agriculture industry than they will struggle to find work (Briggeman et al. 2007). Universities that are teaching technical agriculture skills through developed curricula must be mindful of the needs of the industry in order to prepare graduates to be most successful in the agriculture industry. Without this input

graduates will not only struggle to find work, but the whole industry will be affected due to the lack of well prepared workers.

1.1 Statement of the Problem

The University of Missouri Agricultural Systems Management and Agricultural Engineering Extension program is undergoing a six year review in order to evaluate whether or not the department is satisfying the needs of the community and student population. The goal of this review is to determine the strengths of the department as well as weaknesses in order to offer suggestions to improve the ASM program and Ag Engineering Extension. Ideally the Agricultural Engineering Extension and ASM faculty would work together to provide research for outreach and curriculum enhancement. A part of this review is assessing the current ASM curriculum in order to see if the topics of study are keeping up with new technologies and demands of the agriculture industry. All of the analysis is within the program so it is also important that research is conducted in the agriculture industry to see if the ASM program is teaching the necessary skills for students to be successful in the workplace. Researching employers' perceptions of ASM graduates will guide the faculty in finding areas of the ASM curriculum to improve or expand. "Employer surveys provide further insight into the knowledge, skills, and traits required of recent graduates" (Berle 2007). This information would go hand in hand with the suggestions from the six year review in ensuring that the ASM program is properly preparing students for the agriculture industry.

1.2 Purpose of the Study

The purpose of this study is to survey employers of ASM graduates to assess their perception of the skills acquired by ASM graduates and the importance of each skill for their industry. This research will assist the ASM program review by gathering critical information that will assist in curriculum development that will better prepare ASM students for the workforce.

1.3 Objectives of the Study

1. Describe the demographic characteristics: industry of employment, years working with an ASM graduate, completion of an ASM degree, years working as an ASM graduate, number of graduates hired in the last 5 years, anticipated number of graduates that will be hired in the next five years, previous training desired from potential employees, days spent training new employees, tools used to train new employees, topics focused on most when starting to train new employees, communication with potential employers through social networks (Facebook, LinkedIn, etc.) posting of online applications for potential employees, and level of management of business participant is involved in.
2. Describe the level of acquired skills of ASM graduates as perceived by their employers.
3. Describe the importance of the skill to the organization as indicated by the employers of Agricultural Systems Management graduates.

4. Describe the overall difference among each respondent between graduate's skill level and importance of competency for employer's industry with a Mean Weight Discrepancy Score (MWDS).
5. Compare the calculated Weighted Discrepancy Score (WDS) for each respondent to demographic characteristics such as industry of employment, years working with an ASM graduate, completion of an ASM degree, years working as an ASM graduate, number of graduates hired in the last 5 years, and level of management within the respondents industry.
6. Summarize suggestions for new topic areas, foreseen skills needed in the future, and most common technical information used by ASM graduates as perceived by employers and self-employed ASM graduates.

1.4 Definition of Terms and Abbreviations

ASM: Agricultural Systems Management

MU: University of Missouri

IRB: Institutional Review Board

ABET: Accreditation Board for Engineering and Technology, Inc.

MWDS: Mean Weight Discrepancy Score

WDS: Weighted Discrepancy Score

SAS: Statistical Analysis System

Agricultural Systems Management: A bachelor's degree program offered at the University of Missouri whose goal is to educate students about technical management and physical principles in the agriculture industry.

Skill Level: Special ability or task that requires special training or manual proficiency.

Employer: An immediate supervisor/boss that employs an ASM graduate.

Curriculum: Coursework designed specifically to educate ASM students about management and agriculture.

Competencies: Qualification of ASM students to demonstrate skills acquired upon completion of the ASM curricula.

Employability Skills: Non-technical skills that employers desire in potential employees.

ASM Skills: Technical agriculture management skills acquired by ASM graduates through the ASM curricula.

1.5 Assumptions of the Study

The following assumptions were made when considering any conclusions or suggestions.

1. The sample of ASM graduates was representative of the ASM graduate population.
2. ASM graduates gave accurate information about their current employer.
3. The sample of ASM employers was representative of the target population.
4. Employers answered all questions objectively and without bias.

1.6 Limitations of the Study

Any conclusions or suggestions are limited by the following factors.

1. The study was limited to employers of Agricultural Systems Management graduates.
2. The population consisted of employers of Agricultural Systems Management graduates so any results can only be generalized to this population.
3. The degree that employers fully observed and understood the ASM skills acquired by ASM graduates.
4. Employers' perception of the need for each skill for their industry.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The purpose of this section is to provide a literature review about the importance of input from the agriculture industry about graduates' competency levels and importance of skills acquired for the industry for future curriculum development. It gives the background for the research problem as well as reviewing previous research that will assist in helping to interpret and show the usefulness of the results generated from this study.

2.2 Developing Curriculum to Meet the Demands of the Industry

Postsecondary education provides a unique opportunity for students to enhance their knowledge of personal development and technical skills through detailed curricula. Most universities require students to take classes that enhance their general knowledge to provide more desirable employability skills along with specific technical classes that train them to be successful in their industry. Although these courses teach students skills that will help in their personal development, it has been stated that the fundamental goal of postsecondary education is to prepare students to be successful in their careers in the industry (Cole and Thomson 2002). Universities accomplish this by analyzing the industry, then building and modifying curricula to meet the needs of the real world.

Often the skills and competencies that universities are called to deliver is changing because of “innovation in technology, globalization, and the increasing diversity in the workforce” (Zekeri 2004). These changes happen very quickly, especially in the agriculture industry. Innovative technology is being introduced and changing at a rapid rate as well as employers’ expectations of postsecondary graduates’ skills and competencies. As the agriculture industry is changing, it is vital that agriculture education keep up with new technologies and trends (Suvedi and Heyboer 2003). This has great importance among all postsecondary institutions because “placement of graduates is considered to be a measure of success of educational programs, including those in the agricultural sciences” (Briggeman et al. 2007). If a university fails to adapt its curriculum to reflect the skills and competencies demanded by the agriculture industry, then ultimately the success of the university is at stake because the students will fail to meet the expectations of employers risking their ability to be hired. If the measure of success of postsecondary institutions is their ability to prepare students to find employment and the students are failing to do so, then the reputation and validity of the education given by the university will diminish.

Postsecondary institutions not only have the task of preparing their students. They are also faced with the challenge of balancing research and education and improve undergraduate education (Suvedi and Heyboer 2003). This is a problem that Agricultural Systems Management has been facing in recent years, but it is addressed in a Strategic Plan that was developed in 2008. It states that the goal of the Biological Engineering Division is to have “comprehensive educational and extension outreach programs that

incorporates and integrates teaching, research, and extension outreach,” one crucial part of this plan is surveying ASM alumni and industry leaders to “determine the skills and competencies needed by ASM professionals” (2008). Ideally the research conducted in this program would be current with the industry and used to enhance coursework for students. But “little research has been conducted to determine the current and future directions of Agricultural Systems Management programs across the nation” (Schumacher et al. 2000), especially at the University of Missouri.

According to Strickland and Ess (2001), ABET is encouraging outcome based curriculum for all Engineering programs which means that knowing what students need to learn to be successful is crucial in keeping programs current with the industry. Understanding what knowledge employers expect ASM graduates to possess will help the program to adapt its curricula to meet the demands of industry and better prepare its students to be successful after graduation.

2.3 Importance of Industry Input for Curriculum Development

Postsecondary curriculum is a valuable tool to help students develop general and technical skills that prepare them to be successful for employment. Strong curriculum requires knowledge of the industry it is designed to reflect in order to insure that graduates are equipped with the best skill set and knowledge to meet the demands of the industry. Many curriculum programs have been established and in practice for years and have been successful in providing students with quality education. But “strengthening and updating” curriculum is important in preparing students to succeed in the job market

and be successful in problems they face in the industry, but it requires a knowledge of employers' perceptions of college curriculum (Kitto et al. 1996).

Zekeri (2004) agrees by stating that if universities are going to prepare students to be successful in the workplace they must change curricula to “reflect the dynamic needs” of employers in the industry, and understanding what skills students need most for their careers will assist in improving curricula. Changing and developing curricula is essential to any university program to reflect changes and innovations to research, but without industry input on skills that are needed, crucial areas may be overlooked. It is important to be aware of the competencies desired by employers for preparing students for the workforce and for curriculum development; this requires constant analyses of the changes in the industry (Andelt et al. 1997). It is important to note that the needs of employers in the industry are dynamic so it requires constant assessment of their needs which will transform into constant updates in course curriculum.

Understanding what employers expect not only helps to enhance course work but “industry input” is very valuable for universities when they are assessing ways to improve students' knowledge, skills, and professional development (Beidler et al. 2006). When the faculty of a university understands the needs of employers in the industry they can then develop and update current curricula that will better prepare students for their career after graduation. This also allows the faculty to develop a relationship with employers in the industry and it increases their knowledge of the needs of the industry. With this knowledge the faculty can assist in preparing and helping students find job opportunities (Suvedi and Heyboer 2003). Ultimately knowing what the industry is

expecting will directly benefit students because they will be better prepared to be successful in meeting the problems within their industry and their faculty will be familiar with how they need to be preparing students so they will be desirable for prospective employers.

2.4 Skills that Employers Expect

Graduates often begin work in “specialized positions” that demand a specific skill set that is required for their industry; this makes it very challenging for “higher education institutes to prepare students for employment” (Robinson et al. 2007b). Knowing what employers expect from college graduates is very helpful in preparing new coursework for students and it can also be very helpful in each student’s personal preparation and motivation to succeed in school and the industry. The goal for universities is to prepare students for the workforce, but students’ perception of competencies needed for the industry and their level of skill often are different from employers’ expectations of those skills (DuPre and Williams 2011). Often students focus on succeeding in their classes and focusing on their grades rather than focusing on the skills that will be required in the industry after they graduate. Grade point averages are important for students to be considered for positions, but it is not the only factor that employers consider (DuPre and Williams 2011).

A study conducted by Donhardt (2004) looked at the relationship between academic success and success in the workplace of recent graduates, and found that there is no relationship between grade point average and earnings, but the skills learned at

college help lead to productivity in the workplace. It is important that students succeed and do well in their coursework because this teaches them the necessary skills to be productive and work hard, but employers also are looking for more skills and competencies that can be applied to the industry in the employees that they hire. Out of all of the skills acquired at a postsecondary institute, technical skills are important for employers but they are also looking for more “personal skills such as communication, professionalism, teamwork, and management skills” (VanDerZanden and Reinert 2009). Also, employers look for students who have developed communication skills, work well in teams and individually, keep up with new technology, and have a “strong knowledge base and the ability to comprehend the interaction of complex systems” (Beard 2001). These skill sets provide graduates with more desirable employability attributes but “basic academic and technical skills” are “essential” because they show how well an employee can learn and apply new information which is important because technology is always changing (Briggeman et al. 2007). Skills such as “communication, leadership, interpersonal competence, and computers” are needed to be successful in the agriculture industry and are often indicated as the most important skills by employers, but it is also important not to discount the necessity of technical skills in agribusiness because they are required in the industry (Andelt et al. 1997). Technical skills are necessary to qualify for jobs in the agriculture industry but employers expect students to possess personal skills that will make them a more desirable worker.

Graduates often have an advantage if they possess “outstanding credentials in a number of non-industry specific desired skills” (DuPre and Williams 2011). It is very

important that coursework offered at a university provide students the technical skills that they need to succeed in an industry as well as personal skills that employers are seeking when they look to hire new graduates. Companies often provide technical training for employers to prepare them to fulfill their jobs, but less training is offered to improve “employability skill development” (Robinson et al. 2007a). Universities must do their best to give students general employability skills to ensure their success in starting their careers.

2.5 Closing the Gap between Employers’ Expectations and University Curricula

The reason that employers’ perceptions of the skills and competencies needed in college graduates is considered in curriculum development and enhancement is because of an existing gap between what employers expect and what universities provide. Previous studies tend to focus less on competencies needed in the industry and more on “satisfaction” of the degree program; however they do show that employers, students, and faculty often have different perceptions of curriculum programs (Berle 2007). This is because of the previously mentioned change that is ongoing in the industry. Employers and graduates are often not satisfied with the level of skills that they learn from a University; employers see college education as a indication of the students’ knowledge base (Crebert et al. 2004). Employers understand that college is providing the means for students to increase their knowledge but it does not necessarily teach them all of the skills required to be productive in the industry. Robinson (2009) goes on to explain one reason this is happening is that students often do not possess desired employability skills

because college faculty often focus on “teaching technical content”; as a result employers must retrain employees in these areas.

Employment in the agriculture industry not only requires a high level of technical skills, but a wide range of “non-technical” skills. Lack of skills important to employers is a reason that students struggle to find work (Briggeman et al. 2007). Studies have found that employers often feel that universities do not understand the needs and skills required in the industry while the postsecondary faculty feel that the industry does not “respect” the quality of education offered (Beidler et al. 2006). They go on to say that when these two sectors establish a “collaborative relationship” the students benefit from the information acquired. This relationship established between these two entities is crucial in insuring that students receive the best education possible that gives them the skills and competencies needed to successfully be employed and solve problems that arise in the industry.

Developing a relationship with employers of graduates from the Agricultural Systems Management program will not only help in developing curricula that is current with the needs of the industry, it will also provide students with the skills necessary to be successful in the agricultural industry. The ASM program “is nationally recognized for its integration of agriculture technology with the physical sciences using a systems approach that incorporates management skill development” because of the “systems approach in teaching curricula” that provides necessary technical skills for the agriculture industry that incorporates economic and management principles while developing communication and problem solving skills. Letters from ASM graduates have indicated

the significance and inter-disciplinary nature of the programs (Strickland et al. 2006). The ASM program has strived to develop coursework that matches the demand for the industry but comprehensive curriculum reviews with the knowledge of the skills and competencies desired of its graduates will ensure that the program is taking the necessary steps to improve their curricula.

2.6 Summary

Postsecondary education provides a unique opportunity for students to improve their technical and employability skills. The agricultural industry is changing very rapidly so it is essential that universities assess the skills and competences that are needed by employers within this industry. Often the success of educational programs is determined by the preparation of graduates for the workforce and the skills that are acquired during school. Understanding the needs of the industry is crucial in order to best prepare graduates for the industry. Employers often indicate that non-technical skills or employability skills such as communication, organization, and people management are important to be successful in a job, but this does diminish the importance of the necessary technical skills required to solve problems or to understand how the industry functions. The ASM program is striving to prepare its graduates to meet the needs of the industry but constant analysis of changes in the industry demands is necessary to ensure that the program is best preparing its students to be successful. This will also bridge the gap between differences in expectations between universities, students and employers in the agriculture industry which will benefit all involved with this vital field.

CHAPTER 3

RESEARCH METHODS

3.1 Introduction

The purpose of this section is to provide information regarding the research methods and design used in this research project. The topics discussed include the purpose and goals of the study, the description of the population, sampling methods for the population, instrumentation procedures, and data collection and analysis procedures.

3.2 Research Design

This research project consists of two separate procedures and data collections. The goal of the project was to evaluate the skills and competency levels of ASM graduates as perceived by their employers. To accomplish this goal ASM graduates had to be contacted and asked to provide information regarding their current employment status as well as the contact information for their company or current supervisor/employer because a list of ASM graduates' employer contact information was not available. A list of ASM graduates was acquired from the University of Missouri Alumni Center since the program began in 1960 to determine the number of ASM graduates since the program changed its structure in 1996. Explicit details of the research methods for these two procedures and data collections are described in the following sections.

3.3 Description of the Population and Sampling Procedures

The first population for this study consisted of graduates from the ASM, Agricultural Mechanization, and Agricultural Engineering programs since 1960. A list of ASM, Agricultural Mechanization, and Agricultural Engineering graduates was acquired from the University of Missouri Alumni Center which consisted of 1006 graduates. Only the ASM graduates since 1996 were asked to provide employer contact information because these graduates would best represent the current ASM program. There have been 308 ASM graduates between 1996 and 2011. A sample size of 170 graduates using a 95% confidence interval with a margin of error of 5% was determined from a table produced by Krejcie and Morgan (1970) that listed various population sizes, confidence intervals, and margins of error.

With the determined sample size of 170 participants, a list of random numbers was then generated using an on-line random number generator from StatTrek.com. A list of 170 numbers was created using a minimum value of 1 and a maximum value of 308. Duplicates were not allowed to avoid using the same graduate twice and the seed value was 24. These random numbers were then compared to the list of ASM graduates arranged in alphabetical order and the selected graduates composed the sample of ASM graduates used in this study to provide employer contact information. Of the 170 graduates, 8 names were discarded because their address was located in Columbia, Missouri and it was assumed that the address was their college address and thus, no longer valid. In these cases the next available graduate was selected.

The Graduate Update Letter (Appendix F) that was distributed to the graduate population study yielded 113 responses which resulted in a response rate of 66.5%. Of these responses 4 did not give adequate employer information for contacting their employer and 4 indicated that they were employed by the same employer as earlier responses. Three ASM graduates indicated that they were employed by multiple employers which were added to the employer list so the survey sent out to ASM graduates from 2006 to 2011 yielded contact information for 108 employers. Of the list of 108 employers, 24 were self-employed ASM graduates. In previous research self-employed graduates were eliminated from the study population so that only employer input was considered in the analysis. For this research input from the self-employed graduates were considered so that the skills and competencies needed for ASM graduates to be successful would be more accurate to the needs of all ASM graduates.

The second sample population used for this study consisted of 108 employers indicated by a sample population of ASM graduates from the Graduate Update Letter. These participants were mailed the ASM Program Evaluation Letter (Appendix A) because ASM Graduates indicated that they were employed by these participants. Of the 108 employer participants 24 were considered self-employed ASM graduates. In previous studies the self-employed graduates were left out of the study, but for this research they were included to give a more accurate indication of what skills are needed by all ASM graduates.

Within two weeks of sending the graduate update letter, 6 envelopes were returned due to an invalid mailing address. Two survey packets were resent to an

updated address but 4 participants did not have adequate address information available to resend the questionnaire. This reduced the population size to n=104. Within a month of sending the questionnaire to the study participants 4 employers indicated that they did not wish to participate in the study by marking “no” on the consent form so the final population size was reduced to 100 participants.

3.4 Instrumentation Procedures

The instrument used to gather employer contact information from current ASM graduates was modeled after a Graduate Update (Appendix F) letter generated by Dr. Leon Schumacher in 2006 for the ASM program graduates. This survey was modified to gather the employer contact information for the ASM graduates as well as updating the cover letter to better meet the current goals of the ASM program. This letter included a note from Dr. Schumacher and the ASM program expressing that the program is currently under a review and that it consists of contacting previous graduates in order to understand their current employment status. It also expresses the concern of the ASM program in losing contact with the previous graduates. This survey consisted of 8 questions asking for their year of graduation, current address and phone number, current position, employer company, employer/supervisor name, employer address and employer email.

The instrument used to gather information about the skills and competencies of ASM graduates (Appendix A) for this study was adapted from a previous program evaluation for the ASM program by Shannon Snyder, a graduate student in the

Agriculture Education Department at the University of Missouri (Snyder 2008). This survey was compared to previous curriculum assessments for various agriculture programs to determine the necessary “general skills” as well as “technical skills needed for ASM graduates (Strickland and Ess 2001; VanDerZanden and Reinert 2009). This instrument was also compared with the current class syllabi for the ASM program to determine different technical skill areas as well as specific skills in each emphasis area to better capture what the ASM program curriculum is teaching its students.

The questionnaire consisted of 11 general skill sets and 29 skill sets that the ASM program incorporates into various courses offered to its’ students. The questions were formatted in a Likert-type scale ranging from 1-5 with a not applicable option. After the list of ASM skills the participants were asked to give their input on four open-ended questions addressing new topic areas that ASM graduates would need for the workforce, new skills that they foresee graduates needing for the future, the most frequently used technical skills used by the graduates, and the technical skills that need to be de-emphasized in the ASM curriculum. The last section of the questionnaire consisted of 13 demographic questions that were used to describe the study population. They included questions that asked for the participants industry of employment, years associated with an ASM graduate, number of graduates hired in the last 5 years, number of graduates that the employer is expecting to hire in the next five years, information on training of new employees, use of online resources for communicating and hiring potential employees, and level of management responsibilities within their company.

The list of questions was preceded by an introductory cover letter (Appendix B) stating why the participant had been selected to participate in the study and the importance of their response to the ASM program evaluation and that it would provide valuable information in preparing graduates to be equipped with the necessary skills to be successful in the agriculture industry. The participant was then directed to a consent page where they were informed how the data would be handled and ensuring them that their results would be kept confidential. The participant was then given an option to give their consent with their signature and also given the opportunity to list their email address for a synopsis of the results at the end of the study.

On the following page a description of the Agricultural Systems Management program was given to the participants to make sure that all of the participants had the same understanding of the skills that ASM graduates are expected to have upon finishing their postsecondary education. This summary stated the areas within the agriculture industry that the ASM program provides the necessary management skills for, as well as common career paths that ASM graduates are employed and typical courses that an ASM graduate completes while at college.

The participants were then directed to an instructions page. This section provided the participants with the necessary instructions to properly complete the question. The employers of ASM graduates were asked to indicate the graduate's level of skill and the importance of the skill to their organization for each of the 40 questions that were seeking information of skills acquired by ASM graduates. The questionnaire consisted of 40 Likert-Type questions with a scale from 1-5 with 1 indicating a low skill

level or importance, 2 moderately low skill level or importance, 3 moderate skill level or importance, 4 moderately high skill level or importance, and 5 high skill level or importance. The participants were also given the option of marking Not Applicable (N/A) if the question did not apply to their organization or observation of the ASM graduate's skill level.

3.5 Pilot Test Procedures

The questionnaire used by Snyder (2008) and Strickland and Ess (2001) underwent many revisions before it was distributed to the study population. It was compared to the courses that are offered by the University of Missouri ASM program to improve the ASM skill sets to more accurately reflect the goals of the curriculum. The general skill sets were compared to Strickland and Ess (2001) and VanDerZanden and Reinert (2009) in order to find the most important employability skills that employers are looking for when hiring potential employees.

When a new draft of the ASM Program Evaluation had been developed, it was reviewed by the researcher's advisory committee which consisted of two professionals in the ASM department and one professional in the Statistics department in order to address the layout of the questionnaire and the validity and appropriateness of each question. Correspondence was made through face-to-face meetings and email messages to collect information and suggestions for new questions as well as formatting for the questionnaire.

After the advisory committee reviewed the questionnaire it was sent to faculty members of the ASM program and MU Agriculture Engineering Extension asking for their input on the questions within the survey because the research will also provide valuable information for both programs. Several of the staff members responded offering grammatical corrections as well as suggestions for new questions and changes in the overall layout of the questionnaire. It was also suggested that an section providing information about the ASM program be included within the questionnaire to ensure that all employers of ASM graduates understand what skills the ASM program is teaching in its' curriculum.

The Pilot Study for this project was conducted in a face to face meeting with the ASM program faculty and staff and the Agricultural Engineering Extension Staff. Each member provided their input on the wording, order and grammar of each section. The purpose of this meeting was to evaluate face, content, and instrumentation validity of the questionnaire based on the experiences and opinions of the faculty members. Reliability was assessed using Cronbach's Alpha coefficient which is a post-hoc analysis. A coefficient was calculated for the questions relating to the graduate's skill level within the industry and the questions relating to the importance of each skill to the industry. The responses relating to the graduates skill level yielded a value of 0.972 (n=15) and the responses relating to the importance of each skill to the employer's industry yielded a value of 0.972 (n=14).

The information generated from this meeting was used to modify the questionnaire to address areas of the ASM curriculum that had been overlooked and

rearrange questions and wording to make the questionnaire flow more smoothly for the participants. Several questions regarding the demographics of the study population were also modified to better reflect the characteristics of the study population.

A final copy of the survey questionnaire and data collection procedures was then submitted to the University of Missouri Institutional Review Board (IRB) to ensure that there would be no more than minimal harm to the survey participants and that the data collected from the respondents would meet the standards to personal identifiable information collection by the IRB board. The IRB reviewed the questionnaire and requested that changes be made to the introductory cover letter (Appendix C) and that a permission letter (Appendix J) to recruit ASM graduates be provided.

3.6 Data Collection Procedures

The Data Collection Procedures for both parts of this study (Graduate Update Letter and ASM Program Evaluation: Appendix A, Appendix F) were modeled after *The Tailored Design Method* (Dillman 2007). This method consists of 4-5 different modes of contact to the survey participant. This method was used to improve the employer or graduate response rate of the questionnaire. The questionnaire that was sent to ASM graduates and employers of ASM was delivered through the United States Postal Service. The questionnaire was also sent to 60 of the 108 employee participants online through the Qualtrics (www.qualtrics.com) software because 60 graduates also provided the email address for their current employer. The format and questions for the online survey were identical to the mail distributed questionnaire except for wording like “select” instead of

“circle” their responses due to the formatting of the online software. A paper copy was also sent to the online participants to avoid error in the data collection procedures. The pre-notice letters, cover letters, and thank-you letters were also identical for the online and mail participants.

Each employer and graduate was initially contacted with a pre-notice letter (Appendix C, Appendix G). This letter was modeled after Dillman’s *Tailored Design Method* (Dillman 2007) and printed on a yellow 4.25” by 5.5” post card and sent through email to the online participants. The purpose of this letter was to inform the participant that they had been selected to participate in this study and why they were selected to give their input for this research. It also assured them that participation in the study was completely voluntary and that most participants liked to be informed that their time was requested prior to receiving a survey questionnaire. This letter also stated the importance of each participant’s input in order to improve the ASM curricula to ensure that its’ graduates were adequately prepared to meet the needs of the agriculture industry.

The second mode of contact was the actual questionnaire (Appendix A, Appendix F) accompanied by a cover letter (Appendix B) framed after Dillman’s *Tailored Design Method* (Dillman 2007) explaining the goals of the study and how input from the employers of ASM graduates would help improve the ASM program which would then provide more qualified workers for the agriculture industry. The survey was sent out to all 108 potential respondents within one week of the initial introduction letter. The cover letter also expressed the importance of the participant’s responses to the study as well as why they had been selected to participate. Adequate contact information for contacting

the researcher and MU IRB were also included in case the potential respondent had any questions regarding the questionnaire or study. Each participant was asked to give their consent to participate in the study and then fill out the questionnaire to the best of their knowledge. The survey packet also included instructions on how to sufficiently fill out the survey and return a completed survey back to the researcher. A stamped, pre-addressed envelope was also included with the initial cover letter and survey questionnaire for each survey packet.

Within three weeks of distributing the initial survey packet, 4 envelopes were returned due to insufficient address information and 4 potential respondents indicated that they did not wish to participate in the study reducing the sample size to 100 participants. In this time 34 survey packets were received through the mail and online yielding an initial response rate of 34%.

Approximately one and one half weeks after the questionnaire was distributed to the study population a thank you/reminder card (Appendix D, Appendix H) modeled after Dillman's *Tailored Design Method* (Dillman 2007) was distributed to the participants. This letter was mailed on a yellow 4.25 inch by 5.5 inch post card or sent through email to the online population study. It was sent for the purpose of thanking the participants that had submitted a completed survey as well as to remind the participants that have not submitted a questionnaire to complete and send one back as soon as possible.

Within one month of distributing the initial survey packet to the population study a final 4th contact cover letter (Appendix E, Appendix I) modeled after Dillman's *Tailored Design Method* (Dillman 2007) and questionnaire (Appendix A, Appendix G)

was sent out through the mail or online to the participants who had not submitted a completed questionnaire (n=60). This cover letter used stronger language urging the potential respondent to complete the questionnaire and explaining that the confidentiality of their results was an utmost priority to the researchers of this study and that their response is very valuable and important to ensure that the ASM program curriculum is best preparing its' graduates to meet the needs of a changing industry. A stamped, pre-addressed envelope with an assigned number was provided for each participant to ensure their confidentiality and keep track of who has responded in order to keep them from being contacted about completing a survey if they had already submitted one. Potential participants were also notified that the study would be drawing to a close two weeks after they received the 4th contact letter and they were urged to submit their completed surveys before the cut-off date.

Approximately three weeks after the 4th contact letter had been distributed to the study population 20 participants returned a completed survey bringing the total number of completed questionnaires to 54 yielding a 54% response rate.

3.7 Data Analysis Procedures

The data for this analysis was summarized and analyzed using the Statistical Analysis System (SAS) and Microsoft Excel 2010. Descriptive statistics such as frequency, mean, and standard deviation were used to categorize and explain the data. The frequency can be defined as the classification of data based on the number of occurrences within a defined boundary (Spiegel and Stephens 2008). Mean is the sum

occurrences divided by the total number of occurrences in a population; it usually tends to “lie centrally” within a dataset (Spiegel and Stephens 2008). Standard deviation is defined as the tendency for the data to lie outside of the mean (Spiegel and Stephens 2008). This set of descriptive statistics was used to explain the accuracy and precision of the data.

A comparison of the graduates perceived skill level and importance of skill to the employer’s industry was made and used to create a Mean Weight Discrepancy Score (MWDS) for each of the skills listed in the ASM Program Evaluation survey. These values were calculated by using Borich’s Needs Assessment Model (Borich 1980) and compared to methods used by several other research methods using Borich’s Model (Garton and Chung 1997; Layfield and Dobbins 2002; Christensen et al. 2009; McKim and Saucier 2011). The data was placed in an Excel Based Mean Weight Discrepancy Score Calculator (McKim and Saucier 2011) to generate the results for this analysis. A MWDS value can be determined by calculating a discrepancy score by taking the importance of the skill to the employer’s industry minus the graduates perceived skill level. This value was then multiplied by the mean score of the importance of the skill to the employer’s industry to generate a Weighed Discrepancy Score (WDS). A MWDS value for each of the competencies was calculated by taking the sum of the weighted discrepancy score and dividing it by the number of observations. A positive value represents the competencies that need to be addressed and emphasized more in the ASM program curriculum and a negative value means that the program is adequately preparing their students in that skill area or less emphasis needs to be placed on that competency. A

higher MWDS value means that the skill/competency needs to be addressed in a more timely matter.

Each respondent's WDS was compared to six different demographic characteristics using the General Linear Model (GLM) analysis of variance procedure within SAS to produce the mean weight square for each variable. If the probability of each question had a variance of less than five percent then there was a statistical difference among each respondent.

3.8 Summary

The questionnaire used in this study is modeled after a questionnaire developed by Snyder (2008) and compared to Strickland and Ess (2001) and VanDerZanden and Reinert (2009) and the ASM course syllabi to ensure that the proper ASM skills and employability or general skills were included on the questionnaire. The graduate update letter used to collect employer contact information from ASM graduates since 1996 was modeled after the graduate update letter sent in 2006 by Dr. Leon Schumacher, a professor in the ASM program. Both of these surveys were distributed using Dillman's *Tailored Design Method* (Dillman 2007) which consists of four separate modes of contact to the study population. A pre-notice letter, survey packet and cover letter, reminder/thank you letter, and 4th contact cover letter and questionnaire was distributed to each participant with the goal of increasing the overall response rate of the potential respondents.

The study population consisted of 108 employers indicated from a population of 170 ASM graduates. Of the 108 potential respondents 4 employers did not wish to participate in the study and 4 employers did not have sufficient address information so their packets were returned resulting in a population size of 100 participants. Fifty-four of the potential respondents returned a completed questionnaire yielding a response rate of 54% for the study.

CHAPTER 4

ANALYSIS AND PRESENTATION OF THE DATA

4.1 Introduction

The purpose of this chapter is to present the findings of this research. A survey questionnaire was distributed to employers of ASM graduates asking for their input on the skill levels of the graduates and the importance of skills for the employers' industry that the ASM program is trying to teach through its' curriculum. This section lists the results of this survey in tabular form and provides an explanation of the data that was collected and analyzed for this study.

4.2 Findings Related to Objective One

The purpose of the first objective was to collect demographic characteristics about the study population in order to better understand the employers and self-employed ASM graduates that participated in this study. This information also assisted in describing the data that was collected by helping determine the differences in the responses between individuals. The demographic questions were located on the last page of the ASM Program Evaluation Questionnaire (Appendix A) and the questions collected information regarding the employer's industry of work, years working with an ASM graduate, completion of an ASM degree, years working with an ASM degree, number of ASM graduates hired in the last five years, anticipated number of ASM graduates to be hired in

the next five years, previous training desired by potential employees when hiring, days spent training new employees, training tools used to train new employees, topics focused most on when beginning to train new employees, communication through social networks (Facebook, LinkedIn, etc.) when searching for potential employees, online posting of applications for potential employees, and level of management within employer's/self-employed graduate's business.

The Employers and Self-Employed ASM Graduates Industry of Work was categorized into four main areas that include production agriculture, agricultural equipment, agricultural retail/services and grain, and other (government, education, real estate). The data is presented by frequency and percentage. The breakdown of the industry of work is listed in Table 1.

Table 1.

Description of Employers and Self-Employed ASM Graduates by Industry of Work (n=54).

Industry	<i>f</i>	%
Production Agriculture	24	44.40
Agricultural Equipment	15	27.80
Agricultural Retail/Services, Grain	8	14.80
Other (Government, Education, Real Estate)	7	13.00

Of the 54 respondents for the ASM Program Evaluation Questionnaire, 24 indicated that they were involved with production agriculture which represents 44% of the study population. This group represented the largest classification and the next biggest group is agricultural equipment which accounted for 28% of the respondents. Fifteen percent of the employers indicated that they were involved in agricultural

retail/services or the grain industry. The remaining 13% of the study population were grouped in the category titled “other”, this included education, government, real estate, and veterinary medicine.

The description of employers and self-employed ASM graduates by years working with and ASM graduate is listed in Table 2. The data is described by frequency, percentage, mean, standard deviation, and range. The total years were divided into three categories ranging from 0-4 years, 5-9 years, and greater than 10 years.

Table 2.

Description of Employers and Self-Employed ASM Graduates by Years Working with an ASM Graduate (n=42).

Years	<i>f</i>	%
0-4	20	47.61
5-9	12	28.57
10+	10	23.82

Note: Range =0-17 years, Mean = 5.33, SD = 4.38

The results indicated that approximately 48% of the respondents indicated that they had been working with an ASM graduate for fewer than four years. Less than 29% of participants listed that they had been involved in working with an ASM graduate for 5-9 years. Less than 24% respondents have been working with an ASM graduate for over 10 years. The results ranged from 1-17 years with a mean of 5.33 and a SD of 4.38.

Table 3 lists the total number of respondents that graduated from the University of Missouri with an ASM Degree. The results are tabulated and listed by frequency and percentage.

Table 3.

Description of Employers and Self-Employed ASM Graduates by Completion of an ASM Degree (n=54).

Completion of ASM Degree	<i>f</i>	%
No	30	55.56
Yes	24	44.44

The results indicate that 24 of the 54 respondents or 56% graduated with an ASM degree. Before the questionnaire was distributed to the population, it was determined that 24 of the participants were self-employed graduates because they did not provide employer information, instead the listed themselves as their primary employer.

The description of employers and self-employed ASM graduates by years working with an ASM degree is listed in Table 4. The total years are categorized into three groups ranging from 1-6 years, 7-12 years, and greater than 13 years. The data is listed by frequency, percentage, and range.

Table 4.

Description of Employers and Self-Employed ASM Graduates by Years Working with an ASM Degree (n=25).

Years	<i>f</i>	%
1-6	7	28.00
7-12	11	44.00
13+	7	28.00

Note: Range =1-41, Mean = 10.84, SD = 8.68

It was determined that 24 of the participants graduated with an ASM degree but there were 25 responses for years working with an ASM degree. This is due to one

respondent not indicating that they graduated with an ASM degree but they provided the years working as an ASM graduate. The results indicate that seven respondents or 28% have been working from 1-6 years with an ASM degree. Eleven or 44% of the respondents have been working 7-12 years with their degree. The participants that have been working for over 13 years with an ASM degree represent 28% of the respondents. One employer indicated that they have been working with an ASM degree for 41 years so the range is from 1-41 years with a mean of 10.84 and a SD of 8.68.

The description of employers and self-employed ASM graduates by number of ASM graduates hired in the last five years was categorized into three groups ranging from zero graduates, one graduate, and greater than two graduates. The data is presented by frequency, percentage, range, mean, and standard deviation. Table 5 summarizes the responses for this data.

Table 5.

Description of Employers and Self-Employed ASM Graduates by Number of ASM Graduates Hired in the Previous Five Years (n=50).

Number of Graduates	<i>f</i>	%
0	19	38.00
1	23	46.00
2+	8	16.00

Note: Range = 0-40, Mean = 1.94, SD = 5.95.

Total number of graduates hired in the last 5 years = 97.

The ASM Program Evaluation yielded 50 responses for number of graduates hired in the last five years. Of these responses, the results indicated that 38% of the participants have not hired any ASM graduates in the last five years. This is compared to

46% of the respondents who have hired one graduate. Exactly 16% of respondents indicated that they have hired two or more graduates in the last five years. The number of graduates hired in the last five years range from 0 to 40, the mean is 1.94 and the standard deviation is 5.95. Only two responses generated a number greater than ten (15 and 40), most of the values occurred between zero and three. It is important to also note that several of the self-employed ASM graduates have not hired any ASM graduates because they are giving information about their own skill level and level of importance for their organization. The total number of ASM graduates that have been hired in the last five years by the survey respondents is 97 graduates; one single company is responsible for hiring 40 of those graduates.

The description of employers and self-employed ASM graduates by anticipated number of ASM graduates to be hired in the next five years is also categorized into three groups ranging from 0, 1, and 2 graduates. The data is summarized by frequency, percent, range, mean, and standard deviation.

Table 6.

Description of Employers and Self-Employed ASM Graduates by Anticipated Number of ASM Graduates to be Hired in the Next Five Years (n=44).

Number of Graduates	<i>f</i>	%
0	30	68.18
1	5	11.36
2+	9	20.45

Note: Range = 0-50, Mean = 2.11, SD = 7.80.

Total number of graduates expected to be hired in the next 5 years is 93.

The results indicate that 14 of the 44 respondents indicated that they are anticipating hiring an ASM graduate in the next five years. Of those participants, 68% are not planning on hiring any new ASM graduates in the near future. Less than 12% of respondents indicated that they are anticipating hiring at least one ASM graduate and 20% see the need to hire more ASM graduates. The data ranged from 0-50 graduates with a mean of 2.11 and a SD of 7.80. The total number of graduates anticipated to be hired in the next five years is 93 graduates and one employer indicated that they are expecting to hire 50 graduates in the near future.

Table 7 lists the description of employers and self-employed ASM graduates by previous training desired by employers when searching for potential employers. The data was categorized into three groups ranging from previous training such as work experience, college degree, and internships. The data is presented by frequency and percentage.

Table 7.

Description of Employers and Self-Employed ASM Graduates by Previous Training Desired by Employers when Searching for Potential Employees (n=66).

Previous Experience	<i>f</i>	%
Work Experience	33	50.00
College Degree	24	36.36
Internship	9	13.64

Note: Some respondents gave multiple responses; 43 respondents gave an answer.

The total number of responses for previous training desired by employers when searching for potential employers was 43 responses. Several of the participants gave multiple answers so the total tabulated responses is n=66. Of these respondents, 50%

indicated that previous work experience is an attribute that they desire in potential employers. The next most indicated previous training was a college degree, 36% indicated that this was important. Nine respondents or 14% indicated that previous internship experiences are necessary when they are hiring new employees.

The description of employers and self-employed ASM graduates by total number days spent training new employees is categorized into three groups by number of days ranging from 0-25, 26-90, and greater than 90 days. The data is summarized by frequency, percentage, range, mean, and standard deviation. The results are listed in Table 8.

Table 8.

Description of Employers and Self-Employed ASM Graduates by the Total Number of Days Spent Training New Employees (n=37).

Days	f	%
0-25	16	43.24
26-90	8	21.62
90+	13	35.14

Note: Range = 0-760, Mean = 116.46, SD = 170.16.

Of the 37 respondents, 16 or 43% indicated that they spend 0-25 days training new employers after they begin working. The results indicate that 8 respondents or 22% of employers spend 26-90 days training employees. Approximately 35% of respondents spend over 90 days training workers. The range of responses was 0-170 with a mean of 116.46 and a standard deviation of 170.16.

Table 9 represents the description of employers and self-employed ASM graduates by the training tools used to train new employees. The data is categorized by

the type of training tool used, these classifications include mentors, hands-on experience, computers (online resources, modules), and classroom learning/presentations. The frequency and percentage is given for each category. There were 35 respondents to this question but many gave multiple answers so the total number of listed responses is 73.

Table 9.

Description of Employers and Self-Employed ASM Graduates by the Training Tools used to Train New Employees (n=73).

Training Tool	<i>f</i>	%
Mentors	21	28.77
Computers (Online, Modules)	19	26.03
Classroom/Presentation	18	24.66
Hands-on	15	20.55

Note: Total number of responses is 35, some respondents gave multiple answers so total number of recorded answers is 73.

The results indicate that of the 73 responses for training tools used when training new employees, 21 or 29% indicated that mentors were used. Many respondents also suggested that computers, online resources, or modules were used (26%). Classroom learning and presentations were used by 25% of respondents to train new employees. The least used tool was hands-on experience but this tool represented 20% of employers.

The description of employers and self-employed ASM graduates by topic of most frequent focus when starting to train new employees is listed in Table 10. There were 33 responses to this question, but 4 participants gave multiple answers so the total number of tabulated answers is 37. The topics were categorized into groups such as safety, company procedures and operations, job expectations, computer skills, customer

service, and educational requirements for agricultural education teachers. The data is listed in frequency and percentage.

Table 10.

Description of Employers and Self-Employed ASM Graduates by Topic of Most Frequent Focus when Starting to Train New Employees (n=37).

Topic	<i>f</i>	%
Safety	16	43.24
Company Procedures and Operations	9	24.32
Job Expectations	6	16.22
Computer Skills	2	5.41
Customer Service	2	5.41
Educational Requirements	2	5.41

Of the 37 answers that were given by the respondents for the topic of most frequent focus when training new employees, 16 or 43% indicated that safety was the most important topic of communication during the initial training of employees. Approximately nine respondents or 24% suggested that company procedures and operations are discussed first in training. The results indicate that 16% of employers focus on job expectations and three of the topics yielded only 5% of the responses. They were computer skills, customer service, and educational requirements for new teachers (classroom management and new teacher training).

The description of employers and self-employed ASM graduates by communication with potential employees through social networks is listed in Table 11. The results are tabulated and listed by frequency and percentage by yes and no.

Table 11.

Description of Employers and Self-Employed ASM Graduates by Communication with Potential Employees through Social Networks (n=48).

Communication through Social Networks	<i>f</i>	%
No	41	85.42
Yes	7	14.58

The results indicated that only 15% of the 48 respondents mentioned that they use social networks to communicate to potential employees. These respondents also indicated that the social network used to communicate to potential employees was either Facebook or LinkedIn.

Table 12 lists the description of employers and self-employed ASM graduates by posting online applications for potential employees. The data is summarized by frequency and percentages by employers and self-employed graduates responses

Table 12.

Description of Employers and Self-Employed ASM Graduates by Posting of Online Applications for Potential Employees (n=47).

Online posting of Applications	<i>f</i>	%
No	27	57.45
Yes	20	42.55

The total number of responses for online posting of applications for potential employees was 47. Of these responses 57% indicated that they did post online applications for potential employees.

Table 13 gives a description of the location of posted online applications for potential employers as indicated by the employers and self-employed ASM graduates.

The data is summarized by frequency and percentage.

Table 13.

Description of Employers and Self-Employed ASM Graduates by Location of Posted Online Applications for Potential Employees (n=18).

Posting Location	<i>f</i>	%
Company Website	11	61.11
Public Website	6	33.33
Social Networks	1	5.56

Of the 18 employers that post online applications for potential employers that listed the location of their posted online applications, 61% of employers post applications on their company website. Only 33% of employers post applications on public websites like university career pages or career builder or classified websites. One respondent posts an application on a social network.

The description of employers and self-employed ASM graduates by level of management within the business of their employment is summarized in Table 14. The data is categorized into two groups that consist of owning their own business and managing a business for someone else. The data is summarized by frequency and percentage. Four respondents indicated that they owned their own business and managed a business for someone else so they were counted as owning their own business in the analysis.

Table 14.

Description of Employers and Self-Employed ASM Graduates by Level of Management within the Business of their Employment (n=53).

Level of Management	<i>f</i>	%
Own Their Own Business	32	60.38
Manage Business for Someone Else	21	39.62

Note: Four respondents indicated that they owned their own business and managed a business for someone else. They were counted as owning their own business.

Of the 53 respondents for level of management within the business of the employers and self-employed ASM graduates, 60% indicated that they owned their own business. Approximately 40% of respondents manage a business for someone else meaning that they are employed by someone or are managing only a part of a business.

4.3 Findings Related to Objective Two

Each survey participant was asked to give their perception of the ASM graduate's level of skill/competency that they employ for general skills/competencies that the graduate should have received from the ASM Program. The data is listed in Table 15 by mean from lowest to highest, standard deviation and number of responses.

Table 15.

Description of the Graduate's Level of Skill/Competency for General Competencies as Perceived by Employers.

General Competency	M	SD	n
Skills associated with marketing of a product?	3.57	0.96	49
Ability to motivate employees or co-workers?	3.85	0.97	46
Effective use of financial management skills? <i>creating and operating budgets, expense recording, general accounting</i>	3.88	0.90	50
Ability to effectively manage work of others?	3.91	0.95	45
Ability to communicate information about agricultural systems to clients/co-workers?	3.96	0.93	47
Ability to contribute in multidisciplinary teams?	4.05	0.89	44
Ability to show more desirable employability skills compared to graduates of other Universities?	4.12	0.81	34
Effective computer skills?	4.23	0.91	53
Ability to incorporate safety in the workplace?	4.26	0.74	53
Willingness to adopt new concepts?	4.38	0.80	52
Ability to understand how to manage agricultural systems? <i>developing solutions to problems by locating relevant information and analyzing possible alternatives</i>	4.42	0.73	50

Note. Scale: 1.00 - 1.50 = Low Mastery, 1.51 - 2.50 = Moderately Low Mastery, 2.51 - 3.50 = Moderate Mastery, 3.51 - 4.50 = Moderately High Mastery. 4.51 - 5.00 = High Mastery.

The survey respondents indicated that ASM graduates overall demonstrated moderately mastery for all general competencies obtained through the ASM program. The number of responses ranged from 34-53 for this set of questions. If the respondent marked N/A for their response to a question then it was counted as missing data. The five general competencies with the lowest indicated score with a mean less than 4.00 included “skills associated with marketing of a product” (M = 3.57), “ability to motivate employees or co-workers” (M = 3.85), and “effective use of financial management skills,

creating and operating budgets, expense recording, general accounting” (M = 3.88) The highest rated question was “ability to understand how to manage agricultural systems, *developing solutions to problems by locating relevant information and analyzing possible alternatives*” (M = 4.42), followed by “willingness to adopt new concepts” (M = 4.38), and “ability to incorporate safety into the workplace”

The survey participants were also asked to give their perception of the ASM graduate’s level of skill/competency that they employ for ASM skills/competencies that the graduate should have received from the ASM Program. The data is listed in Table 16 by mean, standard deviation and number of responses. The questions are arranged by mean from lowest to highest.

Table 16.

Description of the Graduate's Level of Skill/Competency for ASM Competencies as Perceived by Employers.

ASM Competency	M	SD	n
Skills associated with grain grading?	3.17	1.41	41
Understanding of challenges associated with logistics of biofuels? <i>transportation, production, handling</i>	3.18	1.06	44
Skills associated with irrigation management?	3.22	1.16	37
Knowledge of conservation of energy in businesses related to agriculture?	3.46	0.92	48
Knowledge of psychrometrics (air characteristics) for grain drying?	3.48	1.24	40
Knowledge of renewable energy and sustainable energy sources?	3.51	0.98	47
Understanding of environmental planning and impact in agriculture applications?	3.51	0.99	45
Proficiency in using electronic technology? <i>programmable logic controllers (PLC), machine control panels, etc.</i>	3.52	1.17	44
Knowledge of water quality relationships with nitrogen, phosphorus, and potassium applications used in crop production?	3.53	0.98	43
Understanding of maintaining grain quality?	3.58	1.31	43
Skills in processing, analyzing, and interpreting data with Geographical Information Systems (GIS)?	3.62	1.03	50
Skills associated with internal combustion engines?	3.64	0.97	47
Ability to develop plans for proper drainage of agricultural land?	3.65	1.03	40
Knowledge to plan appropriate layout of farmstead buildings?	3.68	1.10	40
Ability to understand and operate grain storage systems?	3.71	1.29	42
Ability to install, calibrate, and demonstrate precision agriculture systems?	3.72	1.15	46
Skills associated with 12 volt electricity?	3.73	1.03	48
Knowledge of pesticide laws and how these laws impact use and application of pesticides?	3.77	1.13	43
Ability to calibrate application equipment?	3.80	0.97	50
Knowledge required to construct agricultural structures?	3.81	0.96	43
Skills associated with 120/240 volt electricity?	3.73	0.95	44
Skills associated with understanding hydraulic systems?	3.82	0.91	49

Table 16 (Continued)

Description of the Graduate's Level of Skill/Competency for ASM Competencies as Perceived by Employers.

ASM Competency	M	SD	n
Understanding of how precision agriculture systems operate including GPS, GIS, computers, and sensor and control technology?	3.83	1.04	46
Ability to research and adopt new precision agriculture technologies in order to build on prior knowledge?	3.87	1.05	46
Skills associated with project management? <i>construction, proposal, presentation</i>	3.88	1.10	43
Skills associated with machine power distribution? <i>transmissions, planetary systems, belt drives, chain drives</i>	4.00	0.86	47
Knowledge of safe handling and storage of pesticides?	4.07	0.99	45
Skills associated with machinery management? <i>efficiency, selecting proper equipment, economics</i>	4.12	0.85	50
Ability to select appropriate equipment for pesticide/fertilizer application?	4.14	0.98	44

Note. Scale: 1.00 - 1.50 = Low Mastery, 1.51 - 2.50 = Moderately Low Mastery, 2.51 - 3.50 = Moderate Mastery, 3.51 - 4.50 = Moderately High Mastery. 4.51 - 5.00 = High Mastery.

The employers of ASM graduates and self employed ASM graduates indicated that ASM graduates demonstrate moderately low mastery (n = 5) to moderate mastery (n = 24) for ASM skills. The number of respondents for each question ranged from 37 to 50. The results indicate that the “ability to select appropriate equipment for pesticide/fertilizer application” (M = 4.14) was the highest rated mastery of the ASM skill demonstrated by ASM graduates followed by “skills associated with machinery management; *efficiency, selecting proper equipment, economics*” (M = 4.12), “knowledge of safe handling and storage of pesticides” (M = 4.07), and “skills associated

with machine power distribution, *transmissions, planetary systems, belt drives, chain drives*” (M = 4.00). Five ASM skills were given a moderately low mastery score as indicated by employers and self-employed ASM Graduates. These include “knowledge of psychrometrics (air characteristics) for grain drying” (M = 3.48), “knowledge of conservation of energy in businesses related to agriculture” (M = 3.46), “skills associated with irrigation management” (M = 3.22), “understanding of challenges associated with logistics of biofuels, *transportation, production, handling*” (M = 3.18), and the lowest rated skill, “skills associated with grain grading” (M = 3.17).

4.4 Findings Related to Objective Three

Each survey participant was asked to give their perception of the importance of each general competency/skill acquired by ASM graduates to their industry. The data is listed in Table 17 by mean, standard deviation and number of responses. The questions are arranged by mean from lowest to highest.

Table 17.

Description of Importance of Skill/Competency to Employer's Industry by General Competencies as Perceived by Employers.

General Competencies	M	SD	n
Ability to show more desirable employability skills compared to graduates of other Universities?	3.66	1.19	35
Ability to contribute in multidisciplinary teams?	3.98	0.88	44
Skills associated with marketing of a product?	4.02	0.96	50
Ability to communicate information about agricultural systems to clients/co-workers?	4.04	1.04	47
Ability to motivate employees or co-workers?	4.08	0.91	49
Ability to effectively manage work of others?	4.09	0.88	47
Effective computer skills?	4.16	0.81	55
Willingness to adopt new concepts?	4.28	0.71	54
Effective use of financial management skills? <i>creating and operating budgets, expense recording, general accounting</i>	4.31	0.81	52
Ability to incorporate safety in the workplace?	4.40	0.81	55
Ability to understand how to manage agricultural systems? <i>developing solutions to problems by locating relevant information and analyzing possible alternatives</i>	4.43	0.96	51

Note. Scale: 1.00 - 1.50 = Low Importance, 1.51 - 2.50 = Moderately Low Importance, 2.51 - 3.50 = Moderate Importance, 3.51 - 4.50 = Moderately High Importance, 4.51 - 5.00 = High Importance

The survey results indicate that all employers and ASM graduates see this set of general competencies as moderately high importance to their industry. The number of responses to this question ranged from 35 to 55. If the respondent marked not applicable (N/A) on the question for a specific question then the question was counted as missing data. The skill of most importance to the respondent's industry was "ability to understand how to manage agricultural systems, *developing solutions to problems by locating relevant information and analyzing possible alternatives*" (M = 4.43), followed

by “ability to incorporate safety into the workplace” (M = 4.40), and “effective use of financial management skills, *creating and operating budgets, expense recording, general accounting*” (M = 4.31), “willingness to adopt new concepts” (M = 4.28). Two of the skills had a mean of less than 4; this included “ability to contribute in multidisciplinary teams” (M = 3.98) and the skill of lowest importance to the survey respondents industry was “ability to show more desirable employability skills compared to graduates of other universities” (M = 3.66).

Each survey participant was asked to give their perception of the importance of each ASM competency/skill acquired by ASM graduates to their industry. The data is listed in Table 18 by mean, standard deviation and number of responses. The questions are arranged by mean from lowest to highest.

Table 18.

Description of Importance of Skill/Competency to Employer's Industry by ASM Competencies as Perceived by Employers.

ASM Competencies	M	SD	n
Understanding of challenges associated with logistics of biofuels? <i>transportation, production, handling</i>	2.45	1.25	42
Knowledge of renewable energy and sustainable energy sources?	2.88	1.15	49
Skills associated with irrigation management?	2.91	1.44	34
Knowledge of conservation of energy in businesses related to agriculture?	3.23	1.13	48
Skills associated with grain grading?	3.28	1.56	39
Knowledge of psychrometrics (air characteristics) for grain drying?	3.35	1.55	40
Knowledge to plan appropriate layout of farmstead buildings?	3.35	1.48	37
Proficiency in using electronic technology? <i>programmable logic controllers (PLC), machine control panels, etc.</i>	3.39	1.42	46
Ability to understand and operate grain storage systems?	3.40	1.58	42
Understanding of environmental planning and impact in agriculture applications?	3.48	1.23	44
Skills associated with internal combustion engines?	3.49	1.20	47
Knowledge required to construct agricultural structures?	3.52	1.21	42
Skills associated with 12 volt electricity?	3.53	1.21	49
Skills in processing, analyzing, and interpreting data with Geographical Information Systems (GIS)?	3.53	1.40	47
Ability to develop plans for proper drainage of agricultural land?	3.55	1.41	38
Ability to research and adopt new precision agriculture technologies in order to build on prior knowledge?	3.63	1.43	43
Understanding of maintaining grain quality?	3.64	1.56	42
Knowledge of water quality relationships with nitrogen, phosphorus, and potassium applications used in crop production?	3.65	1.23	40
Skills associated with 120/240 volt electricity?	3.65	1.37	46
Ability to calibrate application equipment	3.69	1.40	49
Knowledge of pesticide laws and how these laws impact use and application of pesticides?	3.74	1.34	42
Skills associated with understanding hydraulic systems?	3.66	1.33	50
Skills associated with project management? <i>construction, proposal, presentation</i>	3.77	1.18	44

Table 18. Continued

Description of Importance of Skill/Competency to Employer’s Industry by ASM Competencies as Perceived by Employers.

ASM Competencies	M	SD	n
Knowledge of safe handling and storage of pesticides?	3.79	1.37	42
Understanding of how precision agriculture systems operate including GPS, GIS, computers, and sensor and control technology?	3.79	1.36	43
Skills associated with machine power distribution? <i>transmissions, planetary systems, belt drives, chain drives</i>	3.79	1.18	48
Ability to select appropriate equipment for pesticide/fertilizer application?	3.83	1.46	41
Skills associated with machinery management? <i>efficiency, selecting proper equipment, economics</i>	3.96	1.18	51
Ability to install, calibrate, and demonstrate precision agriculture systems?	4.00	1.33	44

Note. Scale: 1.00 - 1.50 = Low Importance, 1.51 - 2.50 = Moderately Low Importance, 2.51 - 3.50 = Moderate Importance, 3.51 - 4.50 = Moderately High Importance, 4.51 - 5.00 = High Importance.

The data indicates that employers of ASM graduates and self-employed ASM graduates perceive ASM competencies to be of moderately low importance to moderate importance to their industry. Seventeen of the skills were of moderately high importance with “ability to install, calibrate, and demonstrate precision agriculture systems” (M = 4.00) being the most important skill to the participant’s industry, followed by “skills associated with machinery management, *efficiency, selecting proper equipment, economics*” (M = 3.95), “ability to select appropriate equipment for pesticide/fertilizer application” (M = 3.83), and “skills associated with machine power distribution, *transmissions, planetary systems, belt drives, chain drives*” (M = 3.79). Employers and

self-employed ASM graduates indicated that 10 ASM competencies were of moderate importance and one skill “understanding of challenges associated with logistics of biofuels, *transportation, production, handling*” (M = 2.45) was of moderately low importance. Skills such as “knowledge of renewable energy and sustainable energy sources” (M = 2.88), and “skills associated with irrigation management” (M = 2.91) were of moderate importance to the participant’s industry but they ranked low compared to all of the other ASM competencies.

4.5 Findings Related to Objective Four

The survey participants were asked to give their evaluation of ASM graduate (‘s) skill level for general and ASM competencies gained at MU as well as their overall evaluation of the importance of these competencies to their everyday work within their industry. These values were then used to create a Mean Weight Discrepancy Score (MWDS) which is a positive or negative value stating the importance of each skill as perceived by the survey participants. A higher positive number represents the skills that need to be addressed or emphasized more in the ASM program, and the more negative number represents the skills that need to be de-emphasized in the program. Table 19 is a summary of the MWDS values for general competencies as indicated by employers and self-employed ASM graduates.

Table 19.

Description of MWDS Values for General Competencies as Indicated by Employers and Self-employed ASM Graduates.

General Competencies	MWDS	n
Effective use of financial management skills? <i>creating and operating budgets, expense recording, general accounting</i>	1.90	50
Skills associated with marketing of a product?	1.81	49
Ability to motivate employees or co-workers?	1.07	46
Ability to effectively manage work of others?	0.63	45
Ability to incorporate safety in the workplace?	0.58	53
Ability to communicate information about agricultural systems to clients/co-workers?	0.36	45
Ability to understand how to manage agricultural systems? <i>developing solutions to problems by locating relevant information and analyzing possible alternatives</i>	0.27	49
Effective computer skills?	-0.16	53
Ability to contribute in multidisciplinary teams?	-0.19	43
Willingness to adopt new concepts?	-0.33	52
Ability to show more desirable employability skills compared to graduates of other Universities?	-1.89	33

Note: Scale: MWDS >1 = Emphasis Needed, MWDS 0 - 0.99 = Some Emphasis Needed, MWDS 0 - (-0.99) = Adequate Preparation, Some De-Emphasis Needed, MWDS < -1 = De-Emphasis Needed. MWDS = Mean Weight Discrepancy Score.

The data for MWDS for general competencies indicates that employers and self-employed ASM graduates suggest that seven of the eleven skills yielded positive values, three skills yielded negative values, and one skill yielded negative values large enough to suggest that it needs to be de-emphasized. The skill with the highest MWDS is “effective use of financial management skills, *creating and operating budgets, expense recording, general accounting*” (MWDS = 1.90), followed by “skills associated with marketing of a product” (MWDS = 1.81), “ability to motivate employees or co-workers” (MWDS = 1.07), and “ability to effectively manage work of others” (MWDS = 0.63). Three skills

yielded slightly negative MWDS values but they suggest that the ASM program is adequately preparing its students in this area. They include “effective computer skills” (MWDS = -0.16), “ability to contribute in multidisciplinary teams” (MWDS = -0.19), and “willingness to adopt new concepts” (MWDS = -0.33). Only one skill yielded a MWDS score low enough to suggest that it needs to be de-emphasized from the ASM program; it is the “ability to show more desirable employability skills compared to graduates of other universities” (MWDS = -1.89).

Table 20 is the description of MWDS values for ASM competencies as indicated by employers and self-employed ASM graduates. The MWDS score was calculated using the data generated from the responses of the survey participants for ASM graduates skill level and the importance of that skill to the employer’s industry for 29 ASM related skills.

Table 20.

Description of MWDS Values for ASM Competencies as Indicated by Employers and Self-Employed ASM Graduates.

ASM Skills	MWDS	n
Ability to install, calibrate, and demonstrate precision agriculture systems?	1.14	43
Knowledge of water quality relationships with nitrogen, phosphorus, and potassium applications used in crop production?	0.59	38
Skills associated with grain grading?	0.46	36
Understanding of maintaining grain quality?	0.19	39
Skills associated with 120/240 volt electricity?	0.00	42
Understanding of how precision agriculture systems operate including GPS, GIS, computers, and sensor and control technology?	0.00	42
Proficiency in using electronic technology? <i>programmable logic controllers (PLC), machine control panels, etc.</i>	-0.08	42
Knowledge of pesticide laws and how these laws impact use and application of pesticides?	-0.09	40

Table 20 (Continued).

Description of MWDS Values for ASM Competencies as Indicated by Employers and Self-Employed ASM Graduates.

ASM Skills	MWDS	n
Skills associated with project management? construction, proposal, presentation	-0.09	41
Ability to develop plans for proper drainage of agricultural land?	-0.10	35
Skills in processing, analyzing, and interpreting data with Geographical Information Systems (GIS)?	-0.16	46
Ability to calibrate application equipment?	-0.23	48
Skills associated with internal combustion engines?	-0.24	45
Understanding of environmental planning and impact in agriculture applications?	-0.25	42
Knowledge of conservation of energy in businesses related to agriculture?	-0.43	46
Skills associated with machine power distribution? <i>transmissions, planetary systems, belt drives, chain drives</i>	-0.43	45
Skills associated with understanding hydraulic systems?	-0.53	48
Skills associated with machinery management? <i>efficiency, selecting proper equipment, economics</i>	-0.57	49
Knowledge of psychrometrics (air characteristics) for grain drying?	-0.59	35
Skills associated with 12 volt electricity?	-0.67	47
Ability to research and adopt new precision agriculture technologies in order to build on prior knowledge?	-0.79	42
Skills associated with irrigation management?	-0.85	31
Ability to understand and operate grain storage systems?	-1.01	38
Knowledge required to construct agricultural structures?	-1.02	39
Knowledge of safe handling and storage of pesticides?	-1.02	41
Knowledge to plan appropriate layout of farmstead buildings?	-1.11	34
Ability to select appropriate equipment for pesticide/fertilizer application?	-1.16	40
Understanding of challenges associated with logistics of biofuels? <i>transportation, production, handling</i>	-1.61	39
Knowledge of renewable energy and sustainable energy sources?	-1.74	47

Note: Scale: MWDS >1 = Emphasis Needed, MWDS 0 - 0.99 = Some Emphasis Needed, MWDS 0 - (-0.99) = Adequate Preparation, Some De-Emphasis Needed, MWDS < -1 = De-Emphasis Needed. MWDS = Mean Weight Discrepancy Score.

The data suggests that six skills yielded MWDS values that were above zero, sixteen skills yielded MWDS values above -1, and seven skills yielded a MWDS value below -1. Only one skill yielded a MWDS value above one, it is the “ability to install, calibrate, and demonstrate precision agriculture systems” (MWDS = 1.14). Five skills generated a MWDS value above zero and below one. The largest is “knowledge of water quality relationships with nitrogen, phosphorus, and potassium applications used in crop production” (MWDS = 0.59), followed by “skills associated with grain grading” (MWDS = 0.46), and “understanding of maintaining grain quality” (MWDS = 0.19).

Sixteen skills yielded a MWDS value below 0 and above -1. The skills that need the most emphasis include “skills associated with irrigation management” (MWDS = -0.85), “ability to research and adopt new precision agriculture technologies in order to build on prior knowledge” (MWDS = -0.79), and “skills associated with 12 volt electricity” (-MWDS = 0.67). Seven skills yielded a MWDS score below -1, suggesting that they need to be de-emphasized from the ASM curriculum.

The ASM skill with the lowest MWDS score included “knowledge of renewable energy and sustainable energy sources” (MWDS = -1.74) followed by “understanding of challenges associated with logistics of biofuels, *transportation, production, handling*” (MWDS = -1.61), “ability to select appropriate equipment for pesticide/fertilizer application” (MWDS = -1.16), “knowledge to plan appropriate layout of farmstead buildings” (MWDS = -1.11), “knowledge of safe handling and storage of pesticides” (MWDS = -1.02), “knowledge required to construct agricultural structures” (MWDS = -1.02), and “ability to understand and operate grain storage systems” (MWDS = -1.01)

4.6 Findings Related to Objective Five

The Weighted Discrepancy Score (WDS) was compared to six different demographic characteristics including industry of employment, years working with an ASM graduate, completion of an ASM Degree, years working as an ASM graduate, number of graduates hired in the last 5 years, and level of management within the respondents industry using the GLM procedure to calculate the least square means for each variable. Table 21 is the description of the analysis of variance for general competencies and demographic characteristics of employers and self-employed ASM graduates. The values represent the variance for each comparison or the probability that the variable is statistically significant. In order for a value to be significant it must be less than 0.05. The data is categorized into six different groups representing the demographic characteristic associated with each question.

Table 21.

Description of the Analysis of Variance for General Competencies and Demographic Characteristics of Employers and Self-Employed ASM Graduates.

General Skills	1	2	3	4	5	13
Ability to understand how to manage agricultural systems? <i>developing solutions to problems by locating relevant information and analyzing possible alternatives</i>	0.36	0.98	0.92	0.24	0.30	0.38
Ability to incorporate safety in the workplace?	0.04	0.43	0.73	0.68	0.23	0.00
Effective computer skills?	0.28	0.49	0.35	0.67	0.21	0.59
Effective use of financial management skills? <i>creating and operating budgets, expense recording, general accounting</i>	0.22	0.41	0.82	0.78	0.64	0.61
Skills associated with marketing of a product?	0.65	0.66	0.68	0.32	0.80	0.76
Ability to communicate information about agricultural systems to clients/co-workers?	0.63	0.64	0.97	0.35	0.03	0.18

Table 21 (Continued).

Description of the Analysis of Variance for General Competencies and Demographic Characteristics of Employers and Self-Employed ASM Graduates.

General Skills	1	2	3	4	5	13
Willingness to adopt new concepts?	0.24	0.30	0.52	0.53	0.46	0.05
Ability to show more desirable employability skills compared to graduates of other Universities?	0.12	0.17	0.01	0.49	0.10	0.04
Ability to effectively manage work of others?	0.30	0.78	0.03	0.79	0.29	0.39
Ability to motivate employees or co-workers?	0.04	0.68	0.33	0.84	0.02	0.01
Ability to contribute in multidisciplinary teams?	0.14	0.57	0.01	0.23	0.08	0.00

Note: The variable is statistically significant if the value is less than 0.05

Categories: 1: Industry of employment, 2: Years working with an ASM graduate, 3: Completion of an ASM degree, 4: years working as an ASM graduate, 5: Number of graduates hired in the last 5 years, 13: Level of management within the respondents industry.

The analysis of variance for WDS values and demographic characteristics yielded three demographic variables that showed a statistical difference ($V < 0.05$). There characteristics were industry of employment ($n = 2$), completion of an ASM degree ($n = 3$), and level of management within the respondents industry ($n = 4$). Years working with an ASM graduate, years working with an ASM degree, and number of graduates hired in the last five years did not have any significant differences between respondents or demographic characteristics.

Table 22 is the description of the analysis of variance for ASM competencies and demographic characteristics of employers and self-employed ASM graduates. The values represent the variance for each comparison or the probability that the variable is statistically significant. In order for a value to be significant it must be less than 0.05.

The data is categorized into six different groups (1-5, 13) representing the demographic characteristic associated with each question.

Table 22.

Description of the Analysis of Variance for ASM Competencies and Demographic Characteristics of Employers and Self-Employed ASM Graduates.

ASM Skills	1	2	3	4	5	13
Knowledge of renewable energy and sustainable energy sources?	0.91	0.61	0.43	0.22	0.83	0.56
Knowledge of conservation of energy in businesses related to agriculture?	0.36	0.60	0.77	0.83	0.48	0.60
Understanding of challenges associated with logistics of biofuels? <i>transportation, production, handling</i>	0.26	0.71	0.96	0.85	0.23	0.14
Ability to install, calibrate, and demonstrate precision agriculture systems?	0.37	0.63	0.94	0.05	0.89	0.67
Skills in processing, analyzing, and interpreting data with Geographical Information Systems (GIS)?	0.02	0.33	0.10	0.42	0.74	0.93
Understanding of how precision agriculture systems operate including GPS, GIS, computers, and sensor and control technology?	0.02	0.62	0.63	0.70	0.71	0.48
Ability to research and adopt new precision agriculture technologies in order to build on prior knowledge?	0.23	0.72	0.11	0.30	0.40	0.94
Skills associated with grain grading?	0.30	0.11	0.11	0.29	0.50	0.65
Understanding of maintaining grain quality?	0.06	0.27	0.36	0.24	0.50	0.84
Ability to understand and operate grain storage systems?	0.00	0.36	0.85	0.60	0.94	0.11
Proficiency in using electronic technology? <i>programmable logic controllers (PLC), machine control panels, etc.</i>	0.13	0.41	0.67	0.56	0.22	0.91
Knowledge of psychrometrics (air characteristics) for grain drying?	0.21	0.67	0.41	0.19	0.18	0.53
Skills associated with internal combustion engines?	0.05	0.63	0.50	0.19	0.25	0.10
Skills associated with machine power distribution? <i>transmissions, planetary systems, belt drives, chain drives</i>	0.04	0.93	0.21	0.30	0.04	0.64
Skills associated with machinery management? <i>efficiency, selecting proper equipment, economics</i>	0.00	0.77	0.67	0.64	0.61	0.84

Table 22 (Continued).

Description of the Analysis of Variance for ASM Competencies and Demographic Characteristics of Employers and Self-Employed ASM Graduates.

ASM Skills	1	2	3	4	5	13
Skills associated with understanding hydraulic systems?	0.01	0.83	0.65	0.62	0.11	0.84
Skills associated with 12 volt electricity?	0.18	0.52	0.46	0.46	0.12	0.91
Ability to calibrate application equipment?	0.10	0.80	0.88	0.82	0.26	0.91
Knowledge of safe handling and storage of pesticides?	0.44	0.55	0.90	0.85	0.37	0.95
Ability to select appropriate equipment for pesticide/fertilizer application?	0.04	0.66	0.44	0.66	0.10	0.53
Knowledge to plan appropriate layout of farmstead buildings?	0.27	0.09	0.58	1.00	0.76	0.18
Skills associated with project management? <i>construction, proposal, presentation</i>	0.21	0.61	0.34	0.25	0.29	0.70
Skills associated with 120/240 volt electricity?	0.20	0.97	0.91	0.85	0.91	0.08
Skills associated with irrigation management?	0.29	0.85	0.75	0.82	0.68	0.45
Ability to develop plans for proper drainage of agricultural land?	0.07	0.93	0.51	0.28	0.95	0.03
Knowledge of water quality relationships with nitrogen, phosphorus, and potassium applications used in crop production?	0.03	0.75	0.39	0.72	0.20	0.12
Understanding of environmental planning and impact in agriculture applications?	0.00	0.69	0.80	0.62	0.79	0.21

Note: The variable is statistically significant if the value is less than 0.05

Categories: 1: Industry of employment, 2: Years working with an ASM graduate, 3: Completion of an ASM degree, 4: years working as an ASM graduate, 5: Number of graduates hired in the last 5 years, 13: Level of management within the respondents industry.

The analysis of variance for WDS values for ASM competencies and demographic characteristics yielded two demographic variables that showed a statistical difference ($V < 0.05$). These characteristics were industry of employment ($n = 11$) and level of management within the respondents industry ($n = 2$). Years working with an

ASM graduate, completion of an ASM degree, years working with an ASM degree, and number of graduates hired in the last five years did not have any significant differences between respondents or demographic characteristics.

Table 23 is a summary of least square means comparison of employers and ASM graduates industry of work and WDS value for statistically significant variables. The statistical analysis yielded a statistical difference for thirteen questions within the ASM program evaluation when compared to the respondent's industry of work. The respondents' industry of work was categorized into four groups including production agriculture, machinery, agricultural retail/grain, and other. Each question has a listing of the least square mean value, standard error, variance, F-value, F-probability, and statistical differences between each category for each of the 13 questions.

Table 23.

Summary of Least Square Means Comparison of Employers and ASM Graduates Industry of Work and WDS Value for Statistically Significant Variables.

		<u>Industry of Work</u>							
		Production							
		Agriculture	Machinery	Grain/Retail	Other	F-	F-	Significant	
		(n=24)	(n=15)	(n=8)	(n=7)	Value	Prob.	Differences	
		(1)	(2)	(3)	(4)				
General/ASM Competency	Ability to incorporate safety in the workplace?	LSM ^a	-0.765	1.886	0.000	3.667	3.02	0.039	1≠3, 1≠4
		SE ^b	0.775	0.994	1.315	1.518			
		P ^c	0.329	0.064	1.000	0.020			
Ability to motivate employees or co-workers?		LSM	-0.680	2.914	0.510	3.264	3.03	0.040	1≠2, 1≠4
		SE	0.889	1.008	1.333	1.687			
		P	0.119	0.006	0.704	0.060			
Skills in processing, analyzing, and interpreting data with Geographical Information Systems (GIS)?		LSM	-0.001	1.605	0.504	-5.650	3.82	0.169	1≠4, 2≠4, 3≠4
		SE	0.885	1.223	1.533	1.814			
		P	0.999	0.197	0.744	0.003			
Understanding of how precision agriculture systems operate including GPS, GIS, computers, and sensor and control technology?		LSM	0.541	1.516	-1.516	-6.633	3.83	0.018	1≠4, 2≠4
		SE	0.944	1.368	1.935	2.163			
		P	0.570	0.275	0.439	0.004			
Ability to understand and operate grain storage systems?		LSM	-0.162	-2.835	1.360	-5.958	5.35	0.004	1≠4, 2≠3, 3≠4
		SE	0.691	1.293	1.417	1.584			
		P	0.816	0.036	0.344	0.001			

Table 23 (Continued).

Description of Least Square Means Comparison of Employers and ASM Graduates Industry of Work and WDS Value for Statistically Significant Variables.

		<u>Industry of Work</u>						
		Production						
		Agriculture	Machinery	Grain/Retail	Other	F-	F-	Significant
		(n=24)	(n=15)	(n=8)	(n=7)	Value	Prob.	Differences
<u>General/ASM Competency</u>		(1)	(2)	(3)	(4)			
Skills associated with internal combustion engines?	LSM	0.952	-0.349	-2.493	-5.235	2.84	0.050	1≠4
	SE	0.936	1.388	1.659	2.195			
	P	0.315	0.803	0.141	0.022			
Skills associated with machine power distribution? <i>transmissions, planetary systems, belt drives, chain drives</i>	LSM	0.361	0.345	-0.541	-6.635	3.01	0.042	1≠4, 2≠4, 3≠4
	SE	0.958	1.324	1.659	2.195			
	P	0.708	0.796	0.746	0.004			
Skills associated with machinery management? <i>efficiency, selecting proper equipment, economics</i>	LSM	-0.344	0.609	0.000	6.930	6.38	0.001	1≠4, 2≠4, 3≠4
	SE	0.645	0.858	1.120	1.548			
	P	0.596	0.482	1.000	0.001			
Skills associated with understanding hydraulic systems?	LSM	-1.273	2.745	-2.091	-5.490	4.43	0.009	1≠2, 2≠3, 2≠4
	SE	0.914	1.265	1.656	2.190			
	P	0.171	0.036	0.214	0.016			
Ability to select appropriate equipment for pesticide/fertilizer application?	LSM	-0.870	0.000	0.766	-7.660	3.03	0.043	1≠4, 2≠4, 3≠4
	SE	0.997	1.767	2.091	2.338			
	P	0.389	1.000	0.716	0.002			

Table 23 (Continued).

Description of Least Square Means Comparison of Employers and ASM Graduates Industry of Work and WDS Value for Statistically Significant Variables.

	<u>Industry of Work</u>				F- Value	F- Prob.	Significant Differences	
	Production Agriculture (n=24) (1)	Machinery (n=15) (2)	Grain/Retail (n=8) (3)	Other (n=7) (4)				
General/ASM Competency								
Knowledge required to construct agricultural structures?	LSM	-0.001	-0.390	0.704	-11.455	11.25	0.001	1≠4, 2≠4, 3≠4
	SE	0.838	1.249	1.675	1.873			
	P	0.999	0.757	0.697	0.001			
Knowledge of water quality relationships with nitrogen, phosphorus, and potassium applications used in crop production?	LSM	1.265	-1.932	2.086	-6.953	3.36	0.031	1≠2, 1≠4, 2≠3, 2≠4, 3≠4
	SE	0.683	1.067	1.432	1.601			
	P	0.072	0.079	0.454	0.001			
Understanding of environmental planning and impact in agriculture applications	LSM	1.265	-1.932	2.086	-6.953	9.19	0.001	1≠2, 1≠4, 2≠3, 2≠4, 3≠4
	SE	0.683	1.067	1.432	1.601			
	P	0.072	0.079	0.154	0.001			

Note: LSM^a = Least Square Mean for WDS values, SE^b = Standard Error, P^c = F-Probability for Each Category. Other includes Government, Education, Real Estate, and Veterinary Medicine.

The data indicates that skills associated for understanding environmental planning and impact on agricultural applications and knowledge of water quality relationships with nitrogen, phosphorus, and potassium applications used in crop production had five variables with a statistical difference. Seven skills had three different variables with a statistical difference, three questions had two variables with a variance less than 0.05, three questions had two variables, and one question only had one variable with a statistical difference. Of the questions dealing with employers and self-employed ASM graduates industry that accounted for variance between respondents, and two questions dealt with general skills (ability to motivate employees or co-workers and ability to incorporate safety into the workplace).

Two questions were related to precision agriculture (skills in processing, analyzing, and interpreting data with a Geographical Information Systems (GIS) and understanding of how precision agriculture systems operate including GPS, GIS, computers, and sensor and control technology); one was related to grain handling (ability to understand and operate grain storage systems); five were related to equipment (skills associated with internal combustion engines, skills associated with machine power distribution, *transmissions, planetary systems, belt drives, chain drives*, skills associated with machinery management, *efficiency, selecting proper equipment, economics*, and skills associated with understanding hydraulic systems ability to select appropriate equipment for pesticide/fertilizer application) one was related to structures (knowledge required to construct agricultural structures); and two questions were related to environmental conservation (knowledge of water quality relationships with nitrogen,

phosphorus, and potassium applications used in crop production and understanding of environmental planning and the impact in agriculture applications).

Table 24 is a summary of least square means comparison of employers and ASM graduates completing an ASM degree and WDS value for statistically significant variables. The statistical analysis yielded a statistical difference for three questions within the ASM program evaluation when compared to the respondent’s industry of work. The respondents’ completion of an ASM degree was categorized into two groups: ASM degree and no ASM degree. Each question has a listing of the least square mean value, standard error, variance, F-value, F-probability, and statistical differences between each category for each of the 3 questions.

Table 24.

Description of Least Square Means Comparison of Completion of an ASM Degree by Employers and ASM Graduates and WDS Value for Statistically Significant Variables.

		No ASM Degree (n=30) (1)	ASM Degree (n=24) (2)	F-Value	F-Prob.	Significant Differences
<hr/>						
Competency						
Ability to show more desirable employability skills compared to graduates of other Universities?	LSM ^a	-0.366	-4.209	8.1	0.008	1 ≠ 2
	SE ^b	0.85	1.054			
	P ^c	0.67	0.001			
Ability to effectively manage work of others?	LSM	2.132	-0.929	5.26	0.027	1 ≠ 2
	SE	0.934	0.955			
	P	0.027	0.336			
Ability to contribute in multidisciplinary teams?	LSM	0.954	-1.767	6.48	0.015	1 ≠ 2
	SE	0.692	0.815			
	P	0.175	0.036			
<hr/>						

Note: LSM^a = Least Square Mean for WDS values, SE^b = Standard Error, P^c = F-Probability for Each Category.

Other includes Government, Education, Real Estate, and Veterinary Medicine.

The data for least square means comparison for completion of an ASM degree and WDS yielded three general skills with a statistical difference among respondents. These skills include the ability to show more desirable employability skills compared to graduates of other universities, ability to effectively manage work of others, and ability to contribute in multidisciplinary teams.

Table 25 is a summary of least square means comparison of employers and ASM graduates level of management within their industry and WDS value for statistically significant variables. The statistical analysis yielded a statistical difference for three questions within the ASM program evaluation when compared to the respondent's industry of work. The respondents' completion of an ASM degree was categorized into two groups: respondents owning their own business or managing a business for someone else. Each question has a listing of the least square mean value, standard error, variance, F-value, F-probability, and statistical differences between each category for each of the 3 questions.

Table 25.

Description of Least Square Means Comparison of Level of Management within Respondents' Industry and WDS Value for Statistically Significant Variables.

General/ ASM Competency		Level of Management		F- Value	F- Prob.	Signif- icant Differ- ences
		Manage Other's Business (n=21) (1)	Manage Own Business (n=32) (2)			
Ability to incorporate safety in the workplace?	LSM ^a	2.724	-0.852	13	0.001	1 ≠ 2
	SE ^b	0.766	0.630			
	P ^c	0.001	0.183			
Willingness to adopt new concepts?	LSM	1.070	-1.243	4.13	0.048	1 ≠ 2
	SE	0.887	0.713			
	P	0.234	0.088			
Ability to motivate employees or co- workers?	LSM	2.856	-0.163	7.44	0.009	1 ≠ 2
	SE	0.825	-0.163			
	P	0.001	0.826			
Ability to contribute in multidisciplinary teams?	LSM	1.591	-1.808	10.83	0.002	1 ≠ 2
	SE	0.747	0.713			
	P	0.040	0.015			
Knowledge required to construct agricultural structures?	LSM	-3.795	0.391	6.76	0.013	1 ≠ 2
	SE	1.323	0.918			
	P	0.007	0.672			
Ability to develop plans for proper drainage of agricultural land?	LSM	-2.370	1.080	4.96	0.033	1 ≠ 2
	SE	1.257	0.908			
	P	0.068	0.242			

Note: LSM^a = Least Square Mean for WDS values, SE^b = Standard Error, P^c = F-Probability for Each Category. Other includes Government, Education, Real Estate, and Veterinary Medicine

The comparison of the respondent's level of management within their industry and WDS values yielded six questions with a statistical difference among respondents.

Four of these questions were associated with general skills (ability to incorporate safety in the workplace, willingness to adopt new concepts, ability to motivate employees or co-workers, and ability to contribute in multidisciplinary teams) and two questions were related to ASM skills (knowledge required to construct agricultural structures and ability to develop plans for proper drainage of agricultural land).

4.7 Findings Related to Objective Six

The survey participants were asked to answer four open-ended questions regarding new topic areas that they would suggest that the ASM program add to the curriculum to better prepare ASM graduates for the workforce and future skills that they foresee ASM graduates needing in the future, and the most used skill that ASM graduates exercise on a daily basis. Table 26 is a description of suggested new topic areas to assist in better preparing ASM graduates for the workforce as indicated by employers. They are categorized into 12 topics that include business management/accounting, precision agriculture, employee management, agronomy, equipment, electricity/electronics, grain marketing, regulations, renewable energy, manufacturing, safety, and technical skills. Several participants gave multiple answers to the same question and each response was counted as an individual answer so the total number of responses is (n=56)

Table 26.

Description of Suggested New Topic Areas to Assist in Better Preparing ASM Graduates for the Workforce as Indicated by Employers (n = 56).

Topic	f	%
Business Management/Accounting	11	19.64
Precision Agriculture	10	17.86
Employee Management	7	12.50
Agronomy	6	10.71
Equipment	4	7.14
Electricity/Electronics	3	5.36
Grain Marketing	3	5.36
Regulations	3	5.36
Renewable Energy	3	5.36
Manufacturing	2	3.57
Safety	2	3.57
Technical Skills	2	3.57

Note: Some participants gave multiple responses, each answer was counted as an individual response.

Employers of ASM graduates and self-employed ASM graduates indicated that they would suggest that the ASM program add further in-depth topics such as business management/accounting (20%), precision agriculture (18%), employee management (13%), and agronomy (11%) to their curriculum. Several of the other skills that yielded fewer responses are a part of the ASM program curriculum but the respondents feel that they will be important in the future and thus need to be addressed more in the program.

Table 27 is a description of foreseen skills/competencies needed by ASM graduates in the future as perceived by employers. The data is presented in frequency and percent. The total number of answers is 58 but several participants gave multiple answers. The data is categorized into 6 foreseen skills/competencies including

electronic/computer, management/financial, people management, precision agriculture, interdisciplinary knowledge, and production agriculture.

Table 27.

Description of Foreseen Skills/Competencies Needed by ASM Graduates in the Future as Perceived by Employers (n = 58).

Skill	f	%
Electronic/Computer	19	32.76
Management/Financial	13	22.41
People Management	9	15.52
Precision Agriculture	9	15.52
Interdisciplinary Knowledge	5	8.62
Production Agriculture	3	5.17

Note: Some respondents gave multiple answers.

The respondents indicated that electronic/computer skills (32.76%) is the most foreseen skill needed by ASM graduates for the future followed by management/financial (22.41%), people management (15.52%), precision agriculture (15.52%), interdisciplinary knowledge (8.62%), and production agriculture (5.17%).

Table 28 is a description of the most frequently used technical skills used by the employed ASM graduate as perceived by their employer. The data is summarized by frequency and percent and is categorized into 7 areas including GPS/precision agriculture, electrical, mechanical, manufacturing, grain/material handling, production agriculture, and business/marketing. There were 65 answers to this question because multiple participants gave multiple responses.

Table 28.

Description of the Most Frequently Used Technical Skill Used by the Employed ASM Graduate as perceived by the Employer (n = 65).

	f	%
GPS/Precision Agriculture	21	32.31
Electrical	10	15.38
Mechanical	9	13.85
Manufacturing	8	12.31
Grain/Material Handling	7	10.77
Production Agriculture	6	9.23
Business/Marketing	4	6.15

Note: Several participants gave multiple responses.

The survey participants suggested that GPS/precision agriculture (32.31%) was the most frequently used technical skill by the ASM graduate that they employed followed by electrical (15.38%), mechanical (13.85%), manufacturing (12.31%), grain/material handling (10.77%), production agriculture (9.23%), and business/marketing (6.15%).

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS FOR FUTURE RESEARCH

5.1 Introduction

The purpose of this chapter is to present the summary of the findings, conclusions, discussions, and the recommendations for future research for the data generated by the Agricultural Systems Management Program Evaluation Questionnaire.

5.2 Statement of the Problem

The University of Missouri Agricultural Systems Management and Agricultural Engineering Extension program is undergoing a six year review in order to evaluate whether or not the department is satisfying the needs of the community and student population. The goal of this review is to determine the strengths of the department as well as weaknesses in order to offer suggestions to improve the ASM program and Agricultural Engineering Extension. Ideally, the Agricultural Engineering Extension and ASM faculty would work together to provide research for outreach and curriculum enhancement. A part of this review is assessing the current ASM curriculum in order to see if the topics of study are keeping up with new technologies and demands of the agriculture industry. All of the analysis is conducted within the Biological Engineering Department, so it is also important that research is conducted in the agriculture industry to see if the ASM program is teaching the necessary skills for students to be successful in

the workplace. Researching employers' perceptions of ASM graduates will guide the faculty in finding areas of the ASM curriculum to improve or expand. "Employer surveys provide further insight into the knowledge, skills, and traits required of recent graduates" (Berle 2007). This information would go hand in hand with the suggestions from the six year review in ensuring that the ASM program is properly preparing students for the agriculture industry.

5.3 Purpose of the Study

The purpose of this study was to survey employers of ASM graduates to assess their perception of the skills acquired by ASM graduates and the importance of each skill for their industry. This research will assist the ASM program review by gathering critical information that will assist in curriculum development that will better prepare ASM students for the workforce.

5.4 Objectives

1. Describe the demographic characteristics (industry of employment, years working with an ASM graduate, completion of an ASM degree, years working as an ASM graduate, number of graduates hired in the last 5 years, anticipated number of graduates that will be hired in the next five years, previous training desired from potential employees, days spent training new employees, tools used to train new employees, topics focused on most when starting to train new employees, communication with potential employers through social networks (Facebook,

LinkedIn, etc.), posting of online applications for potential employees, and level of management of business the participant is involved in.

2. Describe the skill level of acquired skills of ASM graduates as perceived by their employers.
3. Describe the importance of the skill to the organization as indicated by the employers of Agricultural Systems Management graduates.
4. Describe the overall difference among each respondent between the graduate's skill level and importance of competency for the employer's industry with a Mean Weight Discrepancy Score (MWDS).
5. Compare the calculated Weighted Discrepancy Score (WDS) for each respondent to demographic characteristics such as industry of employment, years working with an ASM graduate, completion of an ASM degree, years working as an ASM graduate, number of graduates hired in the last 5 years, and level of management within the respondents industry.
6. Summarize suggestion's for new topic areas, foreseen skills needed in the future, and most common technical information used by ASM graduates as perceived by employers and self-employed ASM graduates.

5.5 Summary of Findings

Objective One – Demographic Characteristics of Employers of ASM Graduates and Self-Employed ASM Graduates

The purpose of the first objective was to collect demographic characteristics about the study population in order to better understand the employers and self-employed ASM graduates that participated in this study. This information also assisted in describing the data that was collected by helping to determine the differences in the responses between individuals.

Within the survey respondents, the most common industry in which employers of ASM graduates or self-employed ASM graduates were involved was production agriculture which represented 44% of the participants. Machinery and equipment was the next largest group; it represented about 28% of the survey respondents. Agricultural retail/services/grain operations and other (government, education, and real estate), represented the final 27% of the employer's or self-employed graduate's industry.

The study population was asked how long they have been working with an ASM graduate and almost 48 % indicated that they have been working with the graduate from 0-4 years. The other two categories were closer together in representation, about 29% have been involved with a graduate for 5-9 years and about 24% have been involved for over 10 years. The overall range for this data set was 0-17 years, overall mean was 5.33 years, and the standard deviation was 4.38 years

Of the 54 respondents to the ASM Program Evaluation Questionnaire, 24 of the participants indicated that they completed an ASM degree. The biggest category of graduates have been working for 7-12 years and they represent 44% of the respondents. Both 1-6 years and greater than 15 years each represent 28% of the ASM graduates that responded to the survey. The overall range for this question was 1-41 years, overall mean was 10.84 years, and the standard deviation was 8.68 years.

Employers of ASM graduates and self-employed ASM graduates were also asked to supply the number of ASM graduates that they have hired in the last five years. Thirty-eight percent of individuals indicated that they have hired no ASM graduates in the last five years. The largest group represented 46% of the survey responses and they have only hired 1 ASM graduate in the last five years. Sixteen percent indicated that they have hired more than two ASM graduates. The total number of ASM graduates hired in the last five years was 97. The overall range was 0-40 graduates, overall mean was 1.94 graduates, and the standard deviation was 5.95 graduates.

The survey participants were requested to give an estimation of the number of ASM graduates that they expect to hire in the future. Approximately 68% of respondents indicated that they are not anticipating hiring any ASM graduates in the next five years. Eleven percent indicated that they would like to hire 1 ASM graduate in the next half decade and over 20% of employers and ASM graduates expect to hire two or more graduates. The overall range was 0-50 graduates, overall mean was 2.11 graduates, and the standard deviation was 7.80 graduates. The total number of graduates expected to be hired in the next 5 years is 93.

Another aspect of the demographic characteristics was the previous experience that employers and self-employed graduates look for when hiring new employees. Half of the respondents indicated that they look for previous work experience, 36% indicated that they are looking for a college degree, and approximately 14% prefer internship experience in order for a graduate to be considered for a job.

Participants were also asked to provide information regarding how many days they spend training new employees when they are hired. Approximately 43% of the respondents indicated that they spend 0-25 days training employees. About 22% spend 26-90 days training new employees and the remaining 35% of employers spend over 90 days training new employees. The overall range was 0-760 days, overall mean was 116.45 days, and the standard deviation was 170.16 days.

Employers and self-employed ASM graduates were also asked to list the tools that they use to train new employees. Mentors and computers (online resources and modules) were the most popular tools used at 28.77% and 26.03%, respectively. Classroom learning and presentations and hands-on experience followed close behind at about 25% and 21%, respectively. Many respondents gave multiple answers to this question so the total number of answers was $n = 73$.

Survey participants were also asked to list the most important training topics used when first training new employees. Over 43% of respondents indicated that safety was the first topic that they focused on for new employees. Company procedures and operations (24%) was the second most listed topic. The final three topics (computer

skills, customer service, and educational requirements for teachers) represented 5.41% each of the respondent population.

The study population was asked to indicate whether or not they communicated with potential employees through social networks. Only 7 of the participants or 14.58% do participate with potential employees through social networks. The networks used to communicate are Facebook or LinkedIn.

Within the study population, about 43% of the respondents indicated that they post on-line applications when hiring new employers. Sixty-one percent of these employers post applications on their company website, thirty-three post on public career builder websites, and only one respondent posts online applications on a social network.

Participants were also asked to indicate their level of management within the business in which they work and 32 or 60% of the employers or self-employed ASM graduates indicated that they own their own business. Twenty-one or about 40% of the respondents said that they manage a business for someone else. Four answers indicated that they both owned their own business and managed a business for someone else so they were counted as only owning their own business.

Objective Two - Describe the skill level of acquired skills of ASM graduates as perceived by their employers

The employers of ASM graduates and self-employed ASM graduates indicated that ASM alumni show moderate mastery (overall mean = 3.51 - 4.50) for all general ASM competencies. Overall mean values ranged from 3.57 to 4.42 with a range of

responses from 34 to 53 due to missing data. Six of the eleven general competencies had an overall mean of greater than four; included among these skills is the ability to understand how to manage agricultural systems, willingness to adopt new concepts, ability to incorporate safety into the workplace, effective computer skills, ability to show more desirable employability skills compared to graduates of other universities, and ability to contribute to multidisciplinary teams. Skills associated with marketing of a product were the lowest rated skill that ASM graduates demonstrate by the survey respondents.

The employers of ASM graduates and self employed ASM graduates indicated that ASM graduates demonstrate moderately low mastery (overall mean = 2.51 – 3.50) for 5 competencies to moderate mastery (overall mean = 3.51 – 4.50) for 24 competencies for ASM skills. The number of respondents for each question ranged from 37 to 50 and the overall mean ranged from 3.17 - 4.14. Survey participants rated skills associated with grain grading, understanding of challenges associated with logistics of biofuels, skills associated with irrigation management, and knowledge of conservation of energy in agricultural related business as the lowest level of mastery demonstrated by ASM graduates that they employ. Respondents indicated that ASM alumni show the highest mastery in skills associated with knowledge of safe handling and storage of pesticides, skills associated with machinery management, and ability to select appropriate equipment for pesticide/fertilizer application.

Objective Three - Describe the importance of the skill to the organization as indicated by the employers of Agricultural Systems Management graduates

The survey data indicate that all employers and ASM graduates see all of the general competencies as moderately high importance (overall mean = 3.51 – 4.50) to their industry. The number of responses to this question ranged from 35 to 55 with an overall mean ranging from 3.66 - 4.43. The skills that the survey participants indicated as being the most important to their industry included ability to understand how to manage agricultural systems, ability to incorporate safety into the workplace, effective use of financial management skills, willingness to adopt new concepts, and effective computer skills. Employers and self-employed ASM graduates felt that ability to show more desirable employability skills compared to graduates of other universities and ability to contribute in multidisciplinary teams was overall the least important competencies for their organization.

The data indicates that employers of ASM graduates and self-employed ASM graduates perceive ASM competencies to be of moderately low importance to moderate importance to their industry. Seventeen of the skills were of moderately high importance (overall mean = 3.51 - 4.40), Ten ASM competencies were of moderate importance (overall mean = 2.51 - 3.50) and one skill “understanding of challenges associated with logistics of biofuels” was of moderately low importance (overall mean = 1.51 - 2.50). The ASM competencies of highest importance to the respondent population include skills associated with machine power distribution, ability to select appropriate equipment for pesticide/fertilizer application, skills associated with machinery management, and ability

to install, calibrate, and demonstrate precision agriculture systems. Skills that had a moderate importance to employer's and self-employed ASM alumni include knowledge required to construct agricultural structures, skills associated with 12 volt electricity, skills in processing, analyzing, and interpreting data with Geographical Information Systems (GIS), and ability to develop plans for proper drainage of agricultural land. Skills that have a moderately low importance to the respondent's organization include knowledge of renewable energy and sustainable energy sources, skills associated with irrigation management, knowledge of conservation of energy in businesses related to agriculture, and skills associated with grain grading.

Objective Four - Describe the overall difference among each respondent between graduate's skill level and importance of competency for employer's industry with a Mean Weight Discrepancy Score (MWDS)

The data for MWDS for general competencies indicates that employers and self-employed ASM graduates suggest that seven of the eleven skills yielded positive values, three skills yielded negative values, and one skill yielded negative values large enough to suggest that it needs to be de-emphasized. Three skills yielded a MWDS value high enough to suggest that more emphasis is needed for these skills; they include effective use of financial management skills, skills associated with marketing of a product, and ability to motivate employees or co-workers. Ability to show more desirable employability skills than other universities yielded a MWDS score less than negative one which suggests that less emphasis needs to be placed on this competency. All other

general competencies need slight emphasis or slightly less emphasis placed on these skills.

The MWDS values generated for ASM competencies indicate that six skills yielded MWDS values that were above zero (emphasis needed), sixteen skills yielded MWDS values above negative one (adequate preparation, some de-emphasis needed), and seven skills yielded a MWDS value below negative one (de-emphasis needed). Ability to install, calibrate, and demonstrate precision agriculture systems was the only skill that yielded a MWDS value high enough to suggest that more emphasis needs to be placed in this area. Seven of the ASM competencies yielded a MWDS value low enough to suggest that they need to be de-emphasized in the ASM program. They include knowledge of renewable energy and sustainable energy sources, understanding of challenges associated with logistics of biofuels, transportation, production, and handling, ability to select appropriate equipment for pesticide/fertilizer application, knowledge to plan appropriate layout of farmstead buildings, knowledge of safe handling and storage of pesticides, knowledge required to construct agricultural structures, and ability to understand and operate grain storage systems.

Objective Five – Compare a Weighted Discrepancy Score for each respondent to demographic characteristics

Statistical analysis was conducted using a least mean square comparison between six different demographic characteristics and the Weighted Discrepancy Score (WDS) generated from the ASM Program Evaluation. Of the six demographic characteristics,

only three (respondents industry of work, completion of an ASM degree, and level of management within the respondents' industry) had a significant difference among respondents (F-probability less than 0.05). Years working with an ASM graduate, years working with an ASM degree, and number of graduates hired in the last five years did not have any variance among respondents. Only one question within the number of graduates hired in the last five years had a significant difference for skills associated with machinery power distribution.

The comparison between the respondents' industry of work and WDS values generated 13 questions with a statistical difference among respondents. Please see Table 23 for a summary of which categories had an F-Probability less than 0.05 for each of these questions. Two questions dealt with general skills (ability to motivate employees or co-workers and ability to motivate employees or co-workers), two questions were related to precision agriculture (skills in processing, analyzing, and interpreting data with Geographical Information Systems (GIS) and understanding of how precision agriculture systems operate including GPS, GIS, computers, and sensor and control technology, one was related to grain handling (ability to understand and operate grain storage systems), five were related to equipment (skills associated with internal combustion engines, skills associated with machine power distribution, transmissions, planetary systems, belt drives, chain drives, skills associated with machinery management, efficiency, selecting proper equipment, economics, and skills associated with understanding hydraulic systems ability to select appropriate equipment for pesticide/fertilizer application), one was related to structures (knowledge required to construct agricultural structures), and two questions

were related to environmental conservation (knowledge of water quality relationships with nitrogen, phosphorus, and potassium applications used in crop production and understanding of environmental planning and impact in agriculture applications).

The comparison between the respondents' completion of an ASM degree and WDS value generated three questions that had a statistical difference between the respondents that graduated with an ASM degree and did not graduate with an ASM degree. All of these questions were related to general skills and they include ability to show more desirable employability skills compared to graduates of other universities, ability to effectively manage work of others, and ability to contribute in multidisciplinary teams.

The comparison between respondent's level of management in their industry and WDS values generated six questions with a statistical difference between the respondents that own their own business or manage a business for someone else. Four of these questions were associated with general skills (ability to incorporate safety in the workplace, willingness to adopt new concepts, ability to motivate employees or co-workers, and ability to contribute in multidisciplinary teams) and two questions were related to ASM skills (knowledge required to construct agricultural structures and ability to develop plans for proper drainage of agricultural land).

Objective Six - Summarize suggestions for new topic areas, foreseen skills needed in the future, and most common technical information used by ASM graduates as perceived by employers and self-employed ASM Graduates

Employers of ASM graduates and self-employed ASM graduates indicated that they would suggest that the ASM program add further in-depth topics such as business management/accounting, precision agriculture, employee management, and agronomy to their curriculum. Other topics that were mentioned were equipment, electricity/electronics, grain marketing, regulations, renewable energy, manufacturing, safety, and technical skills.

The employers of ASM graduates and self-employed ASM alumni indicated that electronic/computer skills is the most foreseen skill needed by ASM graduates for the future followed by management/financial, people management, precision agriculture, interdisciplinary knowledge, and production agriculture.

The survey participants suggested that GPS/precision agriculture was the most frequently used technical skill by the ASM graduate that they employed followed by electrical, mechanical, manufacturing, grain/material handling, production agriculture, and business/marketing.

5.6 Conclusions, Discussion, and Recommendations for Future Research.

Objective One – Demographic Characteristics of Employers of ASM Graduates and Self-Employed ASM Graduates

Conclusions

The employers of ASM graduates and the self-employed ASM graduates who participated in this study were mainly from the production agriculture and machinery industries. Production agriculture represented 44% of the study population and the machinery industry represented 28%. The remainder of the population was evenly split between agricultural retail/sales/grain and other miscellaneous groups. The study population is heavily weighted in the production agriculture and machinery industries so they represent graduates who use more technical and agricultural management skills.

Employers of ASM graduates have been working with ASM alumni for an average of 5.33 years with almost half of the responses indicating that it has been between 0-4 years. Many of the employers are working with relatively new employees in their industry. Seventy-five percent indicated that they have been working with an ASM graduate for less than 10 years.

Twenty-four of the participants indicated that they graduated with an ASM degree and they have been working for an average of 11 years with 72 % of them indicating that they have been working for less than 12 years. Most of the respondents have been working as an ASM graduate for some time but many are relatively new to the workforce.

Almost half of the respondents indicated that they have hired at least one graduate in the last five years; the total number of graduates hired was 97. Only 11% of employers expect to hire another ASM graduate in the next five years and 20% of employers expect to hire two or more graduates. The total number of graduates expected to be hired from this study is 93.

When asked about previous work experience, the survey participants indicated that previous work experience is the most important experience when they are looking to hire new employees. Many employers also look for college degrees and some even indicated that an internship is required in order for them to consider a potential employee as a candidate to hire.

Employers spend an average of 116 days training new employees. Sixty-five percent of the respondents indicated that they spend less than 90 days training new employees. Forty-three percent indicated that they spend less than 25 days with new employees. The most common tool for training new employees is using mentors followed by computers/modules, classroom learning, and hands-on experience. These four groups had a similar representation of the population group and many employers use multiple tools. Safety is the most common subject first discussed during training; 43% of employers mentioned that this was the first thing they discussed when training new employees followed by company operations (24%).

Only 7% of employers communicate with potential employees through social networks, but 43% of employers post online applications for potential employees, mainly on their company website and career builder websites.

Of the 54 employers of ASM graduates and self-employed ASM graduates, 60% of the respondents indicated that they owned their own business. Many of the employers that are looking to hire ASM graduates are in charge of their own business.

Discussion

The survey population for this study is dominated by production agriculture and followed closely by the machinery industry. Curriculum changes for the ASM program based on this study would reflect the machinery and production agriculture industry and potentially be biased since the other industries are not as well represented. Many ASM graduates are employed in the grain industry which was not well represented. The results of this study will still provide valuable information to the ASM program because production agriculture and machinery management are the fundamental topics covered in the ASM program. Almost half of the study population indicated that they have been working with an ASM alumni for less than four years. This is important because the employers that responded to this questionnaire may not have had adequate time to accurately assess the performance of the ASM graduate. This introduces error into the data if they do not correctly state the graduate's ability for all competencies. It is also important to note that 24% of the respondents graduate with an ASM degree and 72% of these respondents have been in the workforce for less than 12 years. Most of these respondents are assessing their own level of mastery for the skills that they acquired so their answers could be biased, but they still provide valuable information for the ASM program curriculum evaluation.

Approximately 46% of the survey respondents indicated that they have hired an ASM graduate in the last five years. This number falls to 11% in the next five years with the total number of graduates hired falling from 97 to 93 in the next five years.

According to this study it would seem that there will be a decrease in the total number of available jobs for ASM graduates in the future, but it is important to note that the population study is dominated by the production agriculture industry and many of these respondents were self-employed ASM graduates so they don't represent the larger industries/companies that are looking for ASM graduates.

Over half of the employers indicated that they look for previous work experience when hiring new employees. Only 14% indicated that an ASM graduate needs internship experience to be considered for a job. Again, it is important to note that the study population was dominated by production agriculture so many of the big companies that offer or desire internship experiences were not represented in this study. The ASM program should still promote internship experiences because it provides work experience for students that employers desire.

Approximately 43% of employers indicated that they spend less than 25 days training new employees with the next 22% spending less than 90 days training. This suggests that ASM graduates possess many of the core skills that employers are looking for and they have the ability to adopt new ideas quickly. Many of the tools used in training are mentors, computers (online resources/modules), classroom learning, and hands-on experience. The ASM program currently offers hands-on experience and classroom learning in its curriculum, but if they incorporated more mentoring experiences

and computer learning it would help the ASM graduates in their training with new employers. About 43% of employers indicated that they focus on safety when first training new employees with the following 24% focusing on company operations. This stresses the point that safety is a vital part of agriculture thus; more emphasis should be placed on safety in the ASM curriculum.

Communicating to potential employees through social networks only accounts for 7% of the study population, but 43% of the participants do post online applications for new employees. Online communication is not a priority for employers now but it may be an important aspect of networking in the future. Many of the companies outside of production agriculture were not represented in this study so there may be more potential for using social media for job searching.

Approximately 60% of the survey participants own their own business so they are directly involved in hiring and overseeing employees so they do have a good perception of the ASM graduates level of mastery of the general and ASM competencies. Many of the respondents that indicated that they own their own business are involved in production agriculture so it may not be an accurate representation of other industries.

Recommendations for Future Research

Replication of this study should be done with the addition of more demographic questions to help explain the differences between respondents. An effort should be made to capture more of the employers that work outside of the production agriculture and equipment industries in order to get a better representation of the expectation of all employers in the ASM program. If future studies show similar results then changes in the

ASM curriculum should be made to reflect the needs of the production agriculture and equipment industry.

Objective Two - Describe the skill level of acquired skills of ASM graduates as perceived by their employers

Conclusions

ASM graduates show no less than moderate mastery for the 11 general competencies. ASM alumni show the greatest mastery in general skills like effective computer skills, ability to incorporate safety in the workplace, willingness to adopt new concepts, ability to understand how to manage agricultural systems, and developing solutions to problems by locating relevant information and analyzing possible alternatives. The data shows that ASM graduates are not as strong in areas dealing with skills associated with marketing of a product, ability to motivate employees or co-workers, effective use of financial management skills, and the ability to effectively manage work of others.

ASM graduates show moderately low to moderate mastery skill levels in the ASM competencies. Employers indicated that ASM graduates have a higher level of mastery in skills involving the ability to research and adopt new precision agriculture technologies in order to build on prior knowledge, skills associated with project management, skills associated with machine power distribution, knowledge of safe handling and storage of pesticides, skills associated with machinery management, and ability to select appropriate equipment for pesticide/fertilizer application. The data suggests that ASM alumni have a

lower mastery level in competencies such as skills associated with grain grading, understanding the challenges associated with logistics of biofuels, skills associated with irrigation management, knowledge of conservation of energy in businesses related to agriculture, and knowledge of energy and sustainable energy sources.

Discussion

Employers of ASM graduates and self-employed ASM graduates indicated that ASM alumni show a greater level of mastery in general skills such as solving problems and locating relevant information rather than skills such as accounting, marketing, and personnel management. Overall, the mastery level of general competencies was higher than the ASM competencies suggesting that ASM graduates are better equipped with general skills needed in the workplace rather than specific technical skills. The graduates also show a higher level of mastery in skills related to machinery management, project management, and pesticides. Graduates are more lacking in skills related to biofuel production and storage, irrigation, and energy conservation in agriculture.

Recommendations for Future Research

The ASM program should continue to incorporate all ASM skills within their curriculum but place more emphasis on the skills that ASM graduates show lower mastery levels as long as it is a desired skill for their employers. Information regarding the importance of each skill to the employer's industry and MWDS value should also be considered when deciding which subjects to emphasize/de-emphasize in the ASM curriculum. New technology is introduced in the agricultural industry on a regular basis

so it is crucial that the topics that graduates excel be updated as well in order to reflect the needs of the industry.

Objective Three - Describe the importance of the skill to the organization as indicated by the employers of Agricultural Systems Management graduates

Conclusions

Employers of ASM graduates and self-employed ASM graduates indicated that all eleven general competencies were of moderate importance to their industry. The skills of most importance include effective computer skills, willingness to adopt new concepts, effective use of financial management skills, ability to incorporate safety in the workplace, and ability to understand how to manage agricultural systems. The general skills that employers viewed as least important were the ability to show more desirable employability skills compared to graduates of other universities, ability to contribute in multidisciplinary teams, and skills associated with marketing of a product. These skills were still rated fairly high compared to the skills of most important, so all of the general skills are important to employers and their industry. When looking for new employees they do desire the ability to solve problems and incorporate safety as the most important general competencies needed.

Employers indicated that ASM competencies were of moderately low to moderate importance to their industry. The skills most important to the employers industry were ability to install, calibrate, and demonstrate precision agriculture systems, skills associated with machinery management, ability to select appropriate equipment for

pesticide/fertilizer application, skills associated with machine power distribution, and understanding of how precision agriculture systems operate, including GPS, GIS, computers, and sensor and control technology. Employers felt that skills relating to understanding of challenges associated with logistics of biofuels were the least important skill followed by knowledge of renewable energy and sustainable energy sources, skills associated with irrigation management, knowledge of conservation of energy in business related agriculture and skills associated with grain grading and storage.

Discussion

Overall, employers and self-employed ASM graduates viewed general competencies as more important to their industry than ASM specific skills. Employers are looking for general skill sets that the ASM program is providing for its graduates; like the ability to solve problems and locate relevant information as well as manage and communicate to co-workers. All general skills and competencies were given similar importance ratings but when discussing ASM specific competencies, employers desire workers that have the ability to manage machinery and use precision agriculture technologies. Employers rated skills associated to energy conservation, renewable energy, irrigation, and grain handling as being the least important to their industry. Electronics is becoming a vital part of agriculture and machinery and precision agriculture is one of the leading areas of agriculture that technology is being integrated. These electronic and computer skills need to be a core part of the ASM program curriculum as long as they are providing the graduates with the necessary skills that they need.

Recommendations for Future Research

Employers of ASM graduates are looking for general skills such as problem solving, locating relevant information, safety, and people management skills when hiring new employees. They also desire ASM related skills relating to electronics, computers, and machinery. The ASM program should update its curriculum to ensure that it is incorporating the latest computer/electronic related technology as well as courses to help with problem solving, people skills, and financial management. Skills such as irrigation, grain handling, energy conservation, and biofuel production should not be dropped from the program but rather be promoted in a way to show their importance or restructured so they represent a smaller part of the program.

Objective Four - Describe the overall difference among each respondent between graduate's skill level and importance of competency for employer's industry with a Mean Weight Discrepancy Score (MWDS)

Conclusions

A MWDS was calculated for each of the 11 general competencies using data generated from the ASM program evaluation. Skills such as effective use of financial management skills, skills associated with marketing of a product and ability to motivate co-workers were skills that employers and self-employed ASM graduates felt need to be emphasized more in the ASM curriculum. Respondents felt that only one skill does not need to be emphasized in the program and that is the ability to show more desirable employability skills compared to graduates of other universities. All of the other general

skills either need to be slightly more emphasized, or the program is adequately preparing its graduates in these areas.

The data generated by survey participants indicated that only one ASM specific skill needed to be emphasized more in the ASM curriculum. That skill is ability to install, calibrate, and demonstrate precision agriculture technology. The ASM specific competencies yielded many more values that were less than one so they indicate that these skills need to be de-emphasized in the ASM curriculum. These skills include knowledge of safe handling and storage of pesticides, knowledge to plan appropriate layout of farmstead buildings, ability to select appropriate equipment for pesticide/fertilizer application, understanding of challenges associated with logistics of biofuels, knowledge of renewable energy and sustainable energy sources, ability to understand and operate grain storage systems, and knowledge required to construct agricultural structures. All other skills but four yielded MWDS values that indicate that ASM graduates are adequately prepared in these areas or slight de-emphasis needs to take place.

Discussion

According to the MWDS values that were calculated using the data for ASM graduates level of skill and employer's and self-employed graduate's level of importance to their industry, survey participants overall feel that general skills/competencies need to be emphasized more in the ASM curriculum and more ASM specific skills related to renewable energy and conservation of energy, pesticides, and agricultural structures needs to be de-emphasized from the curriculum. The general skills that need to be

emphasized and incorporated into the ASM program more include skills relating to financial management skills, marketing, and employee management. Overall, the ASM program is doing a good job of teaching these general skills to the students but the results indicate that all but four of these skills need slightly more emphasis placed in these areas. The ASM program is adequately preparing its students in computer skills, willingness to adopt new concepts and the ability to contribute to multidisciplinary teams. The respondents feel like the ability to show more desirable skills than graduates of other universities is not an important skill to possess.

Only one ASM specific skill relating to precision agriculture needs more emphasis placed in this area. Three other skills relating to grain grading and quality and fertilizer application need slightly more emphasis placed in the ASM curriculum. All of the other skills except for seven are adequately preparing students to be successful in the workforce. Skills relating to renewable energy, pesticides, and structures need to be de-emphasized in the ASM curriculum or changed in a way to stress the importance of these topics in the agricultural industry. This could also be a statement that those involved in production agriculture and machinery do not see the importance of these topics to their industry but more research would need to be done to determine this. Irrigation management is a topic that is of little importance to the participants' industry and low mastery of skill among ASM graduates so it may need to be de-emphasized in the ASM program as well.

Recommendations for Future Research

The ASM program should conduct further research to try and get a better representation of the industries that employ ASM graduates. The skills that have a MWDS value of greater than one should receive immediate attention for further research and curriculum development. Other topics with positive MWDS values should receive attention when the department sees fit. All skills with a MWDS value of less than negative one should receive consideration of being de-emphasized or restructured in the ASM program curriculum. Further research should also be conducted to determine the views of the respondents relating to the skills that received a low MWDS value to further explore their opinions about the importance of these topics to the agricultural industry. The ASM department should also stress the importance of financial management skills and personal relation skills in its curriculum.

Objective Five – Compare a Weighted Discrepancy Score for each respondent to demographic characteristics

Conclusions

The survey respondents' industry of work, completion of an ASM degree, and level of management within their industry were the only demographic characteristics that showed any statistical variation among respondents.

The respondent's industry of work was the demographic characteristic that accounted for the most variance among the study population (n=13). Two of these questions were related to general skills. They include ability to incorporate safety into

the workplace and ability to motivate employees or co-workers. The WDS values for these questions also suggest that the equipment category needs the most improvement for these skills. Two of these questions dealt with skills related to precision agriculture; they include understanding how precision agriculture systems operate and skills associated with GIS analysis. The equipment industry had a WDS value of 1.51 and 1.60, respectively for these two questions. One question was related to skills associated with understanding how to operate grain systems. However, the grain and agricultural retail industry indicated that ASM graduates are not adequately prepared for this skill. Five of these questions related to machinery management skills; they include skills associated with internal combustion engines, skills associated with machinery power distribution, skills associated with machinery management, skills associated with understanding hydraulic systems, and ability to select appropriate pesticide/fertilizer equipment. The analysis indicates that skills associated with internal combustion engines and machinery power distribution needs more emphasis for graduates pursuing a career in production agriculture. Skills associated with machinery management and hydraulics need more emphasis for graduates pursuing a career in the machinery industry and skills associated with selecting application equipment needs more emphasis for graduates pursuing a career in the grain and agricultural retail industry. Respondents from the grain and agricultural retail industry indicated that more emphasis needs to be placed on skills associated with constructing agricultural structures. Two questions related to environmental relationships and conservation include knowledge of water quality relationships and understanding environmental planning for agricultural applications.

Both the production agriculture and grain and agricultural retail industries indicated that more emphasis needs to be placed on these types of skills.

The respondents' completion of an ASM degree yielded three questions within the general skills category that had a significant difference between participants that have completed an ASM degree and those who have not completed a degree. They include the ability to contribute in multidisciplinary teams, ability to manage the work of others, and ability to show more desirable employability skills compared to graduates from other universities. Respondents' that have not completed an ASM degree indicated that skills associated with managing the work of others and the ability to contribute in multidisciplinary teams needed more emphasis for ASM graduates. Both categories indicated that ability to show more desirable employability skills needed less emphasis within the ASM program.

The comparison between respondents' level of management within their industry and WDS value generated six questions that showed a statistical difference between participants that manage their own business or manage a business for someone else. Four of these questions related to general skills such as ability to incorporate safety into the workplace, willingness to adopt new concepts, ability to motivate employees or co-workers, and ability to contribute in multidisciplinary teams. For all of these skills, respondents who manage a business for someone else indicated that more emphasis needs to be placed in these areas. Two of the questions related to ASM skills include the knowledge to construct agricultural structures and ability to develop plans for drainage of

agricultural land. Respondents who manage their own business indicated that more emphasis needs to be placed in these areas.

Discussion

The results indicate that the equipment industry is more concerned about skills relating to safety and motivating co-workers or employees are more important for their industry than the other three categories. ASM students pursuing a career in the equipment industry should be required to take additional safety courses as well as personnel management courses. Skills associated with precision agriculture, GIS analysis, machinery management, and hydraulic systems are also very important to the equipment industry and the survey respondents indicated that more emphasis needs to be placed on these skills in the ASM curriculum. The ASM faculty should consider forming an emphasis area dealing with equipment management and precision agriculture applications that include courses in safety, human resources, equipment management, and additional precision agriculture/GIS courses. Skills associated with internal combustion engines, machinery power distribution, water quality relationships, and environmental planning for agricultural applications were indicated as needing more emphasis by the production agriculture industry. The ASM program should also consider creating an emphasis area in production agriculture and including courses in machinery management with an increase in courses related to soil/water/plant relationships and environmental science. Graduates pursuing a career in the grain/agricultural retail industry need more emphasis in skills relating to managing grain storage systems, agricultural structures, application equipment, and also water quality and environmental planning. If the ASM program

creates an emphasis area in grain/agricultural retail then further emphasis in these courses should be required.

Respondents who indicated that they have not completed an ASM degree most likely represent the employers of ASM graduates and not self-employed ASM graduates. This implies that employers are seeking skills related to managing employees and working in teams when they are looking for employees. This emphasizes the importance of additional coursework in human resources within the ASM curriculum. This would be more important in an emphasis area related to equipment management and grain, but it would still be important for production agriculture.

Respondents who indicated that they manage a business for someone else most likely represent the participants who are employers of ASM graduates. This implies that employers who are seeking to hire ASM graduates are more concerned with general skills relating to safety, personnel management, and willingness to adapt to their work environment. This stresses the importance of emphasizing skills related to these areas within the ASM curriculum to better meet the needs of employers who hire ASM graduates. Respondents who indicated that they manage their own business most likely represent self-employed ASM graduates and they indicated that skills relating to agricultural structures and developing plans for drainage for agricultural land as needing more emphasis within the ASM program.

Recommendations for Future Research

Future research should be conducted with additional demographic characteristics in order to better explain the variation among respondents. Questions should also be

included to see if emphasis areas in production agriculture, equipment management, and grain would be valuable for employers who are seeking graduates from the ASM program as employees. Additional questions that would help distinguish between self-employed ASM graduates and employers of ASM graduates should be included in future research to better distinguish the needs of each group.

Additional demographics to explain respondents in outlying industries would be useful to better understand their responses or they should not be included in the analysis so the results will be more uniform.

Objective Six - Summarize suggestions for new topic areas, foreseen skills needed in the future, and most common technical information used by ASM graduates as perceived by employers and self-employed ASM Graduates

Conclusions

Employers of ASM graduates and self-employed ASM graduates indicated that they would suggest that the ASM program add further in-depth topics such as business management/accounting, precision agriculture, employee management, and agronomy to their curriculum. Other topics that were mentioned were equipment, electricity/electronics, grain marketing, regulations, renewable energy, manufacturing, safety, and technical skills.

The employers of ASM graduates and self-employed ASM alumni indicated that electronic/computer skills is the most foreseen skill needed by ASM graduates for the

future followed by management/financial, people management, precision agriculture, interdisciplinary knowledge, and production agriculture.

The survey participants suggested that GPS/precision agriculture was the most frequently used technical skill by the ASM graduate that they employed followed by electrical, mechanical, manufacturing, grain/material handling, production agriculture, and business/marketing.

Discussion

These results are consistent with the MWDS values generated from the questionnaire. They suggest that skills related to computers, electronics, precision agriculture, financial management, and people management skills are important to the agricultural industry now and they will be more important in the future.

Recommendations for Future Research

Further research should be conducted with a further breakdown of these topic areas to give a more specific understanding of how these topics are important to the agriculture industry and how they can be incorporated into the ASM program curriculum.

APPENDIX A:
UNIVERSITY OF MISSOURI
AGRICULTURAL SYSTEMS MANAGEMENT
PROGRAM EVALUATION

University of Missouri
Agricultural Systems Management
Program Evaluation



Dear Survey Participant,

When answering surveys, participants often have concerns about their privacy. Below are the ways this survey process protects your confidentiality.

- To protect participant confidentiality, all responses will be separated from your mailing address and any other identifying information, and will only be associated with a random numerical code.
- All data will be kept in a secure location in the researcher's office.
- No one other than the researcher will know individual responses to any of the questions, and results will be reported only in the aggregate.

Aggregated data and findings will be reported to the research advisory committee for the Agricultural Systems Management Program, and data may be used in journal articles or other publications. Please know that you may withdraw at any time. Should you withdraw, your information will be eliminated from the study and will be destroyed.

If you have questions about your involvement or any aspect of this study, please contact Wayne Martens at 1-800-995-8503, or email wcmwb8@mail.missouri.edu **before** indicating your consent to participate.

If you have any questions regarding your rights as a research participant please contact the University of Missouri Campus Institutional Review Board at:

483 McReynolds Hall

University of Missouri
Columbia, MO 65211
Phone: (573) 882-9585

Consent. If you agree please check the box next to “**I have read the consent form and agree to participate in the research study**” below and then move to the next page to start taking the survey.

- I have read the consent form and agree to participate in the research study.

Signature_____

- I do not agree.

If you would like a synopsis of the results at the end of this study please list your email address:_____

What is Agricultural Systems Management?

Agricultural Systems Management (ASM) integrates physical systems with agricultural science and management skills to provide graduates with the abilities to function in sales, service, and maintenance management positions in agribusiness industries. The uniqueness of Agricultural Systems Management graduates lies in their knowledge of the principles of physical systems, which are the backbone of modern agriculture and food industries. Students graduate with a unique blend of training and education in applied technology, business, and management.

The goal of the ASM program is to prepare graduates to be successful in careers such as:

- Natural Resources and Environment
- Materials Handling and Crop Processing
- Power and Machinery Systems
- Production Agriculture
- Energy Systems
- Food Systems Management
- Safety Management

Typical courses completed by an ASM Graduate:

- Physical Principles for Agricultural Applications
- Agricultural/Industrial Structures
- Internal Combustion Power
- Pesticide Application Equipment
- Chemical Application Systems
- Fluid Power
- Agricultural Safety and Health
- Electricity: Wiring and Equipment
- Biorenewable Systems Technology
- Material Handling and Conditioning
- Preservation of Grain Quality
- Agricultural Equipment and Machinery
- Precision Agriculture Science and Technology
- Surface Water Management
- Irrigation and Drainage
- ASM Capstone

Students also have the option to take courses in Economics, Soils, Engineering, Agribusiness, Plant Science, and Animal Science.

Instructions

Important skills that we believe graduates of the Agricultural Systems Management (ASM) program should possess are included in this questionnaire. We are seeking your input regarding the mastery of those skills possessed by graduates of our program currently employed by you. If you are a self-employed ASM graduate, we are seeking your input on your own skill level and level of preparation. As you respond to this questionnaire, please consider the most recent MU ASM graduate with whom you have worked.

We request that you provide us information about the listed skills regarding our graduates *and* your organization. In doing so, you will circle two response choices for each item.

- In the left response column, please indicate the graduate’s level of mastery in performing each listed skill using the following scale:

Graduate’s Level of the Skill

- 1 = Low mastery
- 2 = Moderately low mastery
- 3 = Moderate mastery
- 4 = Moderately high mastery
- 5 = High mastery

- In the right response column, please indicate the importance of each listed skill as it pertains to your organization/industry using the following scale:

Importance of the Skill to **Your** Organization

- 1 = Low importance
- 2 = Moderately low importance
- 3 = Moderate importance
- 4 = Moderately high importance
- 5 = High importance

Sample Question:

In the sample below, the respondent believes the MU ASM graduate has high mastery of the skill and the skill is of moderate importance to the organization.

Skills	<u>Graduates</u> Level of the Skill					NA	Importance of the Skill to <u>Your</u> Organization					NA
	Low	Mod. Low	Moderate	Mod. High	High		Low	Mod. Low	Moderate	Mod. High	High	
Do our graduates demonstrate:												
#. Skills associated with irrigation?	1	2	3	4	5	NA	1	2	3	4	5	NA

Assessment of Skills

For each item, provide a response for “Graduates Level of the Skill” and “Importance of the Skill to Your Organization.”

General Skills	Graduates Level of the Skill						Importance of the Skill to Your Organization					
	Low	Mod. Low	Moderate	Mod. High	High	NA	Low	Mod. Low	Moderate	Mod. High	High	NA
Do our graduates demonstrate:												
1. Ability to understand how to manage agricultural systems? <i>developing solutions to problems by locating relevant information and analyzing possible alternatives</i>	1	2	3	4	5	NA	1	2	3	4	5	NA
2. Ability to incorporate safety in the workplace?	1	2	3	4	5	NA	1	2	3	4	5	NA
3. Effective computer skills?	1	2	3	4	5	NA	1	2	3	4	5	NA
4. Effective use of financial management skills? <i>creating and operating budgets, expense recording, general accounting</i>	1	2	3	4	5	NA	1	2	3	4	5	NA
5. Skills associated with marketing of a product?	1	2	3	4	5	NA	1	2	3	4	5	NA
6. Ability to communicate information about agricultural systems to clients/co-workers?	1	2	3	4	5	NA	1	2	3	4	5	NA
7. Willingness to adopt new concepts?	1	2	3	4	5	NA	1	2	3	4	5	NA
8. Ability to show more desirable employability skills compared to graduates of other Universities?	1	2	3	4	5	NA	1	2	3	4	5	NA
9. Ability to effectively manage work of others?	1	2	3	4	5	NA	1	2	3	4	5	NA
10. Ability to motivate employees or co-workers?	1	2	3	4	5	NA	1	2	3	4	5	NA
11. Ability to contribute in multidisciplinary teams?	1	2	3	4	5	NA	1	2	3	4	5	NA

ASM Skills	Graduates Level of the Skill						Importance of the Skill to Your Organization					
	Low	Mod. Low	Moderate	Mod. High	High	NA	Low	Mod. Low	Moderate	Mod. High	High	NA
Do our graduates demonstrate:												
12. Knowledge of renewable energy and sustainable energy sources?	1	2	3	4	5	NA	1	2	3	4	5	NA
13. Knowledge of conservation of energy in businesses related to agriculture?	1	2	3	4	5	NA	1	2	3	4	5	NA
14. Understanding of challenges associated with logistics of biofuels? <i>transportation, production, handling</i>	1	2	3	4	5	NA	1	2	3	4	5	NA
15. Ability to install, calibrate, and demonstrate precision agriculture systems?	1	2	3	4	5	NA	1	2	3	4	5	NA
16. Skills in processing, analyzing, and interpreting data with Geographical Information Systems (GIS)?	1	2	3	4	5	NA	1	2	3	4	5	NA
17. Understanding of how precision agriculture systems operate including GPS, GIS, computers, and sensor and control technology?	1	2	3	4	5	NA	1	2	3	4	5	NA
18. Ability to research and adopt new precision agriculture technologies in order to build on prior knowledge?	1	2	3	4	5	NA	1	2	3	4	5	NA
19. Skills associated with grain grading?	1	2	3	4	5	NA	1	2	3	4	5	NA
20. Understanding of maintaining grain quality?	1	2	3	4	5	NA	1	2	3	4	5	NA
21. Ability to understand and operate grain storage systems?	1	2	3	4	5	NA	1	2	3	4	5	NA
22. Proficiency in using electronic technology? <i>programmable logic controllers (PLC), machine control panels, etc.</i>	1	2	3	4	5	NA	1	2	3	4	5	NA
23. Knowledge of psychrometrics (<i>air characteristics</i>) for grain drying?	1	2	3	4	5	NA	1	2	3	4	5	NA
24. Skills associated with internal combustion engines?	1	2	3	4	5	NA	1	2	3	4	5	NA
25. Skills associated with machine power distribution? <i>transmissions, planetary systems, belt drives, chain drives</i>	1	2	3	4	5	NA	1	2	3	4	5	NA

ASM Skills	Graduates Level of the Skill						Importance of the Skill to Your Organization					
	Low	Mod. Low	Moderate	Mod. High	High	NA	Low	Mod. Low	Moderate	Mod. High	High	NA
Do our graduates demonstrate:												
26. Skills associated with machinery management? <i>efficiency, selecting proper equipment, economics</i>	1	2	3	4	5	NA	1	2	3	4	5	NA
27. Skills associated with understanding hydraulic systems?	1	2	3	4	5	NA	1	2	3	4	5	NA
28. Skills associated with 12 volt electricity?	1	2	3	4	5	NA	1	2	3	4	5	NA
29. Ability to calibrate application equipment?	1	2	3	4	5	NA	1	2	3	4	5	NA
30. Knowledge of safe handling and storage of pesticides?	1	2	3	4	5	NA	1	2	3	4	5	NA
31. Ability to select appropriate equipment for pesticide/fertilizer application?	1	2	3	4	5	NA	1	2	3	4	5	NA
32. Knowledge of pesticide laws and how these laws impact use and application of pesticides?	1	2	3	4	5	NA	1	2	3	4	5	NA
33. Knowledge required to construct agricultural structures?	1	2	3	4	5	NA	1	2	3	4	5	NA
34. Knowledge to plan appropriate layout of farmstead buildings?	1	2	3	4	5	NA	1	2	3	4	5	NA
35. Skills associated with project management? <i>construction, proposal, presentation</i>	1	2	3	4	5	NA	1	2	3	4	5	NA
36. Skills associated with 120/240 volt electricity?	1	2	3	4	5	NA	1	2	3	4	5	NA
37. Skills associated with irrigation management?	1	2	3	4	5	NA	1	2	3	4	5	NA
38. Ability to develop plans for proper drainage of agricultural land?	1	2	3	4	5	NA	1	2	3	4	5	NA
39. Knowledge of water quality relationships with nitrogen, phosphorus, and potassium applications used in crop production?	1	2	3	4	5	NA	1	2	3	4	5	NA
40. Understanding of environmental planning and impact in agriculture applications?	1	2	3	4	5	NA	1	2	3	4	5	NA

Before you begin, please refer to page number 4 for a list of course/topics that are currently taught in the ASM curriculum.

What new topic area(s) would you suggest to assist in better preparation of ASM graduates for the workforce?

1. _____

2. _____

What new skill sets do you foresee prospective employees needing for the future?

1. _____

2. _____

What is the most frequently technical information used by the ASM graduate that you employ?

i.e., welding, GPS, grain grading, electrical wiring etc.

What technical information should be de-emphasized in the ASM Program curriculum?

i.e., welding, GPS, grain grading, electrical wiring etc.

Demographic Information

Please Mark N/A if question does not apply.

In what industry do you work?
Please list all that apply:

How many years have you been working
with an ASM graduate?

Did you graduate with an ASM degree?

Yes No

If yes, how many years have you been
working since you graduated with an
ASM degree?

How many ASM graduates have you hired
in the last 5 years?

How many ASM graduates do you
anticipate hiring in the next 5 years?

What previous training do you typically
look for when hiring an employee? *college
degree, internship, work experience, etc.*
Please list all that apply:

How many days do you spend training new
employees?

What training tools do you use to train new
employees? *modules, presentations,
mentors, online resources, etc.*

What topics do you focus on the most when
you first start to train new employees?

Do you communicate with potential
employees through social networks?
Facebook, LinkedIn, etc.

Yes No If yes where? _____

Do you post online applications for new
employees?

Yes No If yes where? _____

Please circle only one:

Do you own your business?

Yes No

Do you manage a business for someone
else?

Yes No

Thank you for participating in this study!

Please use the pre-addressed, postage-paid envelope to return this questionnaire to the researchers.

If you have any questions or comments feel free to contact:

Mr. Wayne Martens
207 Agricultural Engineering Building
Columbia, MO 65211
Phone: 1-800-995-8503
wcmwb8@mail.missouri.edu

If you have any questions regarding your rights as a research participant please contact:

University of Missouri Campus IRB
483 McReynolds Hal
University of Missouri
Columbia, MO 65211
Phone: (573) 882-9585

APPENDIX B:

EMPLOYER QUESTIONNAIRE COVER LETTER

UNIVERSITY OF MISSOURI LETTERHEAD

Mr. John Doe
12345 Anywhere Street
Somewhere, MO 65123

Dear John,

We recently sent you a postcard concerning our efforts to review the Agricultural Systems Management (ASM) Program at the University of Missouri. We believe that the first step in this process is to determine the skills/competencies needed by our graduates.

The goal of this study is to survey employers of ASM graduates and self-employed ASM graduates to see their perception of the skills acquired by ASM graduates and the importance of each skill for their industry. This research will assist the ASM program review by gathering critical information that will assist in curriculum development that will better prepare ASM students for the workforce.

As we mentioned on the post card, one of our alumni listed you as their employer or you are currently a self-employed graduate. We believe that your input concerning how well you consider your employee(s) or you were prepared, will help the ASM faculty determine what modifications are needed in the ASM curriculum.

Your response to this questionnaire is completely voluntary. However, it will be of great assistance to the ASM program if you are able to provide your opinions concerning the items listed on the questionnaire. If you prefer not to respond, simply return the blank questionnaire in the enclosed pre-postage envelope. The input you provide will be kept confidential and will only be released in summary form so that no individual's name will be identified. When we receive your completed questionnaire, your name will be deleted from the mailing list and will never in any way be connected with the information that you have provided.

If you have any questions or comments about this study please feel free to contact us. Our toll-free phone number is: 1-800-995-8503. You can write to us at the address on the letterhead, or email Wayne Martens at wcmwb8@mail.missouri.edu.

If you have any questions regarding your rights as a research participant please contact the University of Missouri Institutional Review Board at: 483 McReynolds Hall, University of Missouri, Columbia, MO 65211. Phone: (573) 882-9585

Sincerely,
Wayne Martens
Graduate Student
Biological Engineering

Leon G. Schumacher
Professor Agricultural Systems
Management

APPENDIX C:

INTRODUCTION LETTER TO EMPLOYERS

Dear _____

In a few days you will receive a questionnaire designed to collect information about the Agricultural Systems Management (ASM) Program at the University of Missouri. You have been selected to participate in this study because an ASM graduate(s) indicated that you were their employer, or you are currently a self-employed ASM graduate. Participation is completely voluntary, but your response will assist the ASM program in ensuring that graduates are adequately prepared for the industry.

I am contacting you prior to the actual mailing of the questionnaire because many people prefer to know in advance that they will be receiving a request of their time. Your response to this questionnaire is important because it will be used to evaluate and update the educational curriculum of the ASM program.

Thank you for your time and consideration. With your input, we will be able to ensure that our graduates are best prepared for employment.

Sincerely,

Wayne Martens
Graduate Student

Leon G. Schumacher
Professor

Wayne Martens
207 Agricultural Engineering Building
Columbia, MO 65211

Mr. John Doe
12345 Anywhere Street
Somewhere, MO 65123

APPENDIX D:

EMPLOYER REMINDER LETTER

Two weeks ago a questionnaire asking for your input about the Agricultural Systems Management (ASM) Program at the University of Missouri was sent to you. You were selected to receive this questionnaire because you are an employer of an ASM graduate(s) or a self-employed ASM graduate.

If you have completed and returned the questionnaire to us, please accept our thanks. If not, please take a moment as soon as possible to complete the survey. We are especially thankful for your response and for helping us better prepare our graduates for the industry.

If you did not receive a questionnaire, or if your name was misplaced, please call us at our toll-free number 1-800-995-8503 or email us at wcmwb8@mail.missouri.edu and we will send you another today.

Sincerely,

Wayne Martens
Graduate Student
Biological Engineering
University of Missouri

Leon G. Schumacher
Professor
Agricultural Systems Management
University of Missouri

Wayne Martens
207 Agricultural Engineering Building
Columbia, MO 65211

Mr. John Doe
12345 Anywhere Street
Somewhere, MO 65123

APPENDIX E:

4TH CONTACT COVER LETTER TO EMPLOYERS

UNIVERSITY OF MISSOURI LETTERHEAD

Date

Mr. John Doe
12345 Anywhere Street
Somewhere, MO 65123

About a month ago we sent you a questionnaire asking for your input about the Agricultural Systems Management (ASM) Program at the University of Missouri. To the best of our knowledge it has not yet been returned. Due to the diversity of careers pursued by our graduates, the responses to the questionnaire that have been received have shown a variety of skills needed by our graduates. The insight gained from responses submitted so far has provided the ASM faculty valuable information to help in preparing our graduates for the industry.

We are contacting you again because of the importance that your response has for providing accurate results. We hope to receive a genuine representation from all employers of ASM graduates in order that no career area is overlooked.

To ensure that answers are completely confidential an identification number which corresponds with your name is printed on the label of the return envelope. This is so that we can determine which responses have been received and can appropriately remove these names from our mailing list. After all the questionnaires have been received, the list of names will be deleted so that individual persons cannot be connected with the results in any way. The data will only be used to assist the ASM faculty in improving curriculum to better prepare our students for the industry. We hope that you will fill out and return the questionnaire soon, but if for any reason you prefer not to answer it, please let us know by returning a note or blank questionnaire in the enclosed pre-paid envelope.

If you wish to participate, please submit a completed survey no later than **June 1, 2012**. Thank you very much for participating in this important study.

If you have any questions or comments about this study please feel free to contact us. Our toll-free phone number is: 1-800-995-8503. You can write to us at the address on the letterhead, or email Wayne Martens at wcmwb8@mail.missouri.edu.

If you have any questions regarding your rights as a research participant please contact the University of Missouri Institutional Review Board at: 483 McReynolds Hall, University of Missouri Columbia, MO 65211. Phone: (573) 882-9585

Sincerely

Wayne Martens
Graduate Student
Biological Engineering

Leon G. Schumacher
Professor
Agricultural Systems Management

APPENDIX F:

ASM GRADUATE UPDATE LETTER

UNIVERSITY OF MISSOURI LETTERHEAD

Date

Mr. John Doe
12345 Anywhere Street
Somewhere, MO 65123

Hope all is well! As a part of our program review we have been asked to catch up with our alumni and find out where you have been and where you are currently employed. Over the years we have lost contact with a lot of our graduates and we would like to know what you are doing! Please fill out the form below and return it to us in the pre-paid envelope and then go to www.mizzou.com and update your contact information for the Mizzou Alumni Association.

Sincerely,

Leon Schumacher
Professor
Agricultural Systems Management

Year of Graduation _____

Current Address: _____

Phone Number: _____

Current Position: _____

Employer Company: _____

Employer Name (Boss, Supervisor, ect): _____

Employer Address: _____

Employer Email: _____

APPENDIX G:

ASM GRADUATE INTRODUCTION LETTER

Dear _____

In a few days you will receive a questionnaire designed to collect information about the Agricultural Systems Management (ASM) graduates at the University of Missouri. You have been selected to participate in this study because you are a graduate of the ASM department

I am contacting you prior to the actual mailing of the questionnaire because many people prefer to know in advance that they will be receiving a request of their time. Your response to this questionnaire is important because it will be used to help the ASM program keep up with and plan the addition of new curricula for its graduates.

Thank you in advance for your time and consideration. With your input, we will be able to ensure that we do our best to keep in touch with our graduates

Sincerely

Leon G. Schumacher
Professor

Leon Schumacher
208 Agricultural Engineering Building
Columbia, MO 65211

Mr. John Doe
12345 Anywhere Street
Somewhere, MO 65123

APPENDIX H:

ASM GRADUATE REMINDER LETTER

March 7, 2012

Two weeks ago a questionnaire asking for your contact information by the Agricultural Systems Management (ASM) Program at the University of Missouri was sent to you. You were selected to receive this questionnaire because you are an ASM graduate.

If you have completed and returned the questionnaire to us, please accept our thanks. If not, please take a moment as soon as possible to complete the survey. We are especially thankful for your response and for helping us keep up with our graduates!

If you did not receive a questionnaire, or if your name was misplaced, please call us at our toll-free number 1-800-995-8503 or email us at SchumacherL@missouri.edu and we will send you another today.

Sincerely,

Leon G. Schumacher
Professor
Agricultural Systems Management
University of Missouri

Dr. Leon G. Schumacher
207 Agricultural Engineering Building
Columbia, MO 65211

Mr. John Doe
12345 Anywhere Street
Somewhere, MO 65123

APPENDIX I:

ASM GRADUATE 4TH CONTACT COVER LETTER

UNIVERSITY OF MISSOURI LETTERHEAD

Date

Mr. John Doe
12345 Anywhere Street
Somewhere, MO 65123

About a month ago a survey was sent to you asking for your employer contact information. As of today it has not been returned back.

Many other ASM graduate have responded and provided valuable employer information for the ASM department and provided a means by which we can keep in contact with our graduates. Having the ability to contact graduates will ensure that the ASM is helping to prepare students for the workplace and encouraging prospective students to be a part of Mizzou.

We are writing and sending you another questionnaire because we regret loosing track of you after graduation and we wish to know how our graduates are succeeding in their jobs. Without your response, our records will be incomplete and not accurately show the success of our students.

Your current address and employer contact information will not be shared with anyone outside of the department. We respect your confidentiality and will not use the data collected in any way but to improve our program and keep in contact with you.

I hope you fill out and return the enclosed questionnaire soon, but participation is voluntary. If you do not wish to participate, please send the blank questionnaire or a note back in the pre-paid envelope.

Sincerely,

Leon G. Schumacher
Professor
Agricultural Systems Management,

APPENDIX J

PERMISSION LETTER TO RECRUTE GRADUATES

UNIVERSITY OF MISSOURI LETTERHEAD

Dear Wayne,

Thanks for working so energetically on this project! Please catch up with our alumni and find out where they have been and where they are currently employed. Over the years we have lost contact with a lot of our graduates and we would like to know what they are doing! Please have them fill out the form below and return it to us in the pre-paid envelope and then go to www.mizzou.com and update their contact information for the Mizzou Alumni Association.

Sincerely,

Leon Schumacher
Professor
Agricultural Systems Management

Year of Graduation _____

Current Address: _____

Phone Number: _____

Current Position: _____

Employer Company: _____

Employer Name (Boss, Supervisor, ect): _____

Employer Address: _____

Employer Email: _____

APPENDIX K

FREQUENCY AND PERCENT OF EMPLOYERS' AND SELF-
EMPLOYED ASM GRADUATES' PERCEIVED MASTERY OF
COMPETENCIES

Table 29.

Frequency and Percentage of Employers' and Self-Employed ASM Graduates' Perceived Mastery of Competencies.

Skill	Frequency/Percent						
	1	2	3	4	5	N/A ^a	N
Ability to understand how to manage agricultural systems? <i>developing solutions to problems by locating relevant information and analyzing possible alternatives</i>	0/0	1/2.00	4/8.00	18/36.00	27/54.00	5	50
Ability to incorporate safety in the workplace?	0/0	1/1.89	6/11.32	24/45.28	22/41.51	2	53
Effective computer skills?	1/1.89	2/3.77	5/9.43	21/39.62	24/45.28	2	53
Effective use of financial management skills? <i>creating and operating budgets, expense recording, general accounting</i>	0/0	2/4.00	17/34.00	16/32.00	15/30.00	5	50
Skills associated with marketing of a product?	1/2.04	4/8.16	19/38.79	16/32.65	9/18.37	6	49
Ability to communicate information about agricultural systems to clients/co-workers?	0/0	3/6.38	12/25.53	16/34.04	16/34.04	8	47
Willingness to adopt new concepts?	0/0	1/1.92	7/13.46	15/28.85	19/55.77	3	52
Ability to show more desirable employability skills compared to graduates of other Universities?	0/0	1/2.94	6/17.65	15/44.12	12/35.29	21	34
Ability to effectively manage work of others?	1/2.22	3/6.67	7/15.56	22/48.89	12/12.67	10	45
Ability to motivate employees or co-workers?	0/0	5/10.87	10/21.74	18/39.19	13/28.26	9	46
Ability to contribute in multidisciplinary teams?	0/0	2/4.55	10/22.73	16/36.36	16/36.36	11	44
Knowledge of renewable energy and sustainable energy sources?	0/0	7/14.89	18/38.30	13/27.66	9/19.15	8	47
Knowledge of conservation of energy in businesses related to agriculture?	0/0	7/14.80	19/39.58	15/31.25	7/14.58	7	48
Understanding of challenges associated with logistics of biofuels? <i>transportation, production, handling</i>	3/6.82	8/18.18	15/34.09	14/31.82	4/9.09	11	44

Table 29 (Continued).

Frequency and Percentage of Employers' and Self-Employed ASM Graduates' Perceived Mastery Of Competencies.

Skill	Frequency/Percent						N/A ^a	N
	1	2	3	4	5			
Ability to install, calibrate, and demonstrate precision agriculture systems?	2/4.35	6/13.04	8/17.39	17/36.96	13/28.26	6	49	
Skills in processing, analyzing, and interpreting data with Geographical Information Systems (GIS)?	1/2.00	5/10.00	18/36.00	14/28.00	12/24.00	5	50	
Understanding of how precision agriculture systems operate including GPS, GIS, computers, and sensor and control technology?	1/2.17	4/8.70	11/23.91	16/34.78	14/30.43	9	46	
Skills associated with grain grading?	7/17.0	7/17.07	8/19.51	10/24.39	9/21.95	14	41	
Understanding of maintaining grain quality?	5/11.6	3/6.98	10/23.26	12/27.91	13/30.23	12	43	
Ability to understand and operate grain storage systems?	3/7.14	6/14.29	6/14.29	12/28.57	15/35.71	13	42	
Proficiency in using electronic technology? <i>programmable logic controllers (PLC), machine control panels, etc.</i>	4/9.09	3/6.82	12/27.27	16/36.36	9/20.45	11	44	
Knowledge of psychrometrics (<i>air characteristics</i>) for grain drying?	3/7.50	7/17.50	7/17.50	14/35.00	9/22.50	15	40	
Skills associated with internal combustion engines?	2/4.26	4/8.51	9/19.15	26/55.32	6/12.77	8	47	
Skills associated with machine power distribution? <i>transmissions, planetary systems, belt drives, chain drives</i>	1/2.13	1/2.13	8/17.02	24/51.06	13/27.66	8	47	
Skills associated with machinery management? <i>efficiency, selecting proper equipment, economics</i>	0/0	2/4.00	9/18.00	20/40.00	19/38.00	5	50	
Skills associated with understanding hydraulic systems?	1/2.04	2/4.08	13/26.53	22/44.90	11/22.45	6	49	
Skills associated with 12 volt electricity?	2/4.17	2/4.17	15/31.25	17/35.42	12/25.00	7	48	
Ability to calibrate application equipment?	2/4	2/4	11/22	24/48	11/22	5	50	

Table 29 (Continued).

Frequency and Percentage of Employers' and Self-Employed ASM Graduates' Perceived Mastery Of Competencies.

Skill	Frequency/Percent						N/A ^a	N
	1	2	3	4	5			
Knowledge of safe handling and storage of pesticides?	1/2.22	2/2.44	8/17.78	16/35.56	18/40.00	10	45	
Ability to select appropriate equipment for pesticide/fertilizer application?	0/0	3/6.82	9/20.45	11/25.00	21/47.73	11	44	
Knowledge of pesticide laws and how these laws impact use and application of pesticides?	2/4.65	3/6.98	12/27.91	12/27.91	14/32.56	12	43	
Knowledge required to construct agricultural structures?	1/2.33	3/6.98	9/20.93	20/46.51	10/23.26	12	43	
Knowledge to plan appropriate layout of farmstead buildings?	1/2.50	5/12.50	11/27.50	12/30.00	11/27.50	15	40	
Skills associated with project management? <i>construction, proposal, presentation</i>	2/4.65	2/4.65	10/23.26	14/32.56	15/34.88	12	43	
Skills associated with 120/240 volt electricity?	0/0	4/9.09	15/34.09	14/31.82	11/25.00	11	44	
Skills associated with irrigation management?	2/5.41	9/24.32	11/29.73	9/24.32	6/16.22	18	37	
Ability to develop plans for proper drainage of agricultural land?	1/2.50	5/12.50	9/22.50	17/42.50	8/20.00	15	40	
Knowledge of water quality relationships with nitrogen, phosphorus, and potassium applications used in crop production?	1/2.33	4/9.30	17/39.53	13/30.23	8/18.60	12	43	
Understanding of environmental planning and impact in agriculture applications?	1/2.22	5/11.11	17/37.78	14/31.11	8/17.78	10	45	

^a N/A data was counted as missing data

APPENDIX J

FREQUENCY AND PERCENT OF EMPLOYERS' AND SELF- EMPLOYED ASM GRADUATES' IMPORTANCE OF COMPETENCIES TO THEIR INDUSTRY

Table 30.

Frequency and Percent of Employers' and Self-Employed ASM Graduates' Importance of Competencies to their Industry.

Skill	Frequency/Percent						N/A ^a	N
	1	2	3	4	5			
Ability to understand how to manage agricultural systems? <i>developing solutions to problems by locating relevant information and analyzing possible alternatives</i>	2/3.92	1/1.96	2/3.92	14/27.45	32/62.75	4	51	
Ability to incorporate safety in the workplace?	0/0	1/1.82	8/14.55	14/25.45	32/58.18	0	55	
Effective computer skills?	0/0	2/3.64	8/14.55	24/43.64	21/38.18	0	55	
Effective use of financial management skills? <i>creating and operating budgets, expense recording, general accounting</i>	0/0	1/1.92	8/15.38	18/32.69	26/50.00	3	52	
Skills associated with marketing of a product?	0/0	3/6.00	13/26.00	14/28.00	20/40.00	5	50	
Ability to communicate information about agricultural systems to clients/co-workers?	1/2.13	3/6.38	9/19.15	14/29.79	20/42.55	8	47	
Willingness to adopt new concepts?	0/0	0/0	8/14.81	23/42.59	23/42.59	1	54	
Ability to show more desirable employability skills compared to graduates of other Universities?	3/8.57	2/5.71	8/22.86	13/37.14	9/25.71	20	35	
Ability to effectively manage work of others?	0/0	2/4.26	10/21.28	17/36.17	18/38.30	8	47	
Ability to motivate employees or co-workers?	0/0	3/6.12	9/18.37	18/36.73	19/38.78	6	49	
Ability to contribute in multidisciplinary teams?	0/0	2/4.55	11/25.00	17/38.64	14/31.82	11	44	
Knowledge of renewable energy and sustainable energy sources?	8/16.33	7/14.29	21/42.86	9/18.37	4/8.16	6	49	
Knowledge of conservation of energy in businesses related to agriculture?	4/8.33	8/16.67	15/31.25	15/31.25	6/12.50	7	48	
Understanding of challenges associated with logistics of biofuels? <i>transportation, production, handling</i>	13/30.95	8/19.05	13/30.95	5/11.90	3/7.14	13	42	

Table 30 (Continued)

Frequency and Percent of Employers' and Self-Employed ASM Graduates' Importance of Competencies to Their Industry

Skill	Frequency/Percent						N/A ^a	N
	1	2	3	4	5			
Ability to install, calibrate, and demonstrate precision agriculture systems?	5/11.36	1/2.27	5/11.36	11/25.00	22/50.00	11	44	
Skills in processing, analyzing, and interpreting data with Geographical Information Systems (GIS)?	7/14.89	4/8.51	7/14.89	15/31.91	14/29.79	8	47	
Understanding of how precision agriculture systems operate including GPS, GIS, computers, and sensor and control technology?	5/11.63	2/4.65	8/18.60	10/23.26	18/41.86	12	43	
Skills associated with grain grading?	9/23.08	3/7.69	7/17.95	8/20.51	12/30.77	16	39	
Understanding of maintaining grain quality?	8/19.05	2/4.76	6/14.29	7/16.67	19/45.24	13	42	
Ability to understand and operate grain storage systems?	8/19.05	6/14.29	5/11.90	7/16.67	16/38.10	13	42	
Proficiency in using electronic technology? <i>programmable logic controllers (PLC), machine control panels, etc.</i>	7/15.22	7/15.22	5/10.87	15/32.61	12/26.09	9	46	
Knowledge of psychrometrics (<i>air characteristics</i>) for grain drying?	9/22.50	3/7.50	5/12.50	11/27.50	13/30.00	15	40	
Skills associated with internal combustion engines?	4/8.51	5/10.64	12/25.53	16/34.04	10/21.28	8	47	
Skills associated with machine power distribution? <i>transmissions, planetary systems, belt drives, chain drives</i>	4/8.33	3/6.25	6/12.50	21/43.75	14/29.17	7	48	
Skills associated with machinery management? <i>efficiency, selecting proper equipment, economics</i>	3/5.88	4/7.84	6/11.76	17/33.33	21/41.18	4	51	
Skills associated with understanding hydraulic systems?	5/10.00	5/10.00	10/20.00	12/24.00	18/36.00	5	50	
Skills associated with 12 volt electricity?	5/10.20	4/8.16	10/20.41	20/40.82	10/20.41	6	49	
Ability to calibrate application equipment?	7/14.29	3/6.12	6/12.24	15/30.61	18/36.73	6	49	
Knowledge of safe handling and storage of pesticides?	5/11.90	3/7.14	5/11.90	12/28.57	17/40.48	13	42	

Table 30 (Continued)

Frequency and Percent of Employers' and Self-Employed ASM Graduates' Importance of Competencies to Their Industry.

Skill	Frequency/Percent						N/A ^a	N
	1	2	3	4	5			
Ability to select appropriate equipment for pesticide/fertilizer application?	6/14.63	2/4.88	5/12.20	8/19.51	10/48.78	12	43	
Knowledge of pesticide laws and how these laws impact use and application of pesticides?	5/11.90	2/4.76	8/19.05	11/26.19	16/38.10	13	42	
Knowledge required to construct agricultural structures?	3/7.14	6/14.29	9/21.43	14/33.33	10/23.81	13	42	
Knowledge to plan appropriate layout of farmstead buildings?	8/21.62	1/2.70	8/21.62	10/27.03	10/27.03	18	37	
Skills associated with project management? <i>construction, proposal, presentation</i>	2/4.55	4/9.09	12/27.27	10/22.73	16/36.36	11	44	
Skills associated with 120/240 volt electricity?	5/10.87	5/10.87	8/17.39	11/23.91	17/36.96	9	46	
Skills associated with irrigation management?	8/23.53	6/17.65	7/20.59	7/20.59	6/17.65	21	34	
Ability to develop plans for proper drainage of agricultural land?	5/13.16	4/10.53	7/18.42	9/23.68	13/34.21	17	38	
Knowledge of water quality relationships with nitrogen, phosphorus, and potassium applications used in crop production?	3/7.50	4/10.00	9/22.50	12/30.00	12/30.00	15	40	
Understanding of environmental planning and impact in agriculture applications?	3/6.82	7/15.91	11/25.00	12/27.27	11/25.00	11	44	

^aN/A was counted as missing data

REFERENCES

- (2008). Agricultural Systems Management and Agricultural Engineering Extension Strategic Plan, University of Missouri-Columbia: 1-22.
- Andelt, L. L., L. A. Barret and B. K. Bosshamer. (1997). "Employer Assessment of the Skill Preparation of Students from the College of Agricultural Sciences and Natural Resources University of Nebraska-Lincoln: Implications for the Teaching and Curriculum." NACTA Journal **41**(4): 47-53.
- Beard, R. (2001). "Evaluating Knowledge in Agriculture Mechanics." The Agricultural Education Magazine **73**(5): 2.
- Beidler, K. M., J. K. Iles, S. M. Nusser and A. M. VanDerZanden. (2006). "Assessing The Preparedness of Postsecondary Graduates Entering the Landscape Contracting Industry." Hort Technology **16**(2): 312-317.
- Berle, D. (2007). "Employer Preferences in Landscape Horticulture Graduates: Implications for College Programs." NACTA Journal **51**(2): 21-25.
- Borich, G. D. (1980). "A Needs Assessment Model for Conducting Follow-Up Studies " Journal of Teacher Education **31**(3): 39-42.
- Briggeman, B., S. R. Henneberry and F. B. Norwood. (2007). "How Do Employers Assess Job Candidate Attributes." NACTA Journal **51**(3): 15-21.
- Christensen, J., B. K. Warnick, D. Spielmaker, R. S. Tarpley and G. S. Straquadine. (2009). "Agricultural In-Service Needs of Introductory Level Career and Technical Education Teachers." Journal of Agriculture Education **50**(4): 1-13.
- Cole, L. and G. Thomson. (2002). "Satisfaction of Agri-business Employers with College Graduates They Have Hired." NACTA Journal **46**(1): 34-39.
- Crebert, G., M. Bates, B. Bell, C. J. Patrick and V. Cragolini. (2004). "Ivory Tower to Concrete Jungle Revisited." Journal of Education & Work **17**(1): 47-70.
- Dillman, D. A. (2007). Mail and Internet Surveys: The Tailored Design Method. Hoboken, NJ, John Wiley & Sons, Inc.
- Donhardt, G. L. (2004). "In Search of the Effects of Academic Achievement in Postgraduation Earnings." Research in Higher Education **45**(3): 271-290.

- DuPre, C. and K. Williams. (2011). "Undergraduates' Perceptions of Employer Expectations." Journal of Career and Technical Education **26**(1): 8-19.
- Garton, B. L. and N. Chung. (1997). "An Assessment of the Inservice Needs of Beginning Teachers of Agriculture Using two Assessment Models." Journal of Agriculture Education **38**(3): 51-58.
- Gilland, B. (2002). "World population and food supply: can food production keep pace with population growth in the next half-century?" Food Policy **27**(1): 47-63.
- Gregory, P. J. and T. S. George. (2011). "Feeding Nine Billion: the challenge to sustainable crop production." Journal of Experimental Botany **62**(15).
- Herren, R. V. (2006). Agricultural Mechanics: Fundamentals and Applications. Clifton Park, NY, Delmar Learning.
- Horlings, L. G. and T. K. Marsden. (2011). "Towards the real green revolution? Exploring the conceptual dimensions of a new ecological modernisation of agriculture that could 'feed the world'." Global Environmental Change **21**(2): 441-452.
- Kitto, S. L., W. G. Smith, J. T. Sims, A. Morehart, B. Vasilas and J. Pesek. (1996). "Evaluation of the Curriculum of a Department of Plant and Soil Sciences." NACTA Journal **40**(2): 24-31.
- Krejcie, R. V. and D. W. Morgan. (1970). "Determining Sample Size for Research Activities." Educational And Psychological Measurement **30**: 607-610.
- Lamp, G. (2008). "Tomorrow's Agriculture Today." Corn and Soybean Digest **68**(2): 4.
- Layfield, K. D. and T. R. Dobbins. (2002). "Inservice Needs and Percieved Competencies of South Carolina Agricultural Educators." Journal of Agriculture Education **43**(4): 46-55.
- McKim, B. R. and P. R. Saucier. (2011). "An Excel-Based Mean Weighed Discrepancy Score Calculator." Journal of Extension **49**(2): 1-3.
- Robinson, J. S. (2009). "Assessing the Employability Skills of University of Kentucky College of Agriculture Graduates: A Comparison of Hard And Soft Science Disciplines." NACTA Journal **52**(4): 56-62.

Robinson, J. S., B. L. Garton and J. Robert Terry. (2007a). "Identifying The Employability Skills Needed In the Workplace According to Supervisors of College of Agriculture, Food and Natural Resources Graduates." Journal of Southern Agricultural Education Research **57**(1): 95-109.

Robinson, J. S., B. L. Garton and P. R. Vaughn. (2007b). "Becoming Employable: A look at Graduates' and Supervisors' Perceptions of the Skills Needed for Employability." NACTA Journal **51**(2): 19-26.

Schneider, U. A., P. Havlík, E. Schmid, H. Valin, A. Mosnier, M. Obersteiner, H. Böttcher, R. Skalský, J. Balkovič, T. Sauer and S. Fritz. (2011). "Impacts of population growth, economic development, and technical change on global food production and consumption." Agricultural Systems **104**(2): 204-215.

Schumacher, L. G., D. Ess, R. M. Strickland and B. King (2000). Agricultural Systems Management in The New Millennium.

Snyder, S. (2008). Perceptions of Employers of Graduates of the Agricultural Systems Management Program Regarding Skills and Competencies Needed for Successful Employment. Department of Biological Engineering, University of Missouri: 123.

Spiegel, M. R. and L. J. Stephens (2008). Schaum's Outline of Theory and Problems of Statistics. New York, McGraw Hill.

Spiertz, J. H. J. and F. Ewert. (2009). "Crop production and resource use to meet the growing demand for food, feed and fuel: opportunities and constraints." NJAS - Wageningen Journal of Life Sciences **56**(4): 281-300.

Strickland, R. M., J. L. Dave, R. K. Taylor and R. L. Plain (2006). Program Review Agricultural Systems Management and Agricultural Engineering Extension Programs in the Biological Engineering Division, University of Missouri-Columbia.

Strickland, R. M. and D. R. Ess (2001). Guidelines for Developing an Outcome Based ASM Curriculum. 2001 ASAE Annual International Meeting. Sacramento, California: 7.

Suvedi, M. and G. Heyboer. (2003). "Perceptions of Recent Graduates and Employers about Undergraduate Programs in the College of Agriculture and Natural Resources at Michigan State University: A Follow-up Study." NACTA Journal **48**(1): 22-27.

VanDerZanden, A. M. and M. Reinert. (2009). "Employer Attitudes and Perceptions of Job Preparedness of Recent Iowa State University Horticulture Graduates." Hort Technology **19**(3): 647-652.

Wolf, J., P. S. Bindraban, J. C. Luijten and L. M. Vleeshouwers. (2003). "Exploratory study on the land area required for global food supply and the potential global production of bioenergy." Agricultural Systems **76**(3): 841-861.

Zekeri, A. A. (2004). "College Curriculum Competancies and Skills Former Students Found Essential to their Careers." College Student Journal **38**(3): 412-422.