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Prioritization of farm success factors by commercial farm managers

RESEARCH ARTICLE

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Abstract

This study elicits U.S. agricultural producer preferences for five key management success factors: managing output prices; managing production; controlling costs; managing land/equipment/facilities; and managing people. The objective of this analysis was to determine the relative importance of each of the five profit-centric functional areas of management among U.S. farm managers. Significant heterogeneity in preferences was observed over the management areas. Farm managers, on average, placed the highest importance in controlling costs (29% preference share). Differences emerged among groups of farmers in a latent class model where managing people became relatively important to the viability of the agribusiness.

Keywords: farm management success factors, human capital needs for farms, management priorities, share preferences
JEL codes: Q10, Q13, Q14, Q19

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1. Introduction and background

The agricultural industry in the U.S. accounts for approximately 9.3% of U.S. employment and 5.7% of the gross domestic product – an immense contribution of $985 billion (Glaser, 2016; Kassel, 2015). Of this contribution, the share from farming amounts to $177.2 billion; about 1% of U.S. GDP (Glaser, 2016). As such an important part of the U.S. economy, the agricultural industry has historically been, and continues to be, a major focus of U.S. and foreign (trade) policy debates. Agricultural industries are particularly relevant to today's sociopolitical discussions encompassing the food system evolution.

Farmers as a whole have, in recent years, anguished over volatile, and at times plummeting, commodity prices (Katchova and Ahearn, 2016; Patrick *et al.*, 2016). U.S. net farm income was expected to drop to $54.8 billion in 2016, the lowest since 2002 and less than half the record of $123.3 billion in 2012, according to the U.S. Department of Agriculture (Barrett, 2016). This volatility in the agricultural industry is typical and is caused by multiple sources (Heady, 1952) forcing many small and inefficient operations out of business (Dong *et al.*, 2016). However, to continue operations, farm producers need to brace for another prolonged downturn. One coping mechanism is to engage in the additive type of opportunities, which more fully exploit existing facilities and are often of lesser risk to the operation (Drucker, 1999; Groenewald, 1987) than engaging in activities that increase risk exposure.

Agricultural enterprises are often led by a single person who undertakes all decision making and carries out the implementation of those decisions (Groenewald, 1987). Under these volatile economic conditions, farmers are faced with difficult management decisions that must be made carefully. Maximizing profits is the main motivating force of the farmer's decision as in most other economic entities (Barnard *et al.*, 2016; Gasson *et al.*, 1988). The operation's profits are made up of two components and simply equal revenues minus expenses. Revenues can be further subdivided into prices and output quantity. The manager must simultaneous manage both output prices, in terms of marketing strategies for pricing commodity sales, and optimal production levels in order to influence profits. With respect to the expenses component of the profit equation, the firm's decision maker must consider both variable and fixed costs.

1.1 Key agribusiness management success factors

Research studies have shown that proper management, through a number of key success factors, contributes to the success of agricultural firms and improves an operator's likelihood of success through higher profits (Nivens *et al.*, 2002). Researchers have identified many aspects or behaviors that have improved agricultural business performance. One example is the adoption of innovative practices or technologies, which have long been touted as being influential to profit (Groenewald, 1987; Nivens *et al.*, 2002). Precision agriculture techniques of the late 1990s are an example that has been examined closely for its impact on profitability with the finding that a large majority of row crops explicitly experienced benefits towards increased profits (Lambert and Lowenberg-De Boer, 2000). However, it is the manager's successful implementation of these novel practices or innovative technologies that expands the farms' production function outward and lowers the cost function relative to other industry participants and results in greater profits (Schumpeter, 1961). Further, imitation by the other industry participants, or competitors, can quickly reduce these profits (Mansfield, 1961; Segerstrom, 1991).

Agricultural commodity prices are considerably more unstable than non-agricultural good and services (Tomek and Kaiser, 2014). It is common for agricultural prices to reach historically high prices only to enter into a sharp decline in a short period of only a few months. Take these reports as an example: December 2016 delivery of corn plunging to $3.85 per bushel from more than $7.80 in June 2016; wheat futures diving from $12 per bushel in March 2016 to $5.18; and soybean prices falling to $8.59 from more than $16 in July 2016 (Kirchhoff, 2016).

Agricultural production output intensity and controlling costs are factors that can contribute to greater profitability (Nivens *et al.*, 2002). On dairy farms, factors such as farm size, milk production rate, and milk systems have been shown to positively impact dairy profitability (Gloy *et al.*, 2002; Haden and Johnson, 1989; Kauffman and Tauer, 1986). The difference between managing crop production versus livestock production is that the farmer has greater control of the factors that determine the production of animals than of the factors that determine crop yields, regardless of the operation's size (Warren, 1914). For example, farmer control over feed rations can aid in managing livestock animal productivity, whereas weather and rainfall are outside of the control of the farm manager (aside from investment in irrigation, which only partially addresses rainfall challenges – as it does nothing to control overabundance of water).

The literature also points towards managerial skills and competencies as important factors that increases profits. Farm operators that viewed business skills as a high priority for training (Bone *et al.*, 2003), and furthered information processing skills of the management team (Bamberry *et al.*, 1997; Gartshore, 2004), were more capable and competent to perform tasks successfully (Sue *et al.*, 1999; Wang and Newton, 2015). Survival of the farm requires good farm management which has become focused on technology, greater business risks, access to reliable information, and actively growing managerial skills (Sue *et al.*, 1999). Focus on managerial skills and the impacts on profitability also extend to hired labor and employees (Grisley and Mascarenhas, 1985; Kauffman and Tauer, 1986).

From Holland *et al.* (2014), the interactions among the key management areas and the manner in which they are connected directly translate to the operation's profits. Specifically, the key management areas of managing output prices; managing production; controlling costs; managing land, equipment, and facilities; and managing people in their contribution to farm profit (Figure 1).

Through past survey findings, research publications, and consultation with industry leaders, these five key management areas together were highlighted as key factors that influence profits and success of farm operations. Each component of profit can be dissected into a corresponding subcomponent linked to a

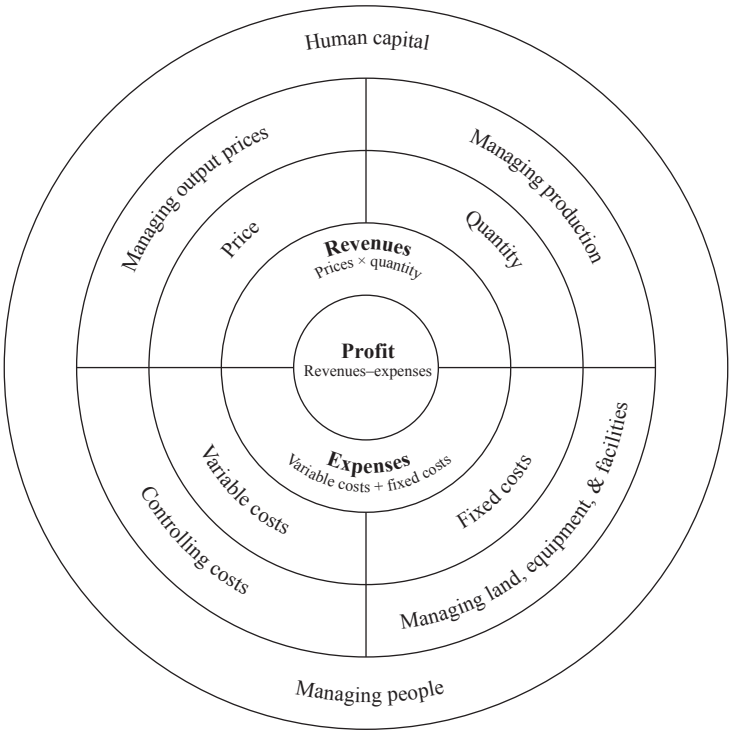

Figure 1. Profit-centric functional areas for key success of agribusiness management.

managerial responsibility. Thus, controlling costs and managing land, equipment, and facilities are of utmost importance for the expense portion of profit. Output prices and production are important to the revenue side of the profit equation. One additional factor, managing human resources, or people, encompasses all of these key success factors in the operation (Holland *et al.*, 2014). Nearly all farms in the U.S. are considered by the USDA as family farms, which account for 90% of farm production (Hoppe, 2016). These operations typically rely heavily on family members providing higher quality labor because they are incented towards the success of the operation (Schmitz and Moss, 2016). Thus, maintaining a stable family relationship is another important issue that impacts profit (Bone *et al.*, 2003).

While previous research has focused on determining whether specific management areas can influence profit, there is little work in determining behavioral or management segments (and their characteristics) that exist among farm managers. That is, there may be evidence to support different farm management styles that can lead to the success or potential detriment of the farm operation. Management myopia, where a manager places nearly all focus on one particular part of the operation, emphasized in the past prohibits producers from attaining success (Gartshore, 2004). Instead, a more holistic managerial approach is recommended, which comprehensively addresses the multidisciplinary nature of farm management (Bamberry *et al.*, 1997).

Business management is crucial to the ongoing success of any farm operation. Farm managers must pay close attention to critical success factors which will help to maintain the viability of their farm operations. This research aims to explore what factors of success are most important to the viability of commercial farming businesses. The analytical objective is to determine the relative importance of each of the five profit-centric functional areas of management among large U.S. agricultural producers.

2. Data

The data used in this analysis were obtained through a survey of large commercial producers conducted every five years. The survey was administered in January and February of 2013 via two mailings and multiple email distributions, which contained links to an online version of the survey. A total of 19,809 surveys were distributed via U.S. mail and 11,495 emails were sent to gather responses. Infogroup, a survey and market research company, made phone contact for those who did not reply to multiple reminders to participate in the survey. Respondents were targeted based on being identified as professional producers with greater than $100,000 in gross farm sales in order to reduce the occurrence of farmers who do not consider agricultural production as a primary source of their livelihood. Out of these 31,304 surveys distributed, 2,348 were completed and returned – a response rate of 7.5%. This consisted of 153 responses online, 748 responses by phone, and 1,447 responses by mail.

The purpose of this survey was to determine buying preferences, marketing segments, producers' demographics, and the methods by which agricultural producers gather information. Information collected in this survey opened the door to understanding the decisions that are made by farmers and how they are affected by strategies for success and purchasing behaviors. The agricultural production areas of interest were dairy; beef; hogs; corn and soybeans; wheat, barley, and small grains; cotton; and fruits, nuts, and vegetables. Respondents were selected from states that were in the top 75th percentile of total U.S. production for each commodity. Above average farm sizes were expected in the sample as this survey intentionally focused on farms with over $100,000 in gross sales.

2.1 Commercial farm manager characteristics

The proportion of male farm managers was 81% versus 19% female, which is typical of agricultural firms (Table 1). Similarly, the distribution of the farm operator's age coincided with the 2012 Census of Agriculture. Approximately 45% of respondents were between the ages of 55 to 69 and nearly all respondents were over 40 years of age. There was a large proportion of farmers in this sample who were high school graduates (32%). Another significant portion of the respondents (36%) had completed at least four years of college.

Table 1. Respondent demographics.

Demographic variable		% of respondents
Gender	Female	19
	Male	81
Age	18-24	0
	25-39	5
	40-54	25
	55-69	45
	70+	25
Education	Attended high school	4
	High school graduate	32
	Two-year college/technical/trade program	17
	Some four-year college	11
	Four-year college graduate	28
	Master's degree	5
	Advanced graduate work	3
Gross farm sales	<$100,000	16
	$100,000-$499,999	34
	$500,000-$999,999	18
	$1,000,000-$2,499,999	19
	$2,500,000-$4,999,999	8
	>$5,000,000	5
Primary production area	Crop	66
	Livestock	34

As for gross farm sales, half of the farm operations in the survey had under $500,000 and half reported over $500,000. When respondents were asked if they were primarily a livestock producer or a crop producer, 66% reported crop and 34% reported livestock.

The questionnaire also collected information regarding areas of management where the most time was being spent (Figure 2). For 45% of respondents, managing land, equipment, and facilities was most often chosen as the most time consuming managerial area. The second-ranked most time consuming management area selected by these farm managers was managing production at 31%. Controlling cost was reported as being the most time consuming by only 9% of the sample. This is closely followed by 8% for managing people and 7% for marketing and prices.

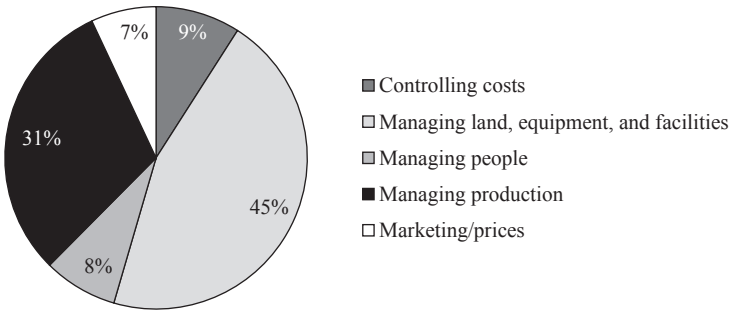

Figure 2. Percent of respondents reporting which management area take most of their time.

Another area of interest was the human capital needs of farmers today and what will be needed in the future (Figure 3). Generally, a small proportion of respondents in the sample switched their position from needing expertise in an area today to then not needing the same expertise 5 years later or vice versa. There is a striking difference for certified public accountants relative to other expertise areas; a large proportion of respondents report relying on accountants today and will continue to rely on accountants in 5 years. This could potentially be due to the high level of complexity in farm finances and regulatory compliance. The majority of farm managers currently do not require environmental (83%) or management consultants (89%) in their operations nor did they indicate requiring these consultants in the future. It may be that farm managers feel they know their own operations best and are reluctant to delegate managerial decision making. For independent crop consultants, 62% of respondents reported "not currently in use" and would not need to use one in the future. Similarly, the respondents seem to also be self-reliant regarding marketing, finance, and legal issues.

3. Methodology

While there are a number of useful methods to elicit preferences, we use pairwise comparisons to overcome the relative disadvantages of Likert-type rating scales and ranking. In this scenario, most and (implied) least important scaling was used to force participants to make a tradeoff among the two key success factors in management instead of allowing the possibility of all factors being chosen as most important.

A choice task was designed and included in the questionnaire (Figure 4) to elicit information from U.S. farmers regarding the tradeoffs faced in managerial tasks. Survey participants were asked to compare two key success factors and choose which was the most important to their success as a farmer. The 5 key success

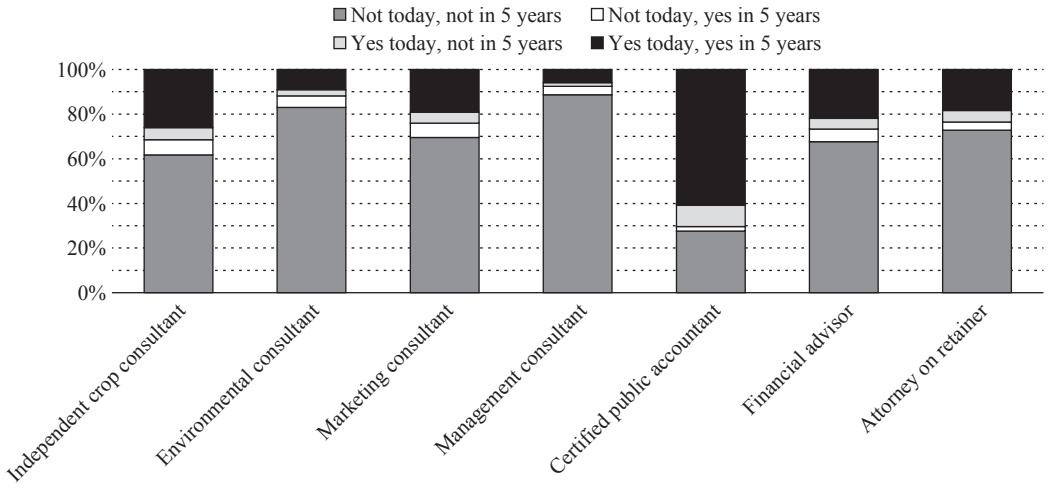

Figure 3. Human capital needs of farmers today versus in 5 years.

Which of the following pairs is most important to your success as a farmer? (check one box for each pair)

□ Managing land, equipment, and facilities	*or*	□ Output prices
□ Managing production	*or*	□ Output prices
□ Output prices	*or*	□ Managing people
□ Controlling costs	*or*	□ Managing land, equipment, and facilities
□ Output prices	*or*	□ Controlling costs
□ Managing land, equipment, and facilities	*or*	□ Managing production
□ Managing production	*or*	□ Controlling costs
□ Managing people	*or*	□ Managing land, equipment, and facilities
□ Controlling costs	*or*	□ Managing people
□ Managing people	*or*	□ Managing production

Figure 4. Questionnaire choice task to determine which managerial area was most important to success.

factors used in this analysis were: managing output prices; managing production; controlling costs; managing land, equipment, and facilities; and managing people. The responses in the choice task were then used to quantify the relative importance of each management area. A total of 2,249 respondents fully completed the entire choice experiment.

In this analysis, the choice task presented to survey participants involved tradeoffs among 5 key success factors, *K*, related to farm management profitability. Each farmer was given two key success factors to decide among which was the most important and leaving the remaining key success factor as being implied to be the least important. The presentation of pairs of success factors, as opposed to sets of three or four factors was selected to facilitate the multiple-mode survey data collection effort, which involved phone surveys (in which remembering multiple sets of three or four key success areas would be considerably more complex than selection among pairs).

Following Lusk and Briggeman (2009), the location of key success factor, *f*, can be designated as P_f. This key success factor location has an underlying scale of importance whereby the unobservable level of importance, *S*, for each farm manager, *m*, is determined by summing P_f with a random error term, ε_{mf}. So, $S_{mf}=P_f+\varepsilon_{mf}$. The farm manager is allowed to choose among a choice set with *F* management areas: *h* as most and *l* implied as least important. The probability of making any combination of selections is equal to the probability of the difference between S_{mh} and S_{ml} being greater than all other *F(F-1)-1* possible differences in the choice set. This probability takes the usually multinomial logit (MNL) form which assumes the ε_{mf} terms are distributed i.i.d. type I extreme value:

$$\text{Prob}\ (h = \text{most} \cap l = \text{least important}) = \frac{e^{Ph-Pl}}{\sum_{a=1}^{F}\sum_{b=1}^{F} e^{Pa-Pb} - F} \qquad (1)$$

Equation 1 is a binary probability statement which takes on the values of 1 or 0. A value of 1 represents the choice pair of most and least important key success factors while a value of 0 represents all other possible pairs, *F(F-1)-1*. This allows for P_f to be estimated by maximization of the log-likelihood function based on Equation 1 and thus represents the importance of *f* relative to a base management area normalized to zero to prevent the dummy variable trap.

The scale of importance is specified as $\tilde{S}_{mf}=\tilde{P}_f+\sigma_m\mu_{mf}$, where $\tilde{P}_f$ and σ_m are the mean and standard deviation of P_f in the population, and μ_m is a random term normally distributed with mean zero and unit standard deviation. The importance of *f* is assumed to be distributed according to a normal distribution with mean $\tilde{P}_f$ and standard deviation σ_m. By substituting $\tilde{S}_{mf}=\tilde{P}_f+\sigma_m\mu_{mf}$ into Equation 1, the probability statement depends on the random term in μ_{mf}. Following Train (2002), the model was estimated by maximizing a simulated log-likelihood function rather than attempting to explicitly integrate over the random terms.

The MNL is restrictive in that it imposes the assumption that across all farm managers in the sample, each key success factor is viewed as equally important. To relax this assumption, two alternative modeling techniques can be used to take heterogeneity among individuals into consideration – the random parameter logit (RPL) and the latent class model (LCM).

While the RPL assumes the variance of $\varepsilon_{mf}=1$, the scale may still differ by individual or choice (Louviere, 2001). The RPL model outlined above accommodates these potential scaling differences because it allows for a separate management area specific variance (Train, 2002). A confound with scale differences may exist among the normally distributed mean estimates of P_f making it necessary to recognize the estimated population parameters reflecting both mean and scale differences. Notwithstanding choice modeling misspecification, RPL can be utilized to approximate any underlying random utility model (McFadden and Train, 2000) and provide efficient estimates of predicted probabilities. This paves the way towards calculating a "share of preferences" for each management area. Summing to 1, these shares represent the estimated probability that each management area is chosen as the most important:

$$\text{share of preference for management area } m = \frac{e^{\tilde{P}_f}}{\sum_{d=1}^{F} e^{\tilde{P}_a}} \quad (2)$$

Share of preference for each management area calculated from Equation 1 is based on a ratio scale. For example: if the controlling cost management area has a share outcome twice that of another managing people area, then this can be interpreted as controlling cost being twice as important as managing people (Wolf and Tonsor, 2013). It should be noted that these preference share calculations for the five management areas not only represent the true importance of the management area but also the relative uncertainty in importance placed by farm operators. The conveyed information is still insightful since it provides the probability that a managerial area is picked as more important than other choices.

A separate approach to modeling the preferences on management areas for these farmers is to use the LCM. The LCM opens up the ability to incorporate operation characteristics and operators' perceptions of importance of the five key success areas of farm management. Since operator characteristics such as primary production area or other measurable may be elemental to a particular operation, it is advantageous to segment based on similar preferences among individuals (Boxall and Adamowicz, 2002). The LCM helps to simultaneously achieve two objectives. One is to identify classifications that may exist among individual respondents through probability and another is to quantify the parameters for each of the latent classes (Swait, 1994). Thus, when given a respondent classification into any group, c, the conditional probability statement where the parameter P_{fc} is indexed by class is represented below (Ouma *et al.*, 2007):

$$\text{Prob}\,(h=\text{most important} \cap l=\text{least important} \mid c) = \frac{e^{P_{hc}-P_{lc}}}{\sum_{a=1}^{F}\sum_{b=1}^{F} e^{P_{ac}-P_{bc}} - F} \quad (3)$$

In the MNL form, the unobserved class probability is:

$$Prob(c) = \frac{e(\theta_c Z_r)}{\sum_{c=1}^{C} e^{\theta_c Z_r}} \quad (4)$$

The model inputs of the observable characteristics is represented by Z_r which is the driving mechanism for classification of each respondent and θ_c is a vector of parameters which represent the magnitudes by which each driver affects respondent classification normalized to zero (Ouma *et al.*, 2007). It is advantageous that the LCM provides the flexibility to fit a statistical model based on maximum likelihood but also accounts for both the similarities and differences between agribusiness managers and their respective operations. Also, it is powerful in that the LCM provides the ability of grouping subtypes of related cases in the sample in regards to relevant unobserved heterogeneity to allow concurrent classification and characterization (Coltman *et al.*, 2011).

4. Results and discussion

Three separate models were estimated using NLOGIT 5.0 software (NLOGIT Version 5, Econometric Software, Inc., Plainview, NY, USA) to predict the most and least important management factors to the farmers sampled. Table 2 reports the estimated coefficients for the MNL, RPL, and LCM as well as calculated shares of preferences for each of the five key success factors for farm management. The MNL was used as an initial starting point to generate a base model which assumed homogeneity among farm managers. This model served as a precursor to be incorporated further into the RPL and LCM and explore the heterogeneous preferences of the farm managers.

Table 2. Estimation results from multinomial logit (MNL), random parameter logit (RPL), and latent class model (LCM).

	MNL	RPL			LCM							
					Coefficients (std. error)				Share of preferences			
	Coefficient (std. error)	Coefficient (std. error)	Std. dev. (std. error)	Share of preference	Class 1	Class 2	Class 3	Class 4	Class 1	Class 2	Class 3	Class 4
Controlling costs	0.8437	1.0963	0.6714	29%	1.9317	0.2399	-0.5878	1.5562	29%	31%	14%	28%
	(0.0166)	(0.0275)	(0.0298)		(0.0625)	(0.0938)	(0.0826)	(0.0931)				
Managing land, equipment and facilities	0.6253	0.7692	0.4757	21%	1.7815	-0.3288	-0.2761	0.8420	25%	18%	19%	14%
	(0.0160)	(0.0223)	(0.0276)		(0.0652)	(0.0714)	(0.0618)	(0.0804)				
Output prices	0.3346	0.3689	0.6524	14%	1.0124	-0.9937	-0.6712	1.6464	12%	9%	13%	31%
	(0.0157)	(0.0229)	(0.0278)		(0.0577)	(0.0991)	(0.0824)	(0.0959)				
Managing production	0.8318	1.0467	0.4850	27%	1.9310	-0.3044	0.1510	1.3081	29%	18%	29%	22%
	(0.0166)	(0.0248)	(0.0296)		(0.0648)	(0.0778)	(0.0658)	(0.0849)				
Managing people	0.0000	0.0000	0.0000	10%	0.0000	0.0000	0.0000	0.0000	4%	24%	25%	6%
	–	–	–		–	–	–	–				
Constant					1.4589	0.5687	0.1349					
					(0.2036)	(0.2224)	(0.2594)					
Primarily crop					-0.7551	-1.5333	-0.7008					
					(0.1789)	(0.2233)	(0.2270)					
Class probability					51%	14%	14%	21%				

As mentioned previously, the RPL model assumes heterogeneity among the farm managers. The farm managers reported that they viewed controlling costs as a priority and allocated, at the mean, 29% of preference share towards this management area. However, managing production was also very important to the farmers as a whole and this area was allocated a mean preference share of 27%. The third most important management area for these farmers was managing land, equipment, and facilities with 21% share of preference. Output prices and managing people were estimated to be of relatively lesser importance, at the mean, with shares of 14 and 10%, respectively.

4.1 Operation management classifications

The LCM used in this analysis revealed how farmers generally allocate a greater prioritization of one farm management area relative to others.[1] A model search process found four classes to be optimal based on model fit criterion. As such, four collective groups were identified to have distinctly contrasting characteristics. The first class could be generalized as production focused (Class 1). Another class was focused on people management with strong emphasis on controlling costs (Class 2). The third class was found to also be focused on managing people with emphasis an on production (Class 3). Finally, the fourth class was characterized as being commodity marketing oriented (Class 4). The LCM model estimates the probability that each survey respondent would belong to each of the aforementioned classes. A number of general similarities stand out across all classes. The four classes of farmers by and large have similar probabilistic profiles across the differing levels of education, gender, and age. Examining more closely, a different narrative emerges among the mean shares of preferences (calculated from the LCM coefficients from Equation 1) and the probabilistic outcomes within each of the differing farmer groups.

The 'production focused' class estimated farmers prioritizing the management areas of controlling costs and production the most, both at 29%. These areas were closely followed by managing land, equipment, and facilities (25%). The next most important management area for this class was output prices. The lowest share of preference in this class, and among all classes, was managing people, at only 4%. With the *Primarily Crop* indicator variable estimated to have a negative coefficient, farm mangers who reported to be primarily engaged in crop production were less likely to be a member of this class. Of farmers who were most likely to fall into this latent class, 65% were primarily involved in crop production. Of the farmers who had the greatest likelihood of being classified into this group, 52% spent most of their time managing land, equipment, and facilities. This relative ranking of management areas aligned well with the results of Burton and Abderrezak (1988). Their ordinary least squares regression on farmers in Kansas showed that profit is positively influenced by larger farm sizes, leasing or rental of intermediate and long-term assets, and increasing production efficiency. By magnitude of statistically significant coefficients, their model had similar rankings to farmers depicted in this 'production focused' group of farmers as depicted by the LCM.

The farm operators likely to have their preferences represented as those outlined in the 'cost control through people group' of farmers generally allocate their highest share towards controlling costs. This is similar to the 'production focused' group but contrasts in that they allocate a large share towards managing people at 24%. Tied for the third most important management area for farm success at 18% were managing production and managing land, equipment, and facilities. Managing prices was the lowest priority for these managers. Similar to that of the 'production' group for the *Primarily Crop* indicator, farmers involved primarily in crop production would have a lower likelihood of their preferences being represented by these shares of preferences. Upon closer inspection, this class was made up of only about 46% crop producers, which was the lowest among all classes. Managing land, equipment, and facilities was likely to be the activity taking the greatest amount of time for farmers well represented by this class. Of particular note was that while the LCM model estimated managing people as being the second highest priority for success of the operation, it was ranked lowest when thinking about the time consumed by each of the management areas. Only 3% of farmers who fell within this class would state that managing people was the most time consuming. This

[1] The models used in this analysis are models with probabilistic outcomes.

finding affirms the results of a study conducted on Kansas farmers in the 1990s which also found that cost control and production intensity were strongly and positively influential on profit. This suggests that farm managers need to continue focusing on the managerial areas over which they have the most control in order to maintain success (Nivens *et al.*, 2002).

The next class focuses on 'production focus through people management' and was similar to the 'production focused' group of farmers in that they allocated 29% of preference share towards production. This class was similar to the 'cost control' group in that they allocated 25% of their preference share towards managing people, the highest among all classes. The third highest priority for this group of managers is managing land, equipment, and facilities, whereas controlling costs and output prices were appropriated only 14 and 13%, respectively. The indicator variable, *Primarily Crop,* was also negative which means that farmers who were engaged in mostly crop production were less likely to be a part of this latent class. About 68% of the farmers whose preferences were represented by this latent class were, probabilistically, involved in crop production with the remainder involved in livestock production. It is intuitive that Class 2 and 3 ('cost control' and 'production focused through people management') allocated greater percent shares of preference towards managing people due to the higher probability that farmers of these classes were larger operations by gross farm sales. Class 2 and 3 probabilistically consisted of 42 and 54% farm operations grossing over $1 million in farm sales, respectively. Growing agribusiness firms typically placed increasingly greater attention in managing people due to greater complexity of the operation (Bitsch and Olynk, 2007; Greiner, 1972) which had been shown to have a positive effect on performance (Crook *et al.*, 2011). This segment of farmers may also be essential to rural development and agricultural productivity due to their focus on production and managing people. Although there are many ways to measure agricultural productivity, research has shown that increasing agricultural productivity on a per worker basis reduces poverty (Byerlee *et al.*, 2005).

For the 'commodity marketing' class, this group of farmers allocated the highest share of preference towards the management area of output prices at 31% and was followed by a 28% preference share in controlling costs similar to Classes 1 and 2 ('production focused' and 'cost control'). Managing production was a lower priority with 22% share of preference. As for managing land, equipment, and facilities, the farmers depicted by preferences of Class 4 were estimated to allocate 14% share of preference which was the lowest across all classes. This segment of producers places managing people at the lowest priority. Serving as the base segment for the *Primarily Crop* variable in the model, farms reporting that they were primarily involved in crop production were more likely to be part of Class 4 whereas all of the other classes were less likely. This was shown by the probability of about 80% of farmers (who most likely fell into this group) identifying themselves as primarily crop producers – the greatest proportion of crop producers among all classes. It was intuitive that a group probabilistically consisting of crop farmers would rank output price management highest. Shifts in livestock agriculture over the years may have contributed to the demographics of this group of farmers – especially as livestock farmers adopt structured contracts which reduce the level of control over prices of livestock and inputs. As a result, crop producers are incentivized more so than livestock farmers to participate in the speculative market. Yet another difference may exist in terms of a temporal aspect due to the challenges associated with storing livestock relative to crop harvest storage. Crop producers are possibly faced with added complexity over when they should sell their product and are tempted to try to time the market. This class was made up of smaller firms with 55% of farmers in this class with gross sales below $500,000. Being a segment of smaller firms, it makes sense that managing people would have the lowest share of preference as smaller firms have not grown to a point predicated by human capital needs, contrary to what is seen in Class 3.

4.2 Probabilistic profiles: most time consuming management area and human capital needs

Thus far, we examined only the general characteristics of each segment of farmers estimated by the model. Here, the attention turns towards the management areas that farmers reported as being most time consuming and areas in which farm managers may find strengths or weaknesses. Farmers, whose preferences could be reflected by Class 1, reported controlling costs and managing production as having the greatest managerial prioritization (Figure 5). Moreover, it was interesting that these similar farmers report managing land, equipment, and facilities as being the most time consuming management area rather than the management tasks having the highest priority. There were about 40% of farmers who reported managing land, equipment, and facilities as most time consuming in Class 2 and 3. However, Class 2 and Class 3 placed the greatest shares of preference on managing people compared to the other classes. Class 2 thereby controls costs and Class 3 manages production through emphasizing management of its human capital (the people who constitute the agribusiness). With Class 4, managing people was the lowest and the managers of this class were 69% likely to be found managing land, equipment, and facilities or managing production.

Examining the human capital needs of farm managers today and their needs moving forward, Class 1 and Class 4 relied on outside help in certain areas less than Class 2 and 3 depicted in Figure 6. These areas were independent crop consultants, environmental consultants, management consultants, and attorneys. Since Class 2 and 3 placed the greatest share of preference on managing people among the four classes and the management area was relatively important within the two classes, it makes sense that these two groups of farmers would find it necessary to rely on the expertise of others. This was especially true in highly specialized human capital areas and was in line with the resource based view of the firm (Wernerfelt, 1984). These segments were also found to be of higher grossing farm sales than Class 1 and 4 which agrees with the conclusions of Greiner (1972).

Of all areas of expertise, the certified public accountant probably stands to be of the greatest use of all of the classes. This may be due to highly complex nature of farm record keeping and the amorphous nature of tax laws related to the agricultural industry. A large proportion of farmers had a high probability of having a persisting need for accountants. Independent crop consultants were probabilistically going to be in demand among Class 3 farmers (managing production through people). It was likely that about 11% of farmers from this group did not require the skills of an independent crop consultant presently but could require the human resource in 5 years.

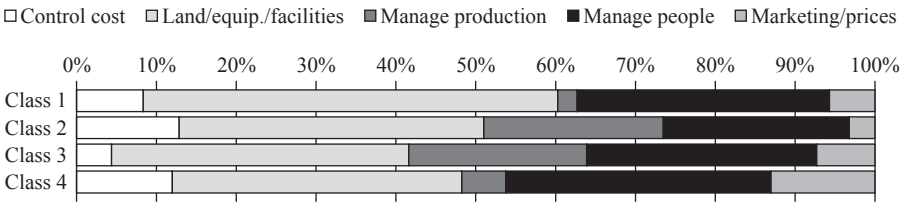

Figure 5. Management area selected as most time consuming.

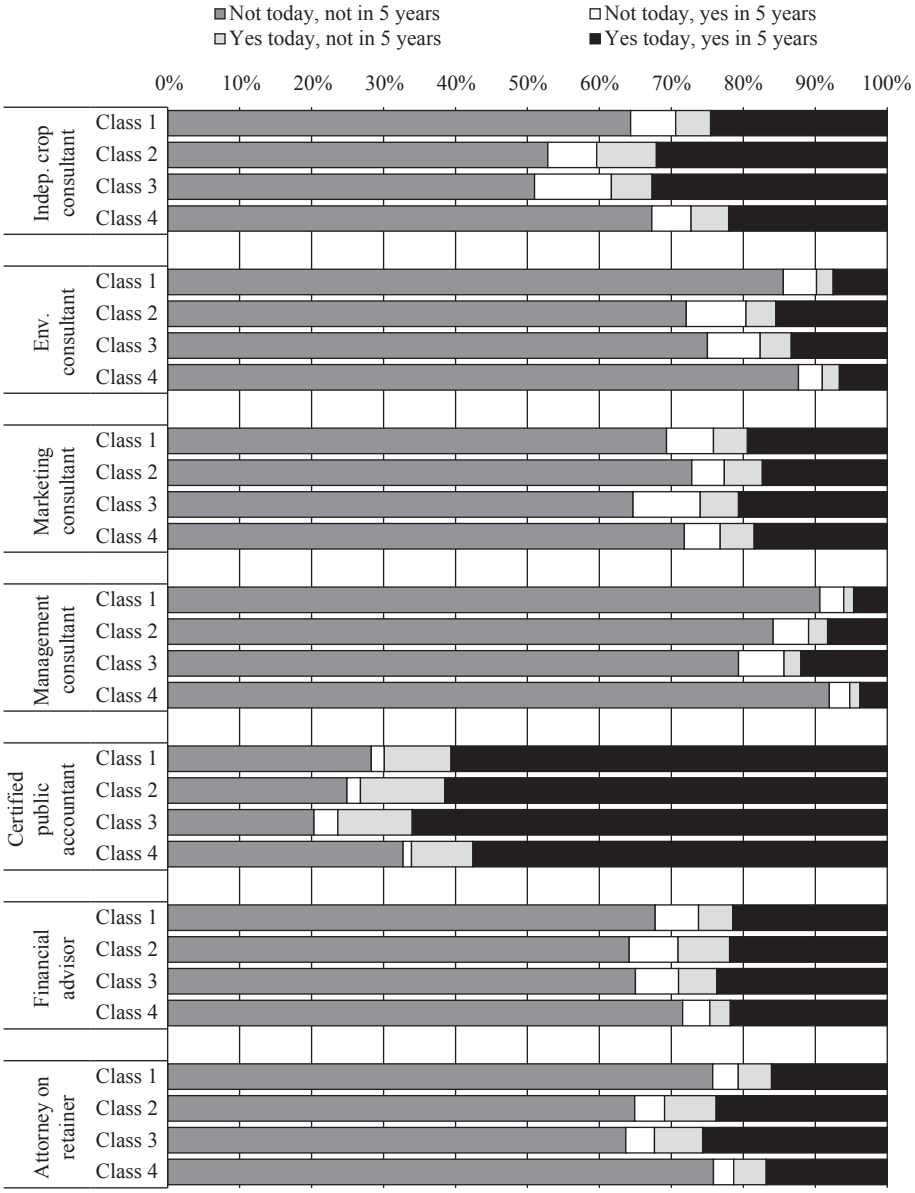

Figure 6. Human capital needs by class for each resource area.

5. Conclusions

The findings from this analysis are particularly useful to agribusiness managers as they attempt to navigate the highly amorphous state of the agricultural industry in recent years. It may also be valuable to key stakeholders or service providers to agribusiness managers seeking to understand the type of operation they must cater towards. The objective of this paper was to understand the critical success factors that help to maintain viability of farm operations and how farms of various characteristics prioritize amongst those factors. In this analysis of a sample of US farm managers, the relative importance of each of the five profit-centric functional areas of management was estimated.

A review of existing agribusiness management literature and in-depth consultations between researchers and industry experts revealed that there are five primary drivers to success. These key success factors were identified to be both internally validated through the literature and researchers but also externally validated by key industry veterans. This analysis revealed the most important and least important factors to farm success, human capital needs of today and tomorrow, and areas of management which were most time consuming.

Overall (from the RPL), the top three high priority management areas among farmers as a whole were controlling costs; managing production; and management of land, equipment, and facilities. Output prices and management of people were rated as slightly less important. However, the analysis was expanded further by employing an LCM approach. This expansion revealed that there were four distinct classifications of farm managers: production purists, cost control through people, production management through people, and commodity marketing focused. Each class of farm managers exhibited different preferences over the management areas and thereby ordered the management areas differently.

This analysis of US farm producers showed that there is a production focused group of farmers who were reported to prioritize cost control and production. Of farmers who had the greatest probability of falling into this classification, the farm managers selected these top management priorities the least often. Furthermore, these farmers likely spent the most time on managing land, equipment, and facilities which falls into the fixed cost category within the framework presented. This may be indicating that while variable costs take little time to manage in their respective operations, fixed costs require much more attention. These and other costs associated with land purchases, equipment or facilities typically require greater financial resources and it is intuitive that these farm managers spend more time in this area out of caution.

Also revealed was a separate group of farmers who prioritized cost control above all else but were found to do so through managing people. This was similar to yet another group that placed management of people at a higher rank than other classes but is production-centric. These two groups of farmers are perhaps crucial to the current state of the agricultural industry. They also have the greatest potential to improve the rural communities due to the high likelihood of these farm operators controlling larger agribusinesses which require greater human resources. This potential is not limited to only on-farm labor because of higher production intensity but also managerial consultants, environmental consultants, and legal resources as regulatory compliance requirements change.

Lastly, the analysis sheds light on a group of farmers who focus greatly on managing output prices, dubbed commodity marketers. The farmers who were most likely to be in this group were primarily engaged in crop production and, among the other groups of farmers, spent the most time on marketing and commodity prices. This group, probabilistically, reported spending a large amount of time on production and costs among the other groups as well which could be an indicator of either sensitivity towards volatile markets or reduced margins or both.

Going forward, industry participants will likely find greater attention on specific human capital needs. This is simply the nature of growing agribusiness firms especially in the face of increasing automated mechanization. Across all classes, certified public accountants remain a key asset to farm operations. This could be due to the complexity of record keeping associated with the interlacing of family and business related activities. While management consultants may not be probabilistically of great importance to production purists and commodity markets, this human capital need was relatively of greater importance to farming operations that manage cost and production through its human resources.

Now that the relative importance of each management area is better understood for a range of farm operations, agribusinesses that are looking to grow can internalize these results in order to improve their own operations. Small additive opportunities to adjust management priorities may help smaller farm operations to grow in the midst of volatility. This also could potentially be crucial to operations in rural communities where many of these agribusinesses are found. Important employment opportunities may be growing in areas such as farm financial record keeping and accounting, management consulting, and legal. These types of positions, requiring specialized skill sets, will likely become more important in five years as farm operations grow larger and become more structurally defined. By reducing unemployment and providing management and other agribusiness employment opportunities, rural communities that depend greatly on the agricultural industry may help stabilize their local economy.

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