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**TEACHING NOTE FOR CASE STUDY:
“STRATEGIC DECISION-MAKING UNDER
UNCERTAINTY: INNOVATION AND NEW
PRODUCT INTRODUCTION DURING
VOLATILE TIMES”**

by

Maud Roucan-Kane, Michael Boehlje

Working Paper #09-14

October 2009

Dept. of Agricultural Economics

Purdue University

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Abstract

This teaching note accompanies the case study titled “Strategic Decision Making under Uncertainty: Innovation and New Product Introduction during Volatile Times” published under the reference: Boehlje, M. And M. Roucan-Kane, ”Strategic Decision Making under Uncertainty: Innovation and New Product Introduction during Volatile Times”, *International Food and Agribusiness Management Review*, 12 (4), 2009. This case study outlines the strategic, marketing, and organizational issues facing the farm machinery and equipment division of Deere and Company as it is considering the development of products in the information domain, which encompasses many opportunities of disruptive innovations to market to new or underserved customers. While these disruptive innovations face uncertainties and challenges, they can also, if successful, generate more profits. Instructors can use the case to discuss uncertainties and tools to mitigate risk. Readers must think strategically about innovation and the uncertainties associated with each innovation project. Beyond a listing of uncertainties, readers are also challenged to think about ways to mitigate risk through the use of real options, an options portfolio, and organizational structure. This teaching note presents some suggested answers to the discussion questions presented in the case study.

Keywords: teaching note, uncertainty, innovation, real options, portfolio

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Teaching Note for Case Study: “Strategic Decision-making Under Uncertainty: Innovation and Product Introduction During Volatile Times”

Maud Roucan-Kane, Michael Boehlje

This teaching note accompanies the case study titled “Strategic Decision Making under Uncertainty: Innovation and New Product Introduction during Volatile Times” published under the reference: Boehlje, M. And M. Roucan-Kane, ”Strategic Decision Making under Uncertainty: Innovation and New Product Introduction during Volatile Times”, *International Food and Agribusiness Management Review*, 12 (4), 2009.

Statement of Relevance

This case study outlines the strategic, marketing, and organizational issues facing the farm machinery and equipment division of Deere and Company as it tries to continue to grow. Deere Ag Division is considering the development of products in the information domain, which encompasses many opportunities of breakthroughs or disruptive innovations to market to new or underserved customers. While these disruptive innovations face uncertainties and challenges (capabilities and capacities that may be beyond Deere’s current skill set, a more intimate knowledge of potential new customers, which may not be the focal point of the current sales/marketing initiatives), they can also, if successful, generate more profits. Since they do not compete with current Deere products (in many cases they are add-ons to existing products), they can also attract new customers and generate new sales.

For these reasons, the information domain has the most potential to answer Lane’s challenge. From a teaching standpoint, the information domain also allows instructors to discuss uncertainties and tools to mitigate them. Readers must think strategically about innovation and the uncertainties associated with each innovation project. Beyond a listing of uncertainties, readers are also challenged to think about ways to mitigate risk through the use of real options, an options portfolio, and organizational structure.

Please note that the case study takes place in the past for intellectual property reasons. Consequently, if students/participants perform some research on Deere, they will find out how

Deere dealt with the uncertainties. This does not affect the case's usefulness. Most of the questions are strategic and specific enough that it would be hard for the students/participants to find the answers in news releases.

Perspectives Presented by the Case

This case gives readers the opportunity to think about strategy in an uncertain environment. The case illustrates the challenges associated with innovation. It highlights the importance of thinking about real options, a portfolio of projects, and type of organizational structure to limit the uncertainties associated with innovation projects. It also explores marketing issues—which type of customers to target for an innovation project. Finally, it is an avenue for students to think about all the changes necessary throughout the supply chain to successfully implement and commercialize an innovation project.

This means the case will work well as a learning tool for strategy implementation where uncertainty is inherent, as an application to lectures on real options and risk and/or for discussions related to innovation and its challenges.

Important discussion points and lessons emphasized by the case include:

1. Innovation projects are characterized by uncertainties, such as market and technical uncertainties.
2. Innovative products may not respond to every customer's needs. Customer segmentation is often necessary.
3. The success of an innovation project requires the buy-in of the entire supply chain.
4. Real options, a portfolio of projects, and organizational structures are ways to mitigate the uncertainties.

Target Market

The case has been tested and is effective as part of executive education courses. Students/participants are challenged to think about real options, a portfolio of projects, and organizational structures. They are also motivated to think about customer segmentation and required changes in the supply chain. The case will be particularly useful for those who already understand the need for innovation, but who may not understand the uncertainties associated with innovative projects. This case could also be used in an agribusiness class for master's degree, MBA, and/or doctorate students.

Teaching Strategy

Teaching this case begins by asking students/participants to individually read and think about the case prior to class. A 15-minute introduction to the case by the instructor may be useful before beginning discussion. The introduction should explain the Deere commitment to innovation. The instructor may want to present the numerous opportunities for new product/service introduction available for the farm machinery and equipment division of Deere and the challenges associated with each of them. Students should realize that Deere is not the only company facing uncertainties as they think about innovation. The goal of the case is not to find the right innovation path for Deere, but rather to understand the challenges inherent in innovation projects and how Deere can mitigate the risk.

Alternatively, the instructor can elicit the same information from the class by asking questions such as:

1. Describe the farm machinery and equipment division of Deere—which issues are they wrestling with?
2. What are the key innovation projects and their associated challenges?

These questions will provide enough background to move into the discussion.

Once the introduction is complete, breaking the class into teams of three to five students may be useful. The teams should discuss and summarize their answers to each of the key questions presented in the case study and choose one representative to present a summary of the team's answers to the class. The facilitator should work to move the discussion past a listing of challenges to an identification of the tools to mitigate the risk.

Activity

Determination of Uncertainties¹

The first step in analyzing the case and finding solutions to the Lane challenge is to have the students/participants determine the sources of uncertainties by asking the following question:

¹ The following references are useful to help in the teaching and the discussion on uncertainties:

- Detre, J., B. Briggeman, M. Boehlje, A. Gray. "Scorecarding and Heat Mapping: Tools and Concepts for Assessing Strategic Uncertainty". *International Food and Agribusiness Management Review*, 9 (1), 2006.
- McGrath, R. G., and I.C. MacMillan (2000). "The Entrepreneurial Mindset." Boston, MA: Harvard Business School Press.

What are the types/dimensions of risk/uncertainties associated with innovations in the information domain?

Once the dimensions of uncertainties are defined, give specific examples in each dimension related to Deere and the information domain.

Table 1 can be used to guide the students/participants in their group discussion or completion of the assignment. It can also be used as a “solution” presented by the instructor to the entire classroom for the wrap-up of the discussion or assignment.

Table 1. Dimensions of Uncertainty

Categories of Strategic Uncertainty		Sources of Strategic Uncertainty
Business/Operational	Operations and Business Practices	Contractual uncertainty, internal processes and controls, management transitions
	People and Human Resources	Recruiting, training, retention, organizational culture
	Strategic Positioning and Flexibility	Mergers and acquisitions, joint ventures, resource allocation and planning organizational agility, information access
Financial	Financing and Financial Structure	Debt structure, non-equity financing
	Financial Markets	Portfolio misalignment
Market Conditions	Market Prices and Terms of Trade	Contract terms, market outlets, market access
	Competitors and Competition	Antitrust, industrial espionage
	Customer Relationships	Poor market timing, inadequate customer support
	Reputation and Image	Corporate image, brand image, reputation of key employees, community relationships
Technology	Technological	Complexity, obsolescence, workforce skill sets, adoption rate, diffusion rate
Business Relationships	Business Partners and Partnerships	Interdependency, confidentiality, cultural conflict, information sharing
	Distribution Systems and Channels	Access, dependence on distributors
Policy and Regulation	Political	Enforcement of intellectual property rights, change in leadership, revised economic policies, budget shortfalls

	Regulatory and Legislative	Government trade negotiations, government farm subsidies
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In the case of the information domain for Deere, there are two main uncertainties—market uncertainty and technical uncertainty. Market uncertainty refers to the lack of knowledge at the market and demand level. Major sources of uncertainty for Deere with innovations in the information domain are: (1) who are the targeted customers, (2) how will competitors react, and (3) how will the members of Deere’s supply chain react. The realization of those uncertainties will affect the revenue/demand and the associated cost of delivering and servicing the innovation.

Technical uncertainty results from the lack of information about the viability of the innovation. Deere is uncertain about whether or not the technology can be developed to the level of quality the company is committing to give to its customers. There is also uncertainty in the nature of the inputs and skills that are needed to provide the new product/service and whether Deere has them or can develop them throughout the supply chain.

Market Uncertainty

Deere faces market uncertainty. To further determine the market uncertainty, one needs to determine the types of customers Deere should target. The following question helps students/participants craft a marketing strategy:

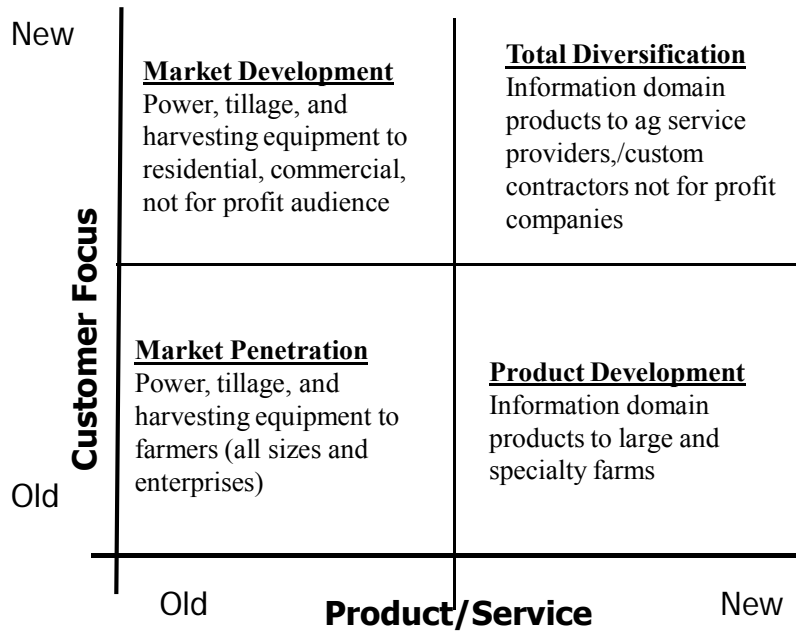
What kinds of customers (in terms of age, size, crops produced, etc.) provide the most potential for adopting the products/services in these domains?

Students/participants may approach the concept of market uncertainty through the growth Ansoff’s product/market growth matrix presented in Figure 1 of the case study. The Ansoff’s product/market growth matrix suggests that the Deere Ag Division could continue to produce and innovate in the traditional areas of enhancing the performance and productivity of its power, tillage, and harvesting equipment. They could continue to market to their existing customers, but also consider new customers. Deere has been successful in adapting their agricultural products to a residential and commercial (country clubs, golf, lawn, and ground maintenance) audience. They should continue this to increase profit and allow for synergies between Deere divisions.

The information domain products clearly represent new products at Deere. As suggested by the case, as with most radically new products, precision farming products are destined, at least in the short term, for early adopters. Because of the high price tag, early adopters also need to have enough acres to leverage the investment. Using the information in the case and Deere's segmentation scheme, Deere should target its current customers, such as the large and specialty farmers, in the short term. These producers need machinery and equipment with more information-based features, have enough acres to justify the investment, and/or are increasingly concerned about precision and process control systems. New customers (or under-served customers) might be the ag service providers/custom contractors, and the not-for-profit entities (state and federal government, etc.).

Christensen and Raynor (2003) argue that innovative products can serve four types of customers—over-served, satisfied, under-served, and non-customers. The products in the information domain would serve the under-served customers that we identified earlier: large/mega farmers, ag service providers/custom contractors, some of the not for profits (state and federal government, etc.), and the specialty crop producers. However, Deere Ag Division may also want to think about the non-customers, which would be country clubs, golf courses, and the landscaping/lawn and ground maintenance companies that are serviced by other Deere divisions. Consequently, there could be some synergies between Deere divisions on this innovation project. The satisfied customers may become targets in the medium term once they have seen what the early adopters can accomplish with the new technology. The over-served customers may be targeted in the long term as the technology simplifies and becomes more affordable. Figure 1 presents a possible Ansoff's product/market growth matrix for Deere.

Figure 1. Deere's Ansoff's Product/Market Growth Matrix



Technical Uncertainty

Deere also faces technical uncertainty. To further assess the technical uncertainty, one may be stimulated by the following questions:

What are the capacities needed to develop, produce, and commercialize information domain products? Does Deere have the capabilities? If not, how should Deere go about getting the capabilities?

Deere's core business up until now has been machinery. For the company to enter the information domain, Deere will need to develop competencies in electronics/computer/information technology by either buying electronic companies or collaborating with them. These electronic competencies will have to be developed at all domains throughout the supply chain. The research and development teams will have to learn about electronics, in addition to continuing their understanding of machinery. The manufacturing processes will have to be adapted to produce electronics. Deere will need to find and build relationships with suppliers of electronics. Quality controllers will have to learn about electronics. Deere's marketers and sales representative will have to learn about electronic

features to market the product properly and to its fullest. Deere's dealers also have service teams at the dealership and on-site; those teams will need to have electronic experts on staff.

Managing the Risk²

To move the discussion past a listing of the market and technical uncertainties, students/participants may be asked the following questions:

How can Deere manage the risk/uncertainties associated with investing in the information domain? Think about flexibility and the concept of real options, and suggest a framework(s) to use this concept.

If no lecture is given on real options and portfolio mapping, students may be given pre-readings on those subjects using, for example, the references presented in this teaching note, or asked to research the subjects of risk mitigation and managing flexibility.

Real Options Valuation

One way to limit the risk associated with innovation projects is by using real options thinking. Real options are a direct extension of financial options, but focus on physical or real assets instead of financial derivatives. In essence, a real option is like a financial option—investing a modest amount today to acquire a right to buy an asset in the future. When the future arrives, the purchase can be made or the option is allowed to expire, depending on the profitability, or lack thereof, of that asset at that point in time. In short, the option approach enables one to maintain the right or the position to exploit that potential opportunity without having to make a commitment to do so today. This same approach is regularly used in making business decisions where option payments are made to maintain the right to acquire a particular parcel of real property in the future, minority investments are made in startup companies with an agreement to have the first right to buy a majority interest in some future time period, or pilot plants are constructed to test an idea before a full scale manufacturing facility is built.

² The following references (in order of importance) are useful to help in the teaching and the discussion on real options valuation:

- McGrath, R. G., and I.C. MacMillan (2000). "The Entrepreneurial Mindset." Boston, MA: Harvard Business School Press.
- Luehrman, T. A. "Investment Opportunities as Real Options: Getting Started on the Numbers." *Harvard Business Review*, (1998): 51-67.
- Boehlje, M., A. W. Gray, J. D. Detre (2005). "Strategy Development in a Turbulent Business Climate: Concepts and Methods." *International Food and Agribusiness Management Review*, 8 (2): 21-40.

This method of thinking explicitly considers the benefits additional information will have on the value of a decision or investment. A real options framework is appropriate for situations where the manager can make incremental decisions throughout time, thus creating flexibility in the decision. Such options might include deferring, abandoning, or expanding a given project. This flexibility is only valuable if managers are allowed to incorporate new information into their decisions over time. Thus, real options are a learning model that allows management to make informed and accurate decisions over the course of time.

There are different types of real options:

- Growth—Making investments today to maintain the “option to play” in the future.
- Contract/Divest—Flexibility to reduce the commitment or divest resources in the future at high residual values or minimum costs if events turn negative.
- Sequence/Follow-on—Deliberately sequencing decisions and making incremental investments to maintain flexibility.
- Pause/Wait—Deliberate reasons to delay with a trigger to commitment.
- Shut-down/Switch—Temporarily stop production when variable costs cannot be covered.

For example, Deere may decide to delay the decision to invest in various projects in the information domain until there is less uncertainty about precision farming. Or they may decide to bet on precision farming and make investments today to potentially be in the precision farming landscape in the future. These investments may take several forms: buy some shares of a start-up companies (a strategy used over and over by Procter and Gamble); working on the development of precision farming products, such as electronic companies producing electronic products or electronic parts; have a small group of the Ag Division (a taskforce if you will) focus on market research and prototyping of precision farming products; set up a new division that focuses on precision farming products; etc. Deere may also decide to contract out the prototyping and market research on precision farming products by using a design company like IDEO. Deere’s investment in precision farming can also be sequential. If precision farming after a few months or a year shows signs of success, Deere may buy more shares of the start-up company or increase the number of employees on the precision farming taskforce. If after a few months, precision farming products still face significant market or technical uncertainties, Deere may decide to pause by not buying more shares of the start-up or by switching the taskforce to another domain. Deere may also decide to shut down the information domain project or sell some of the

prospects/activities to another company, if precision farming does not show much market potential and/or is considered a niche.

To manage risk better, Deere should use the concept of real options at the product level (i.e., for each of the five distinct categories of the information domain mentioned in the case—guidance, machine control, telematics, information management, and robotics). The guidance and machine control products may have less market uncertainty. The time and cost reductions may be more evident with these products, and these products may serve more producers, at least in the short term, than the more advanced products, such as robotics. Consequently, in the short term, Deere may want to make significant investments (have a taskforce or hire a consulting company) on the guidance and machine control products and smaller investments (buy shares of electronics start-up companies) in telematics, information management, and robotics. In the medium term, one may argue that synchronized and autonomous/robotic multi-unit operations products may be technically more challenging (and therefore have more technical uncertainty) than telematics and information management products. Thus, in the medium term, Deere may want to make significant investments (have a taskforce or hire a consulting company) in telematics and information management products and smaller investments (buy shares of electronics start-up companies) in synchronized and autonomous/robotic multi-unit operations products.

It is important to realize that the concept of real options can also be applied to commercialization. In the case of Deere, the company already has a dealer network to commercialize most products. Plus, the precision farming products have the potential to be additions to its current products and could use the same distribution channel. This means not only adapting the manufacturing processes, but also training the dealers/sellers and the service technicians. Deere can provide this training or contract it out. Because precision farming requires a deep understanding of electronics, which is not usually part of a dealership's core competences, people specialized in electronics/computer/information technology will need to work with the dealership's salespeople and service teams. Nevertheless, to capture new customers, Deere may want to consider other avenues to reach them with the full products (i.e., the traditional products with the additional electronic features), as they did with Deere lawn equipment and mowers being sold at Home Depot to reach the residential audience. So, Deere

may think about options to reach the custom contractors and the not-for-profit companies without having to invest in a new sales network at least in the short term.

Options portfolio³

Beyond thinking about real options, it is also important to make sure a business considers diversification—“don’t put all your eggs in the same basket.” While the Ansoff’s product/market growth matrix is a great way to map and diversify the market uncertainty, it does not consider the technical uncertainty. The portfolio of options approach fills this gap. Given the technical and market uncertainty that surrounds almost all new projects, a real options thinking approach combined with portfolio concepts has the potential to maximize the value of new innovations, while minimizing the risk.

McGrath and MacMillan suggest that there are four basic categories of new projects when viewed from the perspective of market uncertainty and technical uncertainty (Figure 2). Positioning options create the right to wait and observe what technologies or standards will develop to serve a relatively well-defined and certain market. Advanced autotrack/guidance/headland management and variable rate seed/fertilizer/chemical application can be considered positioning options for Deere. They have high technical uncertainty, but low to medium market uncertainty as the values of those technologies is fairly easy to communicate to customers. Scouting options are focused on taking relatively well understood technologies and products to a new and not-well-understood potential customer base. Telematics and information management are examples of scouting options for Deere. Telematics and information management uses developed technologies that limits the technical uncertainty. However, the market uncertainty is high. Sales representatives may find it more difficult to convince farmers of the benefits that these technologies bring than for products such as autotrack. Alternatively, these products may service a smaller number of farmers than autotrack systems in the short term. Stepping stone options face both high technical and market uncertainty, and so should be

³ The following references are useful to help in the teaching and the discussion on options portfolio :

- Christensen, C. M., S. D. Anthony, E. A. Roth (2004). “Seeing what’s next: Using the Theories of Innovation to Predict Industry Change.” Harvard Business School Press, Boston Massachusetts.
- Christensen, C., and M. Raynor (2003). “The Innovator’s Solution.” Boston, MA: Harvard Business School Press.
- McGrath, R. G., and I.C. MacMillan. The Entrepreneurial Mindset. Boston, MA: Harvard Business School Press, 2000.

initiated with “experiments” to either gain more information as to customer wants and needs or increased capability and capacity relative to the preferred technology to respond to those needs. Synchronized and autonomous/robotic multi-unit operations are stepping stones for Deere. Requiring the use of new technologies, these products have high technical uncertainty. For the same reasons telematics and information management products, synchronized and autonomous/robotic multi-unit operations also face high market uncertainty. Launches (platform and enhancement) involve fuller commitments that can be safely made because both the technology and the customer base are reasonably well understood and less uncertain. For Deere, products such as power, tillage, and harvesting equipment represent enhancement and platform launches. Deere’s farming customer base is well understood and does not face much uncertainty. There is slightly more uncertainty for the residential, commercial, and not-for-profit customer base. Figure 2 presents the generic portfolio map. Figure 3 presents a possible portfolio map for Deere.

Figure 2. Portfolio Map

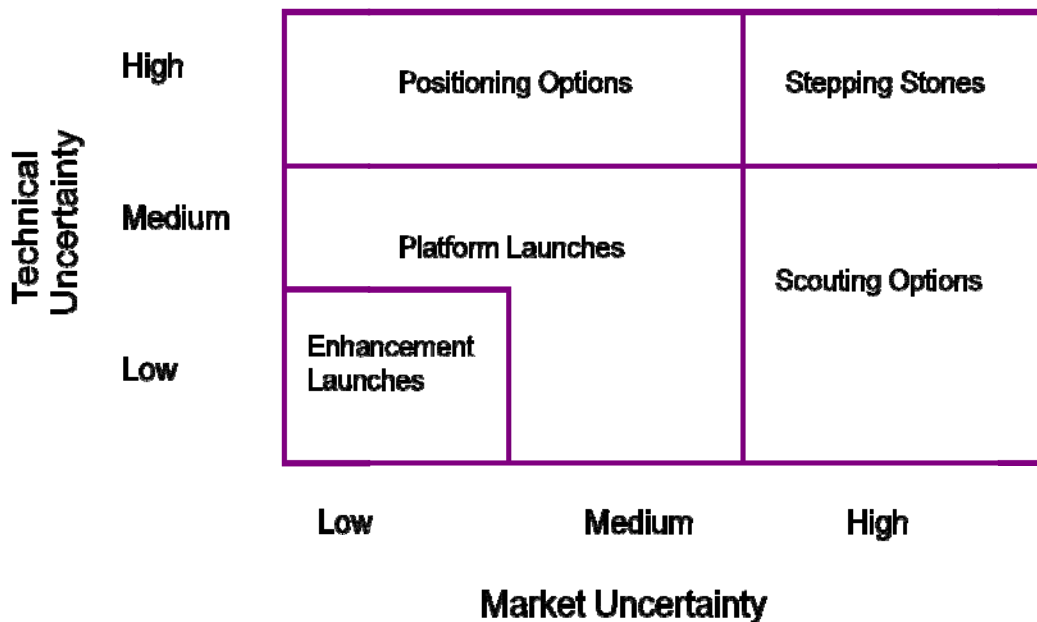


Figure 3. Deere’s Portfolio Map

Technical Uncertainty	High	Positioning Options Advanced autotrack/ guidance/headland management Variable rate seed/ fertilizer/chemical application	Stepping Stones Synchronized and autonomous/robotic multi-unit operations	
	Medium	Platform Launches Power, tillage, and harvesting equipment to residential,	Scouting Options Telematics Information management	
	Low	Enhancement Launches Power, tillage, and harvesting equipment to farmers (all sizes and enterprises)		
		Low	Medium	High
		Market Uncertainty		

To foster the development of new projects, and at the same time, to reduce the risk of new ventures, expansion funding and activities could be allocated in a portfolio context with a specified percentage of the financial and personnel budget (say 10 or 20 percent) used to initiate activities that are positioning options, stepping stones, or scouting options rather than allocating all resources to platform or enhancement launches. The basic argument is that to sustain growth through innovation and new projects, while also managing the technical and market risk associated with that growth, a company should develop and manage a portfolio of innovations and new projects using this portfolio of real options framework.

Organizational Structures⁴

Risk may also be limited or enhanced through the use of organizational structures. Students/participants can be prompted to evaluate organizational structural choices for Deere with the following instructions:

Organizational structures can also be used as a way to mitigate risk. Revisit the notion of organizational structure as a solution to manage risk by answering the following questions: Should Deere collaborate with specialty electronics companies (such as Raven, Ag Leader, etc.)? Which characteristics should Deere look for in the collaborators/partners involved in the development of new technology in these domains and what organizational structure might be used to benefit both Deere and the collaborators?

Organizational structure decisions are important to not only develop and produce the innovative product/service, but also to commercialize it or bring it to market. Different organization structures are used to accomplish different objectives and vary from non-hierarchical to highly hierarchical (i.e., from spot markets to vertical integration). With spot markets, the intensity of commitment is low. Each party engages in price discovery, whether or not to engage in the transaction, and, afterwards, whether or not to repeat the relationship with the same party. To lower the risk, Deere may decide to buy its electronic components/parts on the spot market. However, given the quality and consistency Deere requires, the spot market may be more of an option for the short term while Deere is only prototyping the products. Specification contracts allow parties to negotiate specific and detailed conditions of exchange, incentives for meeting the specifications, monitoring conditions, and renegotiation situations. A specification contract with a supplier for electronics (Raven, Ag Leader, etc.) would be a way for Deere to source components or whole products with the option to set specific features while limiting the risk. In a relation-based alliance, the involved parties share risk and benefits, identify objectives collectively, and mutually control the decision-making processes with both parties, while still retaining their separate identity.

Collaboration and partnership can both be considered examples of relation-based alliances with a collaboration being less committing than a partnership. A relation-based alliance,

⁴ Roucan-Kane, Dealing with Uncertainty in the Pursuit of Agribusiness Innovations: The Use of Organizational Structure. Ph.D. Prospectus.

be it collaboration or partnership, with a supplier of electronics would be a way for Deere to source components or whole products with the option to set specific features. Deere would be taking more risk than with a specification contract, but would also reap more benefits. Equity-based alliances include structures, such as joint ventures and partial ownership relationships. A formal organization is created with substantial investment. The organization/structure exercises control and has a board of directors that sets policies and procedures for each transaction. Deere could decide to form a separate entity with an electronic supplier to produce the components and electronic products. This kind of structure would also allow Deere to have more control over the process. Finally, to gain the most control and reap most of the benefits, Deere can decide to acquire an electronics company and produce the components and products in-house.

Which organizational structures Deere should use would be motivated by diverse considerations beside uncertainty mitigation. Deere does not currently have the knowledge and expertise in electronics, which suggests that they will have to establish an inter-firm relationship with an electronics company or acquire the company. Deere may also have to face the challenges associated with intellectual property rights. If the technology Deere needs to develop its information domain products is patented, Deere will have to acquire the patents through purchase, inter-firm relations, or acquisition. Also on the subject of property rights, Deere may be concerned about the risk of private information being leaked, which makes monitoring more cumbersome. If Deere believes the risk of leaking private information becomes high, monitoring costs may be so large that organizational integration can be justified to make sure Deere can recover its R&D investment.

Depending on how Deere's competitors react to the information domain opportunities, speed to market may or may not be an issue. If the ability to respond quickly to changes in the economic climate is critical for Deere to extract innovators' profits, then good communication systems and knowledge of the supply chain will be necessary, which require a more hierarchical structure. Furthermore, the bigger the expected payoffs, the more interested the firm is in reaping the maximum of the benefits and, therefore, the tighter the requirements on the organizational structure.

It is also worth mentioning that if the five distinct products (guidance, machine control, telematics, information management, synchronized and autonomous/robotic multi-unit

operations) do not all use the same technology, a different organizational structure may be chosen for each or some of them. While this may again be a strategy to reduce risk, this will also limit synergies.

Different organizational structures may be chosen to bring the product/service innovation to market. Deere may create inter-firm relationships with companies that have access to customers Deere is struggling to reach (e.g., the not-for-profit companies or golf course segment). For example, in 2007, John Deere acquired LESCO Inc. to reach non-customers in the professional landscaping and golf course industries.

It is also important to recognize that the choice of organizational structures may evolve over time. Deere may want to use a less committing structure (spot market, consulting company, or buying some shares of an electronics start-up company) in the early stages of the innovation process. This could also be the case in the market research and prototyping phase. If the project shows promise, Deere may want to commit more (collaboration or in-house) to have a first mover advantage and reap most of the commercialization benefits. Ultimately, the level of commitment depends on the market and technical uncertainty, the risk of opportunism, speed to market, flexibility, expected payoffs, Deere's capabilities (market, research, production, commercialization) relevant to the project at hand, and the capabilities of the potential collaborators. Consequently, the characteristics Deere should look for in their collaborators/partners involved in the development of new technology in these domains would be their capacities/skills in electronics, their property rights and/or capacity at keeping an industrial secret, their speed at prototyping or producing a product, and how they are willing to share profits.