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Vision Statements and Road-Map Methodology for Knowledge Management Adoption

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Abstract

The present paper describes the strategy of introducing future knowledge management system at farms. The FUTUREFARM and PREZEM projects strive to apply new knowledge management methods in arable farming where they guarantee an easy adaptation of the farming sector to the everchanging conditions in short, middle and long-term perspective. The knowledge management methods have to be put into practice on strategic, tactic and operational planning levels. Based on the project analysis and workshops with farmers, the paper brings an outline of the main goals and obstacles for new knowledge management methods adoption and furthermore defines the target groups and relevant methods of dealing with them.

Key words

Knowledge management, adaptation, arable farming.

Anotace

Příspěvek popisuje strategii pro zavádění budoucích systém znalostního managementu v zemědělských podnicích. Projekty FUTUREFARM a PREZEM si kladou za cíl zavést nové metody znalostního managementu do rostlinné výroby, který zajistí adaptaci zemědělství na měnící se podmínky ve světě a to jak v krátkodobém, tak i střednědobém a dlouhodobém časovém horizontu. Metody znalostního managementu musí být uplatněny na, strategické, taktické a operativní plánování na úrovni zemědělského podniku. Na základě analýz a workshopy s farmáři článek definuje hlavní cíle a překážky pro přijetí nových metod znalostního managementu, a definuje cílové skupiny a relevantní způsoby, adopce znalostního managementu.

Klíčová slova

Znalostní management, adaptace, rostlinná výroba.

Introduction

The objective of knowledge management is to help farmers in their efforts to be competitive as for product requirements, quality and quantity supplied. Furthermore, it helps them not only respond to market changes, subsidies system changes and environment protection requirements, but also react for example on increased input costs or climate changes. It is also important to produce with a perspective of long-term farm sustainability, to protect soil as the main means of farming production. Future farm knowledge management systems have to support not only the direct profitability or environment protection, but also

activities of individuals and groups allowing effective cooperation between and among agri-food industry, consumers and wider communities, especially in the rural domain. Having the above considerations in mind, the proposed vision lays foundations for meeting ambitious but achievable operational objectives; objectives that will definitely contribute to successful fulfillment of the identified needs in the long run.

Knowledge management represents an ongoing relationship between and among people, processes and technology systems involved in designing, capturing and implementing the intellectual infrastructure of an organization. Moreover, it encompasses essential changes in management attitudes, organizational behavior and policies. Knowledge management should create both values for the customer and profit for the firm. It is clear from the definition that knowledge management is one step ahead of the simple information systems concept as it entails other two significant factors: people and processes. The relationship of the latter should be ongoing, constant and variable; which is the principle of the concept of adaptive knowledge management. Economies grow, develop, and change incessantly.

Social organization of farmers' decision-making

The Future Farm study on social organization of farmers' decision-making analyzed the farming structure in different European countries and the way precision farming adoption progresses in these countries. In many European regions the precision farming was considered a current issue, but not the one enjoying an increasing interest. It was stated that political will and support to these technologies is not really demonstrated yet and therefore their potential is not exploited fully.

In Germany, the Czech Republic and Denmark several site specific technologies have been already put into practice. However, in other countries, such as Greece for instance, small farm size and financial constraints together with a generally lower level of agricultural education hamper the adoption of precision farming.

It was also recognized that agricultural technology firms and private consultants are considered as the main driving force for precision farming adoption. Interviewees pictured that a typical Precision Farming farm is usually larger in size and run by relatively young and highly skilled managers. The role of consultants is important as for site specific crop management where they could be regarded as intermediators or partners, facing though high expectations and pressure. European farmers still prefer to communicate directly over phone instead of using emails, but web pages play an increasingly important role. Farm data is considered commercially sensitive and farmers keep on preferring personal and face-to-face contact with their consultants.

While the communication between farmers and authorities is expected to shift towards online electronic methods within the next ten years in Germany and Denmark, this process has already been partly set up in the Czech Republic and is supposed to be rather slower in Greece.

Joint investment in PF equipment was reported by a few experts and only in case of smaller farms. In general, farmers and contractors prefer to own their machinery. It was considered quite common that farmers operate as contractors themselves to run their machines up to full capacity. Contractors usually use modern technology and they are able to employ specialized and skilled staff thanks to the scale effects. There is a tendency towards offering field services and consultancy at the same time. Site specific tools can be used to document the contractors' performance on the field. Farmers remain land owners and decision makers regarding crops. The Precision Farming industry will have to face increasing contractor requirements concerning compatibility and software solutions for data management.

Non-compatibility of solutions constitutes a significant problem as it has forced customers to purchase solely products of one single provider. Compatibility problems have delayed the adoption of site specific crop management and can still be considered as the most important barrier to investment. We therefore assume that as soon as the Precision Farming technology works trouble-free and economic benefits can be clearly demonstrated according to the kind of client (cooperative, farm, contractor etc.) the technology will develop and spread similarly to mobile phones and become a common standard.

Farmers do not search for hyper-mechanization. Their premise is to register and administer the useful and to report the inevitable. Precision Farming is adopted when economic reasons such as high input prices or environmental regulations are favourable and/or certain barriers are removed. Introduction of site specific technology also happens by evolutionary replacement of old machinery while new machinery is increasingly equipped with site specific on-board technologies. Integrative and easy to handle solutions are needed. Critical discussion on possible ecological benefits of the PF and its practicability should be deepened and intensified.

SMEs environment and culture

As for the number of employees, farms usually belong to small or medium size businesses within the framework of which the knowledge management and internal processes are obviously different from the large ones. Employers need to integrate many heterogeneous skills, such as for example gathering up-to-date information on market tendencies, innovations and new competitor product developments from close contacts with customers. On one hand, SMEs environment can facilitate knowledge management but there are also factors that impede its successful implementation. SMEs managers have a limited amount of time to deal with knowledge management and they are restricted to day-to-day activities that are vital for the survival of their businesses. Systems and procedures are not formalized, restraining the adoption and insertion of a formalized knowledge management system. Moreover, staff is inadequately qualified for the operation of information systems and needs further training, which is a time-consuming and costly option. On the other hand, knowledge management can improve decision-making, learning, innovation, efficiency, competency and value creation. That is why farming should reconsider long-term advantages of adopting such a system and invest more time and funds in this direction. In addition, the tacitness of farmers' know-how is another characteristics to be treated carefully. Tacit is the knowledge that cannot be verbalized and stems from personal experience, insight, beliefs and values. It remains in people’s mind and should be externalized in order to add value. Explicit knowledge on the other hand can be articulated and is usually stored in databases.

Mission of service organizations

The study provided by Ganicky on the crucial question of precision farming adoption, i.e. on when the precision farming is or could be profitable. It is however difficult to answer this question by any published profitability review as there are

- incompatible approaches to economic analyses

- costs often overlooked

- benefits with ill-defined values

Economic analyses may focus on short and/or long term. Short-term evaluations require that immediate improvements from Precision Farming provide sufficient revenue to cover all costs of its adoption. Long-term evaluations allow returns to occur at various magnitudes over a given period. For instance, a long-term evaluation may reveal that the initial few years of Precision Farming adoption generate little or no additional revenue, but in later years, the sequential accumulation of knowledge and improvement in management can lead to significant returns. Both types of the above analyses are needed to address various financial requirements and objectives of farmers. There are still many difficulties in providing a complete accounting of costs and benefits, so economic analyses can vary considerably in their completeness and conclusions.

Is the PF more profitable than traditional farming? That is a key question. There exist a lot of studies dealing with Precision Farming economy. None of these studies attempted or considered the environmental costs and benefits of precise placement and reduced use of agricultural chemicals. Pollution from farm chemicals to the environment does not yet have a significant cost directly charged to the farmer.

In order to illustrate the costs and investments of transition from traditional to Precision Farming, let's analyze the effectiveness and indispensability of these investments. Economically effective management of within-field variability means - in other words - that a well-trained farm manager makes correct decisions based on complex information and that these decisions are precisely

implemented. As far as the investments are concerned, financial requirements are as follows:

1. The role of management in Precision Farming is crucial and therefore investment into education and training of farm management cannot be avoided. This investment into human capital belongs to fixed costs.

2. High quality information is the basis of effective management. Therefore initial investments into boundary mapping, soil sampling, management zones identification, GIS mapping etc. are also inevitable. These investments should be viewed as durable and their costs should be amortized as a fixed cost over a number of years.

3. Implementing farm management decisions in fact means to cultivate fields. All costs of this type are considered to be variable and are inevitable.

4. To operate fields, appropriate Variable Rate Technologies (VRT) and other technologies such as e.g. a GPS-receiver, yield monitor, computer, GIS and other software, VRT application equipment etc. are required. All this equipment makes part of a durable capital investment. Furthermore, there are other fixed costs such as depreciation, interest on investment, insurance costs associated with durable capital (that means the above-mentioned equipment). These investments are however evitable.

The investments and fixed costs associated with purchasing VRT application farm equipment usually constitute a substantial part of all investments made and costs encountered by a farmer when adopting Precision Farming.

However, when do all these investments become effective? Farm equipment such as a yield monitor, VRT application equipment such as a VRT fertilizer spreader, VRT herbicides/pesticides sprayer etc. can operate specified field area size per season – let us call it the Duty Cycle (DC). As soon as the field area size is smaller than the DC, a farmer can never capitalize on the VRT equipment purchased. Thus, part of the investment and part of the fixed costs such as depreciation, interest on investment and insurance costs are a mere waste of money. In other cases, financial requirements of adopting VRT may cause financial difficulties to a farmer.

In any case, effective use of PF management may require development of the knowledge base, experience and accumulating information about fields and their productivity over several years.

In all above-mentioned cases, a farmer may decide to hire the VRT equipment, yield monitor and other technology (e.g. a GPS) together with the consulting services of specialized firms. As a rule, these firms are better equipped with modern VRT machines while having at the same time highly qualified specialists and offering full service (for example GPS field boundary mapping, soil sampling and management, zone establishing, fertilizer recommendation, fertilizer prescription and VRT application). Such operating leases are offered on a variable cost basis – i.e. priced per hectare or per day of operation. For smaller farms, and in any case for a novice to PF management, this way of operating fields is both an optimal and least expensive option.

Outsourcing is a model that can bring farmers fixed cost reduction and PF profitability at the same time. Farmers purchase services from a service organization and as a result, fixed costs are turned into variable costs. Technology on the part of a service organization is used for a longer period and more effectively and thus the cost of the process is reduced. And this is in a nutshell the principle on which the Future Farm business model is based.

Overview of strategies for implementing and adopting adaptive knowledge management

Adaptation means that farms should be in the position to get changed and respond effectively to new situations faced. Innovation is the key to that direction and can provide a sustainable advantage. Close relationships maintained between customers and SMEs give insights to market tendencies, new product developments, competitors' way of doing things so new ideas and propositions are coming to the organization that can change the structure, orientation and strategy. Innovation derives from the combination of previous and new incoming knowledge. In order to achieve it, farms can capture and store previous knowledge through keeping records, archiving short reports concerning work processes and procedures written by the employees and though creating small databases. The reports

can take the form of case studies on project problems, trouble shooting, the lessons learned and the best practices. So, farm employees can help in knowledge storage by developing guidelines, best practices, expertise notes, work flow charts etc. that will be easily accessible as accumulated wisdom in future projects (Hasgall and Shoham 2008). As a result, strong organizational memory will be created, having the infrastructure to acquire and record previous experience, exploit it and integrate it with new knowledge, the stage where innovation process has been successful. However, a vast majority of information is irrelevant to organizational needs - that is why farms should establish a feedback system in order to measure the relativity, relevance and importance of information. The greater the information diversity is, the higher the chance to extract new knowledge. Organizations accomplish it through creative thinking, past experience reflection and combination of knowledge from different fields. The capture of expertise, knowledge assets reuse and assets tagging are the prime mover of the innovation process and allow the firm to respond to change (Sherif and Xing 2006, Taminiau at al. 2009).

Information availability and accessibility are another concern to be taken into account by the farms. The introduction of intranet and information technologies enables successful knowledge sharing implementation. Links to discussion forums and interest groups facilitate the exchange of ideas between and among people living in different regions and countries. People sharing their interests can join chat rooms, whiteboards, instant messaging services, shared calendars etc. to discuss, give and take responses on their topic of interest. This method simplifies the solution discovery process, shortens the time spent and broadens employees' perspective as different opinions are heard and new explicit knowledge is created by combining previous and new knowledge.

Adaptive systems require a decentralized power system where employees will be given the prerogative to act quite independently and not under a constant restriction of the power units within the firm. Namely, employees are free to express their ideas, follow the paths of their own imagination and constructive thinking, take initiatives and explore new ideas. In such a system the hierarchy of power does not restrict or interfere with the development of personal interests. Therefore, such a system should empower employees' abilities and their access to resources and ensure the parallel achievement of organizational goals, needs, abilities and use of available technology within the firm. Furthermore, knowledge sphere can be renewed and updated constantly in order to create value for the firm. Computerized information systems might offer a critical tool for updated information sources such as documents, experts and sources from out of the organization (Wong and Aspinwall 2005, Ang and Massingham 2007).

Training opens the way for constant updating, capture and sharing of skills. Usually, businesses do not take advantage of the knowledge accumulated in older people. On the contrary, older people do not get good treatment from employers who are seeking to replace them with new young employees who are eager to learn, work hard and maybe are better trained according to market trends, new technologies and organizational needs.

As a result, adaptive knowledge management systems require flexible practices that can be adjusted to each case and circumstance according to the availability of resources given to the farms. Innovation is not completely independent and can be influenced when designing and controlling the right environment within the firm. Implementing a communication-friendly culture and ideas sharing atmosphere will ultimately lead to desired outcomes and performance.

Prague workshop discussion

A validation workshop called "Strategies of Knowledge Management Adoption" was held within the framework of the Information Systems in Agriculture and Forestry 2010 conference in Prague.

It was concluded that knowledge management in agriculture production is adopted on many different levels as for using IT and professional services supported by universities or service organizations (either through government or private sector). Precision Farming plays an important role in this adoption process. Farmers involved in precision farming technologies are more flexible to work with computers or use high level technology in crop production, animal production or farm management.

Every farmer is seeking to increase productivity, yield in crop production and to maintain a good quality of production. However, the conditions on the field are not homogeneous! Precision farming system monitors the farm condition using the GPS system for crop production. Then, according to the data analysis a variable rate application for a specific place in time is prepared. Farmers monitor the conditions by data collection and analysis, then prepare fertilizer at variable rate and apply it in accordance with soil conditions, nutrient content in the soil and crop needs.

The description of Knowledge Management – step by step adoption of precision farming tools at a farm:

- Farmers who expect to profit from all the above-mentioned objects have to make up their mind on which one is the most feasible for their farms.

- Farmers do not have to make a substantial investment in the first year and then depreciate part by part every year their investment and wait for results.

- Precision farming tools can be adopted during a period of three to five years, but first results have to be seen even in the first year of its adoption.

Nowadays, many precision farming tools and IT systems exist. A farm central database must be established in order to archive different pieces of information that are processed and used in the decision-making process. Practically, farmers use computers not only for calculation or managing some work processes, but as well to seek important information on the Internet - web services.

The most important discussion notes are as follows:

- many farmers are skeptic to farm KM via information technology

- farmer's point of view: make investments into machinery rather than into KM

- first goal of farmers – farm stability using common tools rather than new technologies

- generation change, survival game

- profit rate, Which rate of profit growth is interesting?

- crop rotation - crop focus on market needs

- different regions, finding right segments for farm development

- different production, different KM (food, energy and bio-fuel, sport- culture), definition and focus

- efficiency of bio-mass energy, newly developed tools and technologies with higher profitability

- living style of farm owners and family farms

- different nature of farmers in the US and in Europe, significant difference in profit approach and creation

- taxes on fertilizers and chemicals in different locations, government stimulation and incentives to use KM at farms

- service people expect pressure from state administration, goods import and exports terms and condition, restrictions etc.

- computer user design, simple use of IT, touch screens, wireless data transport, web support communication.

An open and receptive culture where farmers will be willing to share ideas, experience and new knowledge in an open dialogue and to socialize at the same time must be inspired, motivated and taken care of by managers and leaders. The change of culture must be attached to incentives that will be offered to those adopting and implementing knowledge sharing. This can take the form of a salary increase or providing some other facilities the employees may require. Moreover, a culture which accepts the possibility of making a mistake instead of the safe and ordinary way of doing things must be enforced as it leads to innovation through experimentation.

Individual farmers could come up with knowledge through observation of their own farms where employees can be also asked to write small reports about their project in order to keep records of the progress made and creating a small and cost-effective database in this way. Information availability and accessibility through networking, journals and conference proceedings, databases etc. is a must. On the farm level, training that would include visits to competitors to see their procedures,

job rotation, induction or tutorial (experienced employees induce apprentices or trainees) has to be supported. Managers have to participate in discussion forums and interest groups. It is necessary to organize experience swapping sessions, conferences, exhibitions, seminars with external speakers and to distribute the results of them and also, to organize informal meetings or lunchtimes. It is as well important to involve advisors, innovation centers and have close relationships with universities. The role of journals, informal interviews, conference proceedings etc. is undoubtedly vital in knowledge capture and sharing.

Based on both previous experience and workshop discussion, it is obvious that knowledge management adoption will not be the same on a global or European scale and it goes without saying that not all farms will adopt the KM methods immediately. There are differences among the individual countries, but also inside the countries as such.

Criteria to be considered for the adoption strategy:

- economic criteria – given by the structure of the farming sector (scale, products)

- social and demographic criteria (age and education of farmers)

- cultural criteria – different farming tradition in individual countries

All these aspects have to be included into the Future Farm roadmap. According to the FMIS target market, there exist two ways of solution implementation, each of them having different strategy:

- deliver software as a final product

- offer knowledge management services (Software as a Service – SaaS), not the product itself

Experience acquired in different countries shows that both ways are viable while considering and adopting different strategies.

Roadmap for Future Farming adoption

The roadmap for adoption is about identifying key stakeholders of the project, assessing their interests and power, and planning appropriate forms of engagement with these groups. The analysis aims at defining relationship with different stakeholders and communication strategy for the single groups. This strategy is defined firstly for adopting the ICT platform for knowledge management and secondly as an adoption of KM services.

Platform adoption strategy

Stakeholder	The aim of the relationship	Plans to Communicate
Farmer association, consultants and service organisation	The three groups are the most important partners for platform adoption as the whole. They can attract individual farmers to use the service they provide. These groups constitute potential platform customers.	Direct communication and demonstration is necessary. Exhibition and other similar events are important for establishing and building personal relationships. This has to be combined with standard communication using the existing channels such as the Internet (eventually social networks), newspapers, magazines, TV, radio. The uttermost priority is to establish personal contacts and provide personal demonstration.
Agriculture technology producers Food business	The food business, but also technologies providers and software developers could be potentially good partners. The biggest problem is that all three groups have provided substantial investments into the development of their own platform. It means they will consider	It is necessary to analyze in detail the systems they currently use and to offer complementary components to their services at the beginning. Direct communication and demonstration is necessary taking the form of exhibition and

Agriculture software producers	the future farm solution as a competitive product/system. The only chance is to explain them advantages arising from joining the future farm solution.	conferences.
Big industrially managed farms, smaller young farmers, universities	These three groups will be highly interested in the system, but their potential for direct platform deployment is quite limited. (However, there is an expectation, for example from WIMEX that started the AgroSat company.)	The communication has to be provided through standard communication tools and using the existing communication channels such as the Internet (eventually social networks), newspapers, magazines, TV, radio.
Small older farmers	The potential of this group as for deploying the platform is almost none.	No specific action required

Table 1.

Adoption of knowledge services strategy

Stakeholder	The aim of the relationship	Plans to Communicate
Young small farmers Large industrial farms Farmers association Consultants Service organizations	These are the most important groups for FF services adoption. These services have to be offered in the form Software as a Service. It means they will use future farm platform provided by FF team members.	Direct communication and demonstration is necessary. Exhibition and other similar events are important for establishing and building personal relationships. This has to be combined with standard communication using the existing channels such as the Internet (eventually social networks), newspapers, magazines, TV, radio. The uttermost priority is to establish personal contacts and provide personal demonstration.
Food business	Key player on the market that can profit from the Future Farm system. Previous investment into their own platform and low willingness to use external systems are a real problem.	It is necessary to analyze in detail the systems they currently use and to offer complementary components to their services at the beginning. Direct communication and demonstration is necessary taking the form of exhibition and conferences.
Service organizations	Service organizations could be system providers that will introduce the system in regions. The strategy based on selling services can introduce the system without any big investments.	Direct communication and demonstration is necessary. The communication has to be provided mainly through service organizations.
Universities	Universities could use the FF system for educational and research purposes, but they can also offer their consultancy through it. The strategy	Direct communication and demonstration is necessary mainly using the Internet and social networks.

	based on selling services can introduce the system without any big investments.	
Small older farmers	Low potential market, difficult to attract this user group to FF services.	Exhibition

Table 2.

Implementation Strategy

As we have already mentioned earlier, the system is focused on offering services – a strategy with a high market success potential.

Firstly, offering services to final users – farmers - through partner service organizations.

Secondly, finding new partners - potential service providers. The strategy is mainly to offer services under the form of Software as a Service (see above). The profit is normally generated from the services on the basis of costs per hectare payment.

An alternative strategy will be to search for a bigger potential seller of the system (machinery producers, software developers). Chances to succeed on this market are lower, but on the other hand, there exist a potential for different kinds of disclosure or non-disclosure agreements.

Conclusion

Basic strategy of increasing fast the precision farming position and knowledge based system is to offer mostly the services that can attract more local providers, because the initial investment will not be necessary. On the other, this strategy also enables entering new markets quite cost free, without any investment.

At first, the services have to be offered in regions by single project partners as it is obviously difficult to attract the global market immediately.

The market position can be rapidly built and improved by and through

- strategic partnership with food business

- strategic partnership with machinery producers

- strategic partnership with software producers

Main potential threats arising from team cooperation:

- - clash of interests in the team
- - insufficient economic power to grow
- - competitors can copy our solution

Successful implementation of the afore-mentioned strategy requires the following:

- team cooperation on future implementation strategy
- clearly defined spheres of interest
- establishing member management board
- regular checks upon the indicative numbers, comparison with reality and implementing relevant changes in time
- looking for strategic partners

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