VISION OF FARM OF TOMOROV

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ABSTRACT

This paper defines vision of farm of tomorrow and adoption of knowledge management system in the farm, which still has to be designed and developed by common Farms and also farms of the future. The main focus of this vision is on integration among different levels of farm management systems and on requirements designed from analyzes of external drivers, which will have in the future a big influence on farm production, using knowledge management and direction on future agriculture development in crop production. The report defines thee levels of farm management. The proposes architecture is based on communication of interoperable services, so called Service Oriented Architecture (SOA) for easy integration of different levels and components of farm management. The most important decision has to be provided by decision supporting system on farm level.

Keywords: Vision, Service Oriented Architecture, external drivers, knowledge management

INTRODUCTION

In order to build vision for future knowledge management in arable farming, there were analysed examples of existing knowledge management systems and also drivers, which will have in future potential influence on farming sector. The objective of knowledge management is to help farmers to be competitive on the market in the sense of required products, quality and amount, to be to able react on changes on the market, changes in subsidies systems, requirements about environment protection, but also to be able to react for example on increase cost of inputs or on climatically changes. It is also important to produce with long term sustainability of the farm, to protect soil as main mean of farming production. Within the Future Farm project a trans-European investigation has led to the definition of the key objectives needed to realise this vision of a new concept of farming knowledge management respecting changing conditions and demands.

As a result privies analysis we can recognise next groups of drivers, which will have influence on farm management and which could also eventually stimulate new demand on knowledge management:

- Climate changes
- Demographic (Growing population, Urbanisation and land abandonment)
- Energy cost
- New demands on quality of food (Food quality and safety,
- Aging population and health problems Ethnical and cultural changes)
- Innovative drivers (Knowledge based bio economy, Research and development, Information and communication, Education, Investment)
- Policies (Subsidies, Standardisation and regulation, National strategies for rural development)
- Economy (Economical instruments, Partnerships, Cooperation and Integration and voluntary agreements)
- Sustainability and environmental issue (Valuation of ecological performances, Development of sustainable agriculture)
- Public opinion (Press, International Organisation, Politicians)

The results of analysis of using and adoption level of Knowledge management on the farms are division of knowledge managements systems divided into three levels:

- Macro level, which includes management of external information, for example about market, subsidies system, weather prediction, global market and traceability systems, etc)
- Farm level, which include for example economical systems, crop rotation, decision supporting system
- Field level including precision farming, collection of information about traceability and in the future also robotics.

Future farm knowledge management systems have to support not only direct profitability of farms or environment protection, but also activities of individuals and groups allowing effective collaboration among groups in agri-food industry, consumers and wider communities, especially in rural domain. Having these considerations in mind, the proposed vision lays the foundation for meeting ambitious but achievable operational objectives that will definitively contribute to fulfil identified needs in the long run.

From the level of cooperation or collaboration requirements, the knowledge management systems could be split also in two groups:

- groups of individual farmers that cooperate and share machines or also worker - like e.g. organized with the help of cooperatives as there are machine cooperatives
- the chain itself - farmers chain management has to be organized also with the help of IT in the future. The farmers, the partner of farmers organized within cooperatives, that partner of the farmers who deliver input to the farm and such that buy products from the farmers have information needs that have to be covered by chain management structures. Farmers have

today document lots of information to different stakeholders of the market as follow:

- Ministries for subsidies or government bodies for several other tasks,
- Buyers of food products from the farm need to get documents to allow them to follow the farm-to fork legislation;
- it is expected that in the near future (2010) farm produced biomass has also to have for reasons of sustainability to document information to the biomass industry.

The farmer has to have either if able to handle easy to use tools that allow with a few clicks to solve all these problems or he gets support by new models of farm advisory systems that are able to solve his needs. The existing extension services are only partly able to keep updated with the farmers common needs.

The vision is mainly focused upon new knowledge management for arable farming, which is the main objective of Future Farm project. Having all of the main industry players involved is critical. Achieving the ambitious goals will require an equal commitment from all partners.

1. RATIONALE

The agriculture sector is a unique sector due to its strategic importance for both European citizens (consumers) and European economy (regional and global) which, ideally, should make the whole sector a network of interacting organisations. Rural areas are of particular importance with respect to the agri-food sector and should be specifically addressed within this scope. As in no other sector there is an increasing tension between the requirements to assure full safety and keep costs under control, but also assure the long-term strategic interests of Europe and worldwide. The balance between food safety and food security will be important task for future farming worldwide, but also for farming knowledge management. Complexity arises both with regard to the production itself, taking into account its diversity and perishable nature of food products, which is much higher than in many other sectors, and the very nature of the sectored networks. Knowledge management systems for generation of homogeneous information for traceability transfer and business as well as integration and management of such information are thus specifically complex issues in this sector. Therefore, the challenging problem is twofold. Firstly, how to assure the full security and safety of products but minimising costs. Secondly, how to provide benefit to the food sector networks of organisations enabling them to interoperate, to exchange information and data and to fully integrate miscellaneous business functions along the value chain. These problems (partly valid for a number of other sectors) are increasingly becoming critical and difficult in the Agri-food sector (due to complexity of full traceability and minimal margins).

The farming sector doesn’t play only role of food producers, but there are also other tasks or challenges of farming sector. The most controversial issue

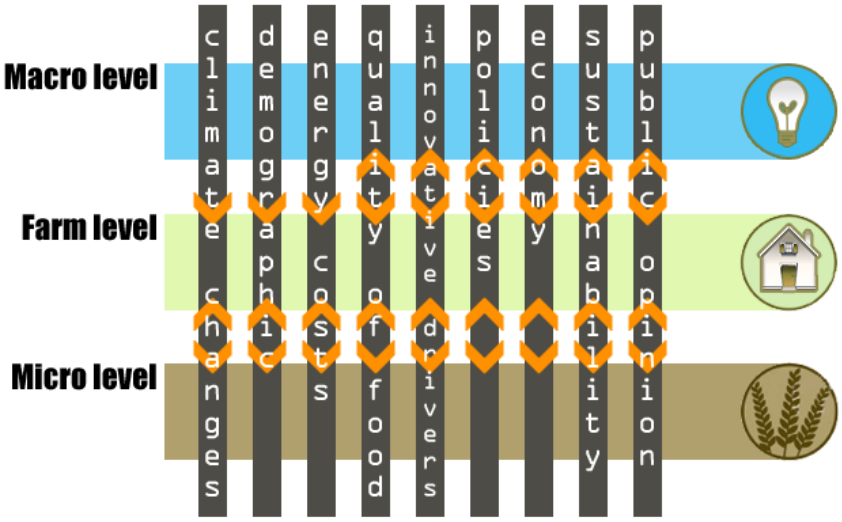
in last couple years is bio energy production. The experiences from last year open many new questions about bio energy production, ant it is clear, that current methods of bio energy production are not able to guarantee long time sustainability of food production. There are clear requirements for innovation and mainly new development in knowledge base bio economy.

Other important aspects of farm decision are, if it will be better for farm to be oriented on food or non food production or on non production farming activities as agro tourism.

Important question id also environmental role of farming. The farming cold positively or negatively influenced landscape, but, there is also influence on water protection, soil protection and on CO2 production. This all are interest not only of farmers, but all society. So there are important, who will pay this costs, and how it will be valorised to farmers.

2. DEMANDS FOR FARM KM SYSTEM FROM EXTERNAL DRIVERS IN FUTURE

For suggestion of future knowledge management system functionalities and interrelation is necessary consider previous analysis. The basic principles of interrelation could be expressed by next image



If this scheme will be studied deeply, we can expected next transfer of knowledge:

Climate changes

- Macro to level – Global trends in long and short time
- Farm to Micro level – regional forecast, decision about crops, application of pesticide, herbicide, fertilisation
- Micro –to farm level – local forecast, local changes, alert situation

Demographic

- Macro to farm level – changes in demand on amount of food
- Farm to Micro level – selected methodology of production

- Micro to farm level – yield monitoring

Energy cost

- Macro to farm level – cost of energy, demand on bio energy
- Farm to Micro level – selected crops, selected methodology of production
- Micro to farm level – yield monitoring

Quality of food

- Macro to farm level – prices, demand on quality
- Farm to Micro level – selected crops, selected methodology of production
- Micro to farm level – yield monitoring, traceability
- Farm level to Macro - traceability

Innovation

- Macro to farm level – new crops, new methods of work
- Farm level to micro - new crops, new methods of work
- Micro to farm level– data for research analysis
- Farm to macro level - data for research analysis

Policies

- Macro to farm level – regulation, subsidies
- Farm level to micro - selected crops, selected methodology of production
- Micro to farm level– traceability, evidence for subsidies
- Farm to macro level – traceability, evidence for subsidies

Sustainability and environment

- Macro to farm level – regulation, valorisation
- Farm level to micro - selected crops, selected methodology of production
- Micro to farm level– traceability
- Farm to macro level - traceability, evidence for subsidies

Public opinion

- Macro to farm level – changes in public opinion, public requirement
- Farm level to micro - selected methodology of production
- Micro to farm level– traceability
- Farm to macro level - traceability

3. TRAINING ACTIVITIES, DISSEMINATION AND TECHNOLOGY TRANSFER

Dissemination, in order to address the wide rural community, specific dissemination campaigns will be needed addressing Future Farm solution. Creating awareness and showing benefits of the implementation of selected activities will have to be designed customised to the very nature of the target audience.

Training, an important task for the next years will be the training rural population to be able to adopt new technologies in rural areas. In addition to

ICTs, special attention needs to be paid to the training of farmers will answer to an increasing demand for new fading methods It is necessary the support from all agents involved, to provide the infrastructures and technical support required. The overall development of local human capital will improve the conditions for farming.

Encouraging the **ICT take-up,** a development of the take up activities will be of key relevance in this specific domain taking into consideration the mirror effect such projects will generate profit in the whole sector.

Further implement **technology transfer from pilots.** Economies of scale can be achieved through ICT initiatives combining IT equipment, networking and e-skills training through community structures. Such initiatives can greatly facilitate IT take-up by local farms. Technology transfer means that pilot structures have to be set up where the different stakeholders of the market take part and get demonstrated their benefits. An integrated solution will benefit several stakeholders of the complex farm-food/biomass-consumer chain where beside this also ecological requirements have to be fulfilled, in the future much more than in the past because alone a growing population from 1 Bio (1850) to 10 Bio (2060) people means that we have only 10% of the earth available per head and with 10 (5+5) Bio hectare on the world this is only 1 hectare per head. Not to much to allow failures.

As indicated above the **Experience Research** already taken up for an early user involvement has to be continued regarding Future Farm topics. This means that the strong involvement of the end users is of key importance for the Future Farm objectives related to this area.

Active participation in IT related standardisation activities will also be necessary in terms of facilitating that work related to standards do comply with the users long term requirements. Here, having the input of rural users to future standards and regulations will facilitate a faster take up of ICTs

4. VISION OF FARM OF TOMORROW

It is expected, that process of WTA negotiation will be closed during this period and there will be defined common agreement about free market with food and agriculture product and about subsidies systems. Also in year 2013 is expected to bring a CAP reform, where new regulations will be introduced. But both of these facts will not have direct influencing on farming till 2013.

Currently the aim of the CAP is to provide farmers with a reasonable standard of living, to provide consumers with quality food at fair prices and to preserve rural heritage. To enable an average midsized European farmer to compete on the world market in a populated region with a high demand on the environment and on environmental products, these products have to be evaluated and must become part of the farmer’s income. Until 2013, a revision of currently used economical instruments for managing agriculture production is expected. All this processes, which are necessary, could be delayed by current economical crises for two or three years, but in principle has to start. But for vision of farm of 2013 is necessary to consider current regulation of rural development policy for 2007 to 2013 is focused on three themes. These are:

- improving the competitiveness of the agricultural and forestry sector;
- improving the environment and the countryside;
- improving the quality of life in rural areas and encouraging diversification of the rural economy.

The process of diversification of farm will continue and generally we can define three types of farms, which will dominate to European Agriculture:

- Multifunctional farms
- Large scale industrial farms production of food or energy
- Farms with focus on specific production like bio production or production of foods for specific groups of consumers

By 2020, current food production methods will be unable to meet the worldwide food and energy demands of the growing world population and it will also have influence of European farming sector. Food security will be a problem as larger parts of the world populations will start consuming at present developed countries' levels. We can't afford unsustainable production with a growing human population. Food demand increases requirements for better utilisation results of research and for new management methods. Combined with advanced bioprocess engineering the development of high performance crop plants is the key to this vision becoming reality. Crops will serve as factories for enzymes, amino acids, pharmaceuticals, polymers and fibres, and will be used as renewable industrial feedstock to produce bio-fuels, biopolymers and chemicals. Green biotechnology will be employed since conventional or smart breeding alone will probably not be able to provide the required increase in performance. It is anticipated that already by 2020, in addition to the then mature gasification technologies, the conversion of ligno-cellulosic biomass by enzymatic hydrolysis will be standard technology opening up access to large feedstock supplies for bioprocesses and the production of transport fuels.

Research breakthrough in the second generation of bio-fuels derived from lignocellulosic material will make bio-fuels production more competitive and without using food material. The medium term influence will be to have food products with higher nutritional values, reduced chemical contamination and more advanced traceability systems. In this period, the average age of populations will continuously grow. This generation will be more active than previous senior generations and will require specific diets. It is expected, that the percentage of ethnic groups in Europe and US will increase. They will have an influence on specific requirements of agriculture and food production. Investments in high-value crops, high quality food products and new technologies in crop production will be the case in the medium term. In the medium term the need for more food and for energy from crops due to the high prices of fuel will also boost R&D in Europe and worldwide.

Diversification of three basic types of farm from previous period will continue and differences mainly between first two types will be deeper. In some way, there will continue diversification inside of third group and both directions will in some way converged to first two groups. Principles of ambient mobile intelligence will be adopted by farming sector to guarantee

effective management of production but also traceability. Agriculture will require highly educated staff.

Global food production must grow by 50 per cent by 2030 to meet the increasing demand of a growing population. Massive efforts are required to maintain fertile cropland. Demand for animal protein may increase, triggering massive investments into genetically modified food, aquaculture, and stem cells for meat production without growing the animal. Seawater agriculture on desert coastlines could produce bio-fuels, pulp for the paper industry, and food for humans and animal bio-fuels, while absorbing carbon and reducing the drain on fresh water. In the biggest part of Europe urbanization and land abandonment will result in more concentrated production in the urbanised areas and reduction of the production in less favourite areas. A long term strategy is necessary to solve the impacts of raising energy prices like increasing field areas or increasing production of bio-energy from agriculture.

The net benefits of climatic long-term, however are less certain. Particularly in lower areas, droughts and desertification will create significant social challenges in some of the world's poorest economies. Areas such as Siberia, Scandinavia and Canada will profit from global warming.

The key issue will be also food quality. Long term influence will be on the intensive use of traceability systems in the food supply chain and this will be compulsory to all farmers producing food stuff and to the retailers. The focus on aging population and health will be a major requirement of food production. There will be important shift in composition of production in direction of vegetable, fruits, fish, chicken, etc. The percentage of ethnic groups will grow further. Around 2030, ethnic groups could comprise a major portion of the European population. This will influence food and agriculture production. There will be complete change of economical instruments, which will influence production. The main focus will be on removing distortion of the market but support healthy and environmental friendly production and support worldwide food security. In the long term, partnership agreements will be more 'mainstream', where local industries will be closely connected to the region and farmers will directly sell their products to them securing prices disposal of their production. Agricultural production will be horizontally and vertically integrated.

Biotechnology will be an important pillar of Europe's economy by 2030, indispensable to sustainable economic growth, employment, energy supply and to maintaining the standard of living. It will be increasingly used in labour-intensive sectors, e.g. industrial processing, pharmaceuticals, agriculture and food. The increasing demand of energy will keep prices high and support the demand for bio-fuels. Therefore investment interest will continue. In this period, if the oil reserves estimation is correct, it is expected that some oil reserves will be depleted and this will worsen the supply of energy. Thus energy prices will increase and investment in Renewable Energy Sources and biomass produced by the farms will be enhanced. New dimension of farms will also take place, such as pharmaceutical crops, industrial crops as well as high quality and safety food. Research in agriculture for new and advanced agricultural commodities will be needed to keep raw material supply at low cost. The trends of the previous period will be maintained and funds

will be available for research in the sector. If the climatic change scenarios are verified, strict measures have to be adopted. This will be an important driver for farms to change practices and management to more environmental friendly direction. A worldwide valuation of ecological performances with rules like "who has to pay how much for whom", taking into consideration the impact of environmental caretaking for local, regional, national, continental or worldwide influence.

Efforts to enhance the environmental performance of agriculture will play important role. Social and political pressures for increased environmental standards are expected. Resulting policy tools, whether positive (subsidy based) or negative (penalty based), if substantial enough, could play a major role in shaping future agriculture. On the other hand, the cost of dealing comprehensively with the above set of environmental issues would be many times greater than the public funds currently available through the main policy programs. It may be that public funds continue to play a marginal role in protecting or enhancing the rural environment. No dramatic increase in environmental regulation governing agriculture is expected.

It could be expected, that due the requirements on quality of production and also on environmental friendly production on one side and on second side in increasing demand on high quality food, vegetable and fruits and also grooving demand on special production, the convergence of two types of farms to two main groups will continue and in final stage we will have two basic types of farms:

- Multifunctional farms
- Industrial farms with focus on high efficiency and high quality of production

CONCLUSION

The recommendation for Future Farm project is usage of the Service Oriented Architecture (SOA), which provides methods for systems development and integration where systems group functionality around business processes and package these as interoperable services. An SOA infrastructure allows different applications to exchange data with one another as they participate in business processes. Service-orientation aims at a loose coupling of services with operating systems, programming languages and other technologies which underlie applications. SOA separates functions into distinct units, or services], which developers make accessible over a network in order that users can combine and reuse them in the production of business applications. These services communicate with each other by passing data from one service to another, or by coordinating an activity between two or more services. In future farm is recommendation to used SOA for integration of the Software (SW) tools and web services and implements an idea of Open Agriculture Service (OAS). The integration and communication among the independent components of the system is based on the implementation of the Open Standards defined mainly by the World Wide Web Consortium (W3C), Open Geospatial Consortium (OGC) and Organization for the Advancement of Structured Information Standards (OASIS).

This choice provides the capability of easy access to the individual services exposed by any domain specific application wishing to participate in the knowledge management system. The framework also helps to easily provide the insertion of new services and components, and the re-use of existing blocks and services, hence a great flexibility both in the platform management, especially in the choice and integration of system components and services, and in the requirement for developers of new services, as these are loosely coupled object oriented systems that are distributed and maintained with eventual service level agreements by the single service provider.

The approach has to be based on a service-oriented basis and these both reflect in the user view of the platform facilities and provisions, and in the approach for application providers and developers that implement new components.

System architectural design has to be evolved from monolithic applications to more client-server oriented ones. Nowadays, a brand new architectural paradigm has to appear from the standardization of the Web Services. The Service-Oriented Architecture (SOA) is a software architectural concept that defines the use of services to support business requirements. In an SOA, resources are made available to other participants in the network as independent services that are accessed in a standardized way. Normally, the definitions of SOA identify the use of Web Services (using SOAP and WSDL) in its implementation.

In view of the project objectives – especially those that relate or influence the environment within the ***Future farm*** system – developments in the following domains will be highly relevant to the project:

- Geographic Information Systems (GIS). The intelligent use of technologies for maintaining, querying, displaying, and analyzing geographic information will be an important determinant to the project's success.
- Information Integration using XML: an important objective of this project is to present to end-users information from a wide variety of sources that can have very different types of content organisation (geographic databases, textual information, graphic content, …) The family of technologies that are being developed around the XML format provide an obvious environment for developing the necessary content integration and content transformation tools.
- Robotics will play important role on farms

It is of utmost importance for ***Future Farm*** offer possibility of efficient knowledge management on all levels of management. In general we can say that the ecological, technical business and legal requirements need new structures that are able to fulfil and support the farmer's needs. As existing structures - this is valid for public structures like ministries or government driven extension services but also for semi governmental organizations like chambers of agriculture have a tendency to move slowly as every change hurts and sometimes change shows also the wrong structure of existing organizations. This could show us that in countries that have no structures yet technology are implemented much faster because when a new structure is set

up this will be done with newest technology. The danger is given for the European structures that have been in general very effective for the farmers need during the last hundred years but are not so effective or contra productive for the needs of the future.

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