Smart Nursery Construction Based on the Idea of Cost Performance

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Abstract

China's ecological environment constructionrequires higher demands to nursery stock industry. Nursery stock enterprises' upsizing and specialization become the trend of the development of nursery stock industry. Based on the fundamental principle of cost effectiveness, this paper establishes the basic framework of smart nursery by the application of smart technology. The smart nurseryis divided into five layers and five modules. The five layers are composed of access layer, supporting layer, network communication layer, exhibiting layerand application layer, creating a complete technical supporting system. Five modules respectively are smart production module, smart sales module, smart logistics module, industrial information module and financial guarantee module, forming a complete industrial chain. The application of smart technology to nursery stock industry can provide services for pre-production, production and after production of nursery stock, promotes industrial overall efficiency and effectively reduces consumption of resources and energy.

Keywords: Smart, Nursery, Cost Effectiveness, Ecological Environment

1. Introduction

With the rapid development of Chinese economy, the urbanization process speeds up unceasingly, and the scale of the city continues to expand. The voice of improving the ecological environment in society is growing louder, which promotes the ecological infrastructure construction to become an important part of the city construction. As major material for the construction of ecological infrastructure, the strong demands for nursery stock industry is fair obvious: on the one hand, the requirement of construction of ecological environment on the greening three-dimensional quantity as well as the promotion of stereoscopic planting method increase the quantity demand of nursery stock; on the other hand, the improvement of quality requirements of landscape aesthetics puts a higher demand for quality, aesthetics, healthy condition and so on of nursery stock. Market demands promote the rapid development of the nursery stock industry, and make it become one of the most active industries in the adjustment of agricultural industry structure. The nursery stock industry has become the local backbone industry in many regions, which increases employment and facilitates the development of local economy. It forms dozens of large-scale nursery stock production areas such as Xiaoshan in Zhejiang Province, Ningxiang in Hunan Province, Tai'an in Shandong Province, Yanling in Henan Province of China. For example, the area of nursery in Yanlin has reached 60 thousand hectares. Most parts of the traditional nursery stock industry mainly adopt the independent plantation and operation of peasant households. With the gradual improvement of the industry, the trends of corporatization, large-scale, collectivization have appeared in the nursery stock industry, and perfect industrial chains such as production, sales, logistics

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and maintenance management have been gradually formed as well. Currently, the construction of urbanization in China is still developing at a fast pace and the prospect of nursery stock industry is still positive.

However, there also are many problems in the development of nursery stock industry. In production area: underdeveloped production technology results in the increase of production cost, meanwhile, the quality of parts of the nursery stocks is hard to meet the market demand; In sales field: due to the inflexibility of information, on one hand, the nursery stock from the producer turns up the unsalable phenomenon; on the other hand, the demand side can't gain the supply information of nursery stock; In logistics field: the obstructed load and transportation links of nursery stock lead to the increase of transportation cost of nursery stock; In industrial information field: minimal nurseryman or producer cannot get the demand trend of nursery stock from the market in time. It leads to the underdevelopment of variety and technology, which cannot cater to the demand of the market; In the nursery stock's financing field: small and medium-sized seedling producers hope to expand their scales of production, but they cannot take out a loan from banks. The collection of funds becomes the key factor to restrain their development. The development of information technology offers a solution to how to solve these problems.

Large-scale and specialization of nursery stock enterprises have become the trend of the development of nursery stock industry in the future. In order to promote the healthy development of nursery stock enterprises, it must improve the production efficiency of enterprises, lower the cost as well as increase profit, save resources and energy, improve the comprehensive competition strength of enterprises and build smart nursery. Since IBM enterprise proposed the concept of "Smart City" in 2010, the smart technology has been widely applied to each aspect of city construction, including smart city, smart transportation, smart community, smart scenic spot, etc. The level of public service has been improved through a series of smart services. The objective of this study is to explore the framework and technical means of wisdom nursery construction, so as to promote the healthy development of nursery stock industry.

2. Methods

The application of smart technology to nursery stock industry makes information collection, information processing, and information supply automated and smart through Internet of things, cloud computing, mobile Internet and other technological applications to trigger the revolution of nursery stock production method and promote production efficiency. There is no doubt that the application of smart technology can increase a certain investment, but because of cost-benefit theory, it can achieve a greater income with less cost. Apart from increasing the economic benefit of enterprise, it can also make contribution to protecting public environment through energy saving and emission reduction, low carbon saving to reduce the consumption of resources and energy.

The application framework of the smart nursery is generally composed of 5 layers: access layer, supporting layer, network communication layer, exhibiting layer and application layer. The access layer includes the user terminal and the data collection terminal, which meets the use and collection demand of different places through the devices including mobile phone, computer, self-service terminal, all kinds of sensors and so on (Figure 1); The supporting layer includes data collection center and logical processing center of data, which handles, processes and classifies the data collected by a variety of sensors and terminal through the information system software; network communication layer is mainly responsible for the transmission of raw data and processed data; The exhibiting layer is composed of five functional modules, and these five modules respectively are assumed of production, logistics, sales, market information and financing functions, respectively, covering various aspects such as planting, sales, logistics, distribution of logistics, new products development, supply and demand intentions,

sources of fund and so on of the nursery stock; application layer mainly refers to the types of the service objects, including technicians, directors, governments, suppliers, vendors, developers, nursery farmers, logistics operators, tourists, which meets the demands for different types of groups.
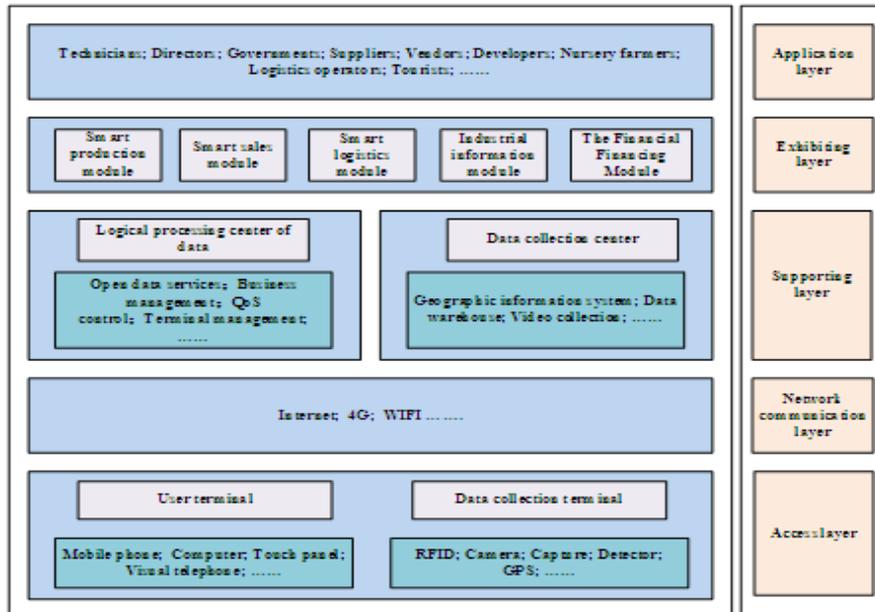

Figure 1. The Construction Framework of Smart Nursery

3. Result and Analysis

The exhibiting layer is the core of the smart nursery construction. Each module consists of a number of the sub-modules (Table 1).

3.1. Smart Production Module

Table 1. Sub-modules and Contents

Module	Sub-module	Contents
Smart production module	Greenhouse production	Soil environmental sensors, meteorological sensors and soil nutrient sensors
	Field production	
	Production control centers	
Smart sales module	Tracking systems	Identity information
	Exhibiting systems	Real-time status
	Trading systems	Order management and payment
Smart logistics module	Reserve module	Information and positioning system of nursery
	Distribution module	Logistics distribution center
	Transportation module	Vehicle navigation location system
Industrial information module	Market module,	Developmental trend
	Scientific research module	New variety, New technologies and New equipment
	Foreign industrial module	Development trends abroad
The financial financing module	Financing module	Development financing
	Guarantee module	Project guarantee

Smart production module is formed by greenhouse production, field production and production control centers and other sub-modules. Soil environmental sensors, meteorological sensors and soil nutrient sensors arranged in the different production sites will transmit the ambient temperature, humidity and light intensity, soil temperature, soil moisture, soil nutrients and other parameters to the information management center. When the data is higher or lower than the set parameters, the system will automatically start the responding facilities and equipment to process. Besides, the instructions can also be operated by the executive staff. Partition, types, specifications and other information of nursery stock are usually transmitted through handheld terminator by the technicians, to the production control center, automatically forming distribution map with GPS positioning and realizing the dynamic management of nursery. Management center can also assign production tasks and update cultivation techniques through the system.

3.2. Smart Sales Module

Smart sales module includes tracking systems, exhibiting systems and trading systems. Nursery stock tracking system: in order to facilitate the management of nursery stock, nursery stock is implemented tabbed management that puts the location, growing trend, watering, soil ball, pest status, and so on of each nursery by the sub-time way into data entry system, managers can make long-range and dynamic management; Nursery stock exhibiting system: a surveillance camera system is set in the nursery at a certain interval, so that the customer can view the growth condition of nursery stock online, which can provide support to their selections; trading system can perform online order business processing and guarantee the smooth running of transactions through the establishment of the payment system together with financial institutions.

3.3. Smart Logistics Module

Smart logistics is the dynamic management of material data such as nursery stock in the changes of space and time. Therefore, smart logistics management mainly refers to the management of the space information and attribute information of nursery stock. Use RFID technology, infrared induction, laser scanning and other sensor technology through the smart terminal to acquire the all kinds of attribute information of nursery stock commodity. Then transmit the information to smart data center through communication method for concentrated statistics, analysis, management, sharing and use, which afford decision support for nursery stock logistics management.

Smart logistics module includes reserve module, distribution module and transportation module. Reserve module organizes the sources of nursery stock mainly according to the orders from sales module; the distribution module dispatches nursery stock reasonably according to the time required to reach the destination, in order to achieve the goal of economic savings; the transportation module guides the transportation of nursery stock through technologies such as cargo tracking and positioning and smart transportation to achieve the goal of higher economic efficiency.

3.4. Industrial Information Module

Industrial information module is aimed at providing the publishing platform for industrial information, including market module, scientific research module, foreign industrial module, *etc*. Market module includes all the information which divided into three levels: macroscopy, mescopy and microscopy, in nursery stock industry. Macroscopic aspects mainly refer to the national macroeconomic policy, city development plan, *etc.*; mesoscopic aspects mainly refer to the regional or city-scale nursery information; microscopic aspects mainly refer to the nursery information of production enterprises or customers, *etc.*; the scientific research module mainly includes the introduction and presentation of new varieties, new technologies, new equipment, etc.

in the nursery industry; the foreign industrial module mainly introduces the advanced foreign experience of the development of nursery stock industry.

3.5. Financial Financing Module

Financing module mainly includes the two big modules of financing and guarantee. Financing module is mainly used for expanding production of the enterprises. For example, when its capacity is insufficient, the smooth implementation of the project can be guaranteed through investing small and medium sized nursery stock enterprises; investment guarantee module mainly solves the problem of lack of short-term capital. When nursery stock enterprises haven't enough fund to contract work, purchase nursery stock and build high-tech production facility of nursery stock, they can get the fund that they need through the guarantee of nursery stock, for it has a complicated procedure and takes a long time to get a loan from bank. Large-scale nursery stock enterprises can set up the bonding company, which makes reasonable investment guarantee after evaluating the strength, reputation, social influence and so on of the guaranteed enterprises, so as to further promote the healthy development of nursery stock industry.

4. Conclusion

Chinese nursery stock industry enters a rapid development stage, and cost-effectiveness principle is an important idea of realizing sustainable development of the industry. The smart nursery has become an important way to realize the cost-effectiveness goal. This paper constructs the basic framework of the smart nursery. The smart nursery is divided into five layers and five modules. The five layers consist of access layer, supporting layer, network communication layer, exhibiting layer, application layer, which forms a complete technology supporting system. Five modules respectively are smart production module, smart sales module, smart logistics module, industrial information module and financing guarantee module respectively, which forms an integrated industrial chain. Through The application of smart technology to nursery stock industry, it can provide services for the pre-production, production, after-production of nursery stock so as to perfect the development of nursery stock market, promote the overall efficiency of the industry as well as effectively lower the consumption of resources and energy.

Acknowledgements

References

[1]   Z. Li and H. Zhang, "Productivity growth in China's agriculture during 1985–2010", Journal of Integrative Agriculture, vol. 12, no. 10, (2013),pp. 1896-1904.
[2]   S. Ma and H. Feng, "Will the decline of efficiency in China's agriculture come to an end? An analysis based on opening and convergence", China Economic Review, vol. 27, (2013), pp. 179-190.
[3]   R. Chen, C. Ye, Y. Cai, X. Xing and Q. Chen, "The impact of rural out-migration on land use transition in China: Past, present and trend", Land Use Policy, vol. 40, (2014), pp. 101-110.
[4]   S. Zygiaris, "Smart City Reference Model: Assisting Planners to Conceptualize the Building of Smart City Innovation Ecosystems", Journal of the Knowledge Economy, vol. 4, no. 2, (2013), pp. 217-231.
[5]   M. A. Fernandes, S. G. Matos, E. Peres, C. R. Cunha, J. A. López, P. J. S. G. Ferreira, M. J. C. S. Reis and R. Morais, "A framework for wireless sensor networks management for precision viticulture and agriculture based on IEEE 1451 standard", Computers and Electronics in Agriculture, vol. 95, (2013), pp. 19-30.

[6]   J.M. M. Barradas, S. Matula and F. Dolezal, "A Decision Support System-Fertigation Simulator (DSS-FS) for design and optimization of sprinkler and drip irrigation systems", Computers and Electronics in Agriculture, 86: 111-119. **(2012)**.

[7]   D. Kolokotsa, G. Saridakis, K. Dalamagkidis, S. Dolianitis, I. Kaliakatsos. "Development of an intelligent indoor environment and energy management system for greenhouses", Energy Conversion and Management, vol. 51, no. 1,**(2010)**, pp. 155-168.

[8]   S. Shen, A.Basist, A. Howard, "Structure of a digital agriculture system and agricultural risks due to climate changes", Agriculture and Agricultural Science Procedia, vol. 1, **(2010)**, pp. 42-51.

[9]   E. Murakami, A. M. Saraiva, L. C.M. Ribeiro Junior, C. E. Cugnasca, A. R. Hirakawa and P. L.P. Correa, "An infrastructure for the development of distributed service-oriented information systems for precision agriculture", Computers and Electronics in Agriculture, vol. 58, **(2007)**, pp. 37-48.

[10] A. Javier, G. Sanchez, F. Garcia-Sanchez and J. Garcia-Haro, "Wireless sensor network deployment for integrating video-surveillance and data-monitoring in precision agriculture over distributed crops", Computers and Electronics in Agriculture, vol. 75, no. 2, **(2011)**, pp. 288-303.

[11] L. Zheng, M. Li, C. Wu, H. Ye,X. D. RonghuaJi, Y. Che, C. Fu and W.Guo, "Development of a smart mobile farming service system", Mathematical and Computer Modelling, vol. 54, no. 3-4, **(2011)**pp. 1194-1203.

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