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Blockchain for Traceability on Fruits and Vegetables Sector

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Abstract

In 2016, it is estimated that intra-mural R&D expenditure supported by companies, public institutions, private non-profit institutions and universities amounted to 23.2 billion euros (+4.6% compared to 2015).
The percentage incidence of intramural R&D expenditure on GDP (Gross Domestic Product), equal to 1.38% in 2016, is slightly up on the previous year (it was 1.34% in 2015).
The business sector contributes 60.8%, universities 24.2% and public institutions 12.6% of the total expenditure. Compared to 2015, R&D spending grew by 9.3% for businesses, remained stable in public institutions, while it fell in universities (-1.0%) and, to an even more marked extent, in private non-profit institutions (-18 .6%).
Since 2015, the contribution to total R&D expenditure of nationally controlled enterprises and foreign lenders has increased by 2.1 and 1.5 percentage points respectively; that of public institutions, universities and non-profit organizations is decreasing (-3.5 percentage points in total).
The most significant increase in intra-mural R&D expenditure concerns experimental development activities (+15.6%); basic and applied research recorded a slight decline (overall -0.2%).
In 2016, the number of personnel engaged in R&D activities, counted both in units and in terms of full-time equivalent units (Etp), grew. In particular, it amounts to 435,283 units (+11.7% since 2015) and 290,039.5 in terms of Etp (+11.9%).
Compared to the total number of employees, researchers in terms of units increased by 6.6% (from 174,327 units in 2015 to 185,916 in 2016). In terms of Etp, the researchers increase by 6.2% (from 125,875.0 to 133,705.7 units expressed in Etp).
The most consistent increase in Etp is detected in companies (+11.3%) and universities (+4.0%).

For 2017, preliminary data indicate an increase in R&D expenditure of 1.8% at current values both in companies and in public institutions (data on universities are not yet available).
In the same period, the R&D allocations of Central Administrations, Regions and Autonomous Provinces recorded slight variations: the funds went from 8.7 billion euros in 2016 (adjusted expenditure forecasts) to around 8.6 billion euros in 2017 (initial forecasts).
For 2018, the forecasts provided by companies and institutions confirm a further increase in intra-mural R&D spending (+3.4% on 2017): in particular, public institutions +5.6%, private non-profit institutions +4.9 % and businesses +2.9%.

Keywords: agroalimentar, blockchain, traceability

1. Introduction

Agripeppe Soc. Coop. Agr." is a company born from the will of a consolidated group of farmers, operating in the Piana di Fondi-Sperlonga area, which aims to launch the products of the Agro-Pontino on the market, qualifying and enhancing them. In compliance with the mutualistic end inherent in its nature, the Company wants to represent all the farmers who believe in the principles of cooperation and intends to give the individual producers a formal entity recognized and well defined on the market.The uncertainty of this research is at the basis of the project and specifically, the possibility of using the by-products in the agricultural and agri-food sector, to date never experimented by the Company.It was necessary to develop innovative and experimental protocols.

During 2019, the Company decided to continue a Research and Development project aimed at developing an innovative control and management system on blockchain technology, which allows for the rapid processing of Company data and which allows an internal organization, capable of allow precise monitoring of fruit traceability. The main objective that the Company had set itself was in fact to develop a new control and management system capable of processing Company data, which also served as a container for organizational flows, in order to operate with maximum fluidity, without incurring in critical situations, which inevitably translate into delays and disservices. The first phase was to study the Company's production characteristics in depth, trying to understand its potential, the key production phases and to develop solutions to the critical issues encountered. The possible application of blockchain technology within the Company was also studied. This was done by the internal Research Team, made up of highly trained personnel with undoubted experience in the reference sector of the Company. Furthermore, a substantial phase of data collection was also launched and systematically carried forward during the year. the Company has considered the possibility of developing it exclusively, possibly resorting to the support of highly specialized external consultants. For the implementation of the innovation transmission model in the company - taking into account the implementation

difficulties from an organizational point of view, an articulated experimentation was devised carried out with specific programs in the year 2019 and 2020.

2. Materials and methods

Through Business Process Management, innovative changes to the business process as a whole are undertaken [6], intensifying and improving the conservation and tracking of the data of interest (by computerizing and innovating them) between the various areas of improvement and management, identified by the previous analyzes. The Business Process Management life cycle can be globally decomposed as follows:

• Study of the company: analyze its objectives and its organization to be able to break down the whole of its activity into work processes
• Creation of models for work processes: computerize a model as close as possible to reality
• Solution implementation: implementation of a BPM solution, connected to the company's information system (applications and databases)
• Execution: this is the operational phase where the BPM solution is put into practice
• Assistance: which consists in analyzing the status of processes through dashboards with process performance
• Optimization: proposing solutions that improve the performance of work processes [7].

Of the areas that make up the Business Process Management model, the Company's innovation project focused on Process Redesign, which aligns and transforms the main business processes by improving their organizational performance, supporting their action of change and innovation at target through IT technologies [8].

From what has been highlighted above and with reference to the specific activity of the company in question, the methodology identified to support the innovative process implemented by the Company can be traced back to the transition from the phase of analysis and comparison from Business Process Management [9] to the implementation methodology of Business Process Modeling (BPM in simplified form), through the specific "As Is - To Be" model.

Business Process Modeling is highlighted in the activity of representing business processes, where there is a tendency to improve the efficiency and effectiveness of business processes, or to reduce costs and increase quality understood as customer satisfaction [10]. In this field, the activity of representing company processes is divided into two perspectives:

The mapping of real processes ("As-Is") and those to tend ("To-Be") are two clearly distinct analysis activities, which lead to the definition of the improvements necessary to move from the processes detected in the As-Is to those formalized in the To-Be.

The Company has divided the business processes into:
• Primary processes, which have a greater impact on the company's business results,

are able to create value recognized by the customer and their operational performance, in terms of costs, quality and times, strongly influence the level of satisfaction of the end customer same; they are processes that directly produce a result for the outside.
• Support processes, necessary for company management but which contribute to the creation of value indirectly, playing a role of suppliers of primary processes, providing them with input and support, favoring their efficiency and effectiveness. They are strictly necessary for the functioning of the primary processes, even if they do not produce an output recognizable by the final customer. They are characterized by internal customers only.
This model envisages nine components, distinguished between infrastructural and "core business", i.e. linked to the characteristic processes of a given company, as previously described. Upstream of the model we find the constraints related to the environment and resources, while downstream the output that the end customer wants to receive is represented, the value he attributes to the result of the value chain.

3. Results and Conclusion

The Company has divided the business processes into:
• Primary processes, which have a greater impact on the company's business results, are able to create value recognized by the customer and their operational performance, in terms of costs, quality and times, strongly influence the level of satisfaction of the end customer same; they are processes that directly produce a result for the outside.
• Support processes, necessary for company management but which contribute to the creation of value indirectly, playing a role of suppliers of primary processes, providing them with input and support, favoring their efficiency and effectiveness. They are strictly necessary for the functioning of the primary processes, even if they do not produce an output recognizable by the final customer. They are characterized by internal customers only.
This model envisages nine components, distinguished between infrastructural and "core business", i.e. linked to the characteristic processes of a given company, as previously described. Upstream of the model we find the constraints related to the environment and resources, while downstream the output that the end customer wants to receive is represented, the value he attributes to the result of the value chain.
The results obtained show that the waste residues, at the doses tested, show a potential to support the growth of Solanum lycopersicum L.,. In general, however, a slight improvement of the physiochemical and biometric parameters, and of the response to the infection with Botrytis cinerea is observed, mainly due to the effect of the residual waste. Further tests will be conducted to investigate the agronomic effect of the residues, at the tested doses, in the field conditions, more specifically agronomic.
Through the objectives envisaged by the Fruits - Chain 4.0 research project, the

Company has experimented, acquired and made new organizational models its own, developing innovative IT technology applications for future objectives relating to the new and creative implementation of the confectionery sector at the order to build new models and methodologies to be applied to the issue of both food safety and the guarantee of Made in Italy products, to arrive at the development of both the Fruitsing of data from the reference food chain, and the digital document conservation in Blockchain of confidential data company, with the aim of certifying its absolute integrity and validity (and as such cannot be eliminated or modified), which will guarantee the stored data by making it accessible over time, in order to associate a transparent and guaranteed, immutable and defined traceability value with respect to the traditional values of the business sector.

The development of the Fruits - Chain 4.0 project is part of an innovation process that affects the organizational aspects of the existing and reference company, as well as improving and integrating those performance management activities in the company areas relating to the operations in question and more precisely:

• Management
• Production
• Quality
• Others for reference

In greater detail, the objectives of the Fruits - Chain 4.0 research project were aimed at prototyping the introduction of new IT tools for implementation in terms of innovation, quality and efficiency of the company's production and qualitative processes, thus achieving the objective the development of a new re-engineering of company processes using advanced IT tools, to obtain maximum efficiency and effectiveness with respect to the evolution of the production/quality needs of the external environment, through:

• Ideation and conceptualization of an innovative Fruits system based on the blockchain in a context of supply chain in smart food, with the perspective of ensuring new levels of guarantee in the organization of food safety.
• Conception, conceptualisation and development, in a creative and innovative way, of digital document storage in the Blockchain of confidential company data (distribution chain tracking, exclusive recipes), with the aim of certifying their absolute integrity and validity (and as such not eliminated or modifiable), which will guarantee the stored data making it accessible over time, in order to associate a transparent and guaranteed traceability value, immutable and defined with respect to the traditional values of the business sector.
• Innovation of the Company's procedural/systemic asset, with particular emphasis in the managerial, administrative, quality and production areas, through the Basic Research and Experimental Development Project Fruits - Chain 4.0.

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