Value creation in undergraduate programs in agricultural sciences. A prospective analysis

Creación de valor en programas de pregrado en ciencias agrarias. Un análisis prospectivo

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ABSTRACT

Purpose: To conceive a value proposal through prospective analysis, based on the experience of a Faculty of Agricultural Sciences in Colombia, in which an institutional strategic process was carried out, oriented towards the achievement of academic excellence in its undergraduate curricular programs: Agronomic Engineering, Agricultural Engineering, Forest Engineering and Zootechnics.
Scope: The prospective analysis was carried out to generate updating and modernization processes in each curricular program. The reports generated allowed a cross-sectional analysis of results, which led the authors to develop a proposal to create value in training.
Methodology: The workshops developed the stages of contextualization, identification of analysis elements, prioritization and synthesis, enunciation of scenarios and formulation of objectives, during 2016 and 2017. The results were later analysed for the conception of the value proposition.

Results: The priority elements allowed the design of a value proposition of main and support activities, for the creation of value in the training processes, within a system of activities.
Conclusions: The prospective exercise can contribute both to the strategy formulation process and to the deployment of the strategy in the structural design for the generation of value, in the university context.
***Keywords**:* strategic prospective, agricultural sciences, value system

RESUMEN

Propósito: Concebir una propuesta de valor mediante análisis prospectivo, con base en la experiencia de una Facultad de Ciencias Agrarias en Colombia, en la cual se adelantó un proceso estratégico institucional, orientado hacia el logro de la excelencia académica en sus programas curriculares de pregrado: Ingeniería Agronómica, Ingeniería Agrícola, Ingeniería Forestal y Zootecnia.
Alcance: El análisis prospectivo se adelantó para generar procesos de actualización y modernización en cada programa curricular. Los informes generados permitieron un análisis transversal de resultados, el cual condujo a los autores a elaborar una propuesta de creación de valor en formación.
Metodología: Los talleres desarrollaron las etapas de contextualización, identificación de elementos de análisis, priorización y síntesis, enunciación de escenarios y formulación de objetivos, durante 2016 y 2017. Los resultados fueron posteriormente analizados para la concepción de la propuesta de valor.
Resultados: Los elementos prioritarios permitieron diseñar una propuesta de valor de actividades principales y de soporte, para la creación de valor en los procesos de formación, dentro de un sistema de actividades.
Conclusiones: El ejercicio prospectivo puede contribuir, tanto al proceso de formulación de la estrategia, como al despliegue de la estrategia en el diseño estructural para la generación de valor, en el contexto universitario.

Palabras claves: prospectiva estratégica, ciencias agrarias, sistema de valor.

1. INTRODUCTION

A Faculty of Agricultural Sciences in Colombia, initiated a process to determine initiatives for preparing an institutional plan for 2016-2018 [1], oriented towards the improvement of academic excellence in its four undergraduate curricular programmes, namely: agronomical engineering; agricultural engineering; forestry engineering; and animal science. Several workshops held in 2016 allowed determining twenty-one activities to be carried out, highlighting long-term challenges and strategic initiatives for three years [2].

The central initiative was the modernisation of undergraduate curricular programmes. Consequently, a foresight analysis (prospective) was initiated to consider future long-term scenarios [3] for the training and teaching processes, in each of the four curricular programmes.

Subsequently, the main results of the foresight exercises were integrated to configure a value creation model for training, identifying the most relevant variables [4]. The document presents the proposal for the creation of specific value for the management of the teaching process at a Faculty of agricultural sciences in Colombia.

2. THEORY

STRATEGIC FORESIGHT IN FORMATION SYSTEMS

Planning the future of education through alternatives given by a prospective method allows to understand the possibilities and dynamics it educational processes faces [5]. According to Fuertes-Camacho *et al*. [6], point out the relevance of planning and thinking about the future of such important aspects as the rethinking of educational organizations, curricula, and formation systems [7]. Especially in curriculum models, "Systematic changes occur within the extended timeframes of formal curriculum review processes. Programmes need to be reviewed periodically for internal and external accountability or to determine whether the curriculum has lost its coherence due to the accumulative effect of continual small-scale changes" [8, p. 1].

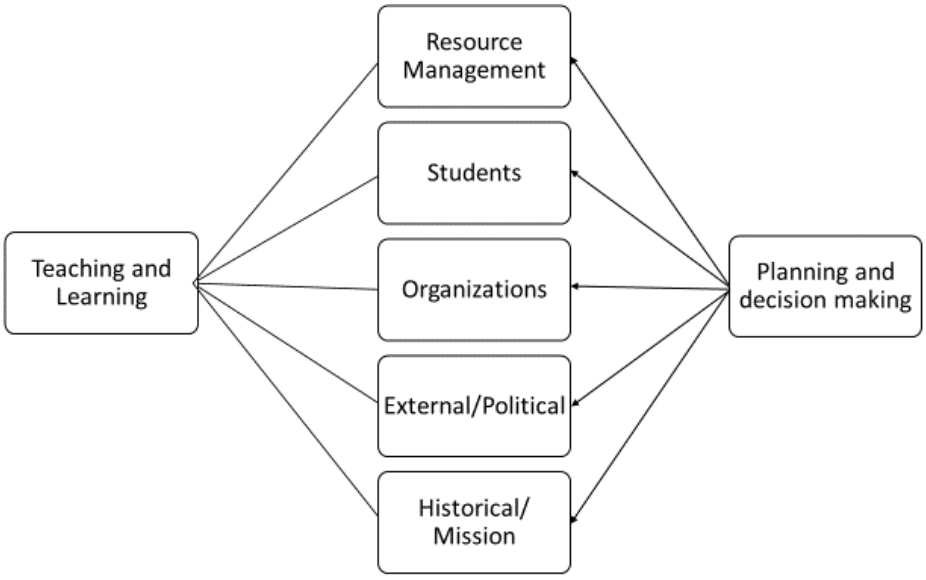
Strategic foresight is a planning tool to develop the critical thinking, planning, and management competencies for considering the impact of long-term uncertainties on near-term decision making [9]. Also, Foresight can be particularly useful for understanding the forces shaping a system, recognizing system elements, becomes a tool for developing policy development, strategic planning, decision-making, and even audit and evaluation. Therefore foresight, building on the context provided by strategic foresight, supports innovative solutions to specific problems is used in different contexts. The objective of foresight is not to predict the future, but to consolidate information that allows to prepare strategies, policies, and programs that are robust across a range of plausible futures [10, p. 252]. For the achievement of the proposed, foresight should give activities necessarily involves simplification and evaluation processes in knowledge elicitation that need to be carefully monitored for effectiveness [11].

To support organizational adaptability, foresight practices can also complement dynamic models that allow management to anticipate market and environmental feedback as competitive actions unfold [12], [13]. In this sense, it is important to involve a significant number of variables while respecting the complexity of the system.

While design often addresses complex business problems for today’s world and the immediate future, strategic foresight develops alternative scenarios for the futures in which these solutions will exist. Scholars and educators in these core fields are devoting increased attention to the

question the most effective organizational process or fit for successful, actionable long-horizon strategies [14, p. 1107]. Figure No. 1. shows the different elements to be considered in a curriculum reform.

Figure 1. Conceptual Framework Underpinning curriculum

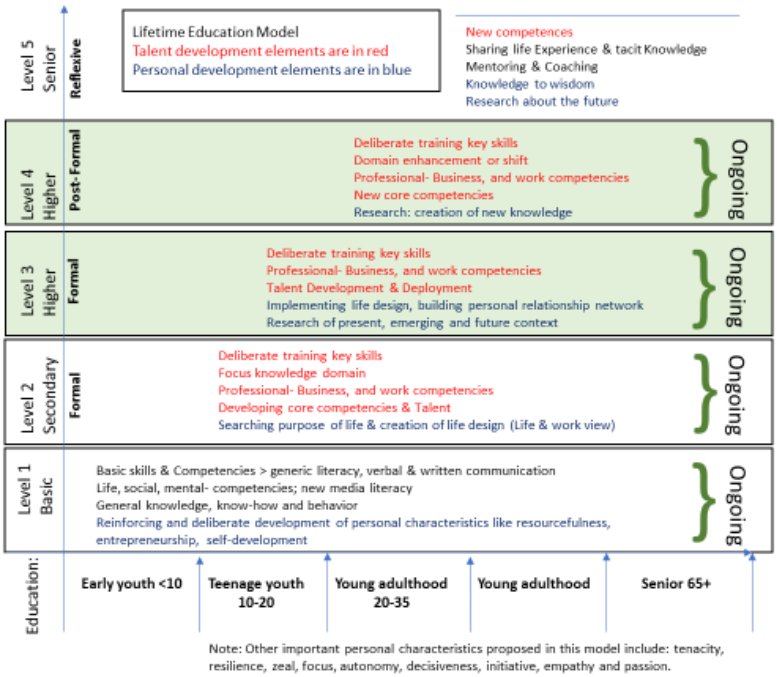


Source: Adapted from Clark [15, p. 2].

For Iden *et al*. [16] foresight and foresight methods are well-known areas and have long been applied in practice. Strategic foresight provides insights into organizations' operating environment of challenges and opportunities and identification of innovations and opens the competitive [16].

Regarding educational models, foresight (or prospective) models provide a useful tool that allows finding the changes that the curricula need, finding an interesting sequence between the phases of the educational process. Raich *et al*. [17], they propose Figure no. 2 in which is indicated the main needs in each of the levels of education

Figure 2. Education model



Source: Raich *et al*. [17, p. 45].

Within the education model, updating the curricula is a central aspect. The curriculum is proposed as a: "inventory of activities related to the design, organization and planning of an education or training action, including definition of learning objectives, content, methods (including assessment) and material, as well as arrangements for training teachers and trainers" [18, p. 3]. Curriculum planning should be considered as a necessary task of teachers at each time a new course is started [19].

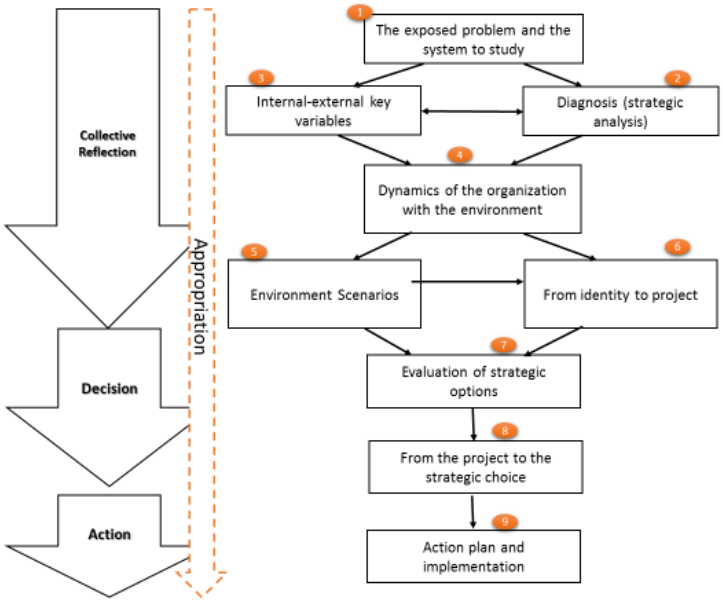
The key conditions of a successful curriculum will enable the achievement of the objectives and a better performance of educational processes and their impact on society. But not only the foresight analysis contributes to enrich the curricula, because also the development of educational processes oriented to specific competences contributes to the formation of futurists and foresight practitioners. Gary [20] proposes, for example, a close relationship between training activities and programs in foresight and the assessment of competency-based learning.

3. METHODOLOGY

Within this conceptual framework of analysis, knowledge about trends and changes in the external environment is elaborated collectively by the professed to understand future scenarios, where explicit and implicit knowledge of their educational work allows them to invest in the foresight process [21], [22]. According to these efforts, the workshops were oriented with adaptations in accordance with the prospective process, as proposed

by Godet & Durance [23], which can be seen in figure 3 related with Planning by scenarios.

Figure 3. Planning by scenarios

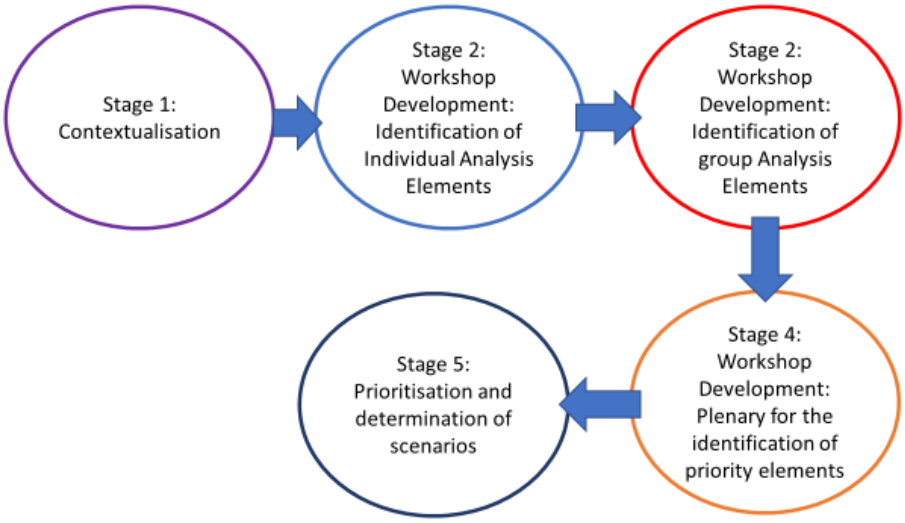


Source: Godet & Durance [23, p. 25].

The methodological design adopted for the workshops and for the cross-sectional analysis is presented in the following section.

Workshops were held for each undergraduate curriculum programme, with teachers from each of the departments related to the respective programmes during 2017. The workshops were based on a methodology composed of several stages in Figure 4.

Figure 4. Methodological stages of the workshops. Source: prepared by the authors based on the prospective process proposed by Sánchez *et al.* [24].



Source: Adapted from Sánchez *et al*. [24].

The stages were the following in accordance with the integral process suggested by Sánchez *et al*. [24]:

Stage 1. Contextualisation: the research question was presented, delimited within the framework of the training and teaching system of the university. A questionnaire was delivered to each participant and a talk was held by an expert teacher from each department, discussing the central aspects of the problematic characteristics of each curricular programme.

Stage 2. Identification of individual analysis elements: the participants were asked to define a list of priority elements, based on the following analysis parameters proposed to the participants through the initial form: current and future aspects related to the curricular programme; relevant activities recognised, developed, and belonging to the system; and aspects of the internal and external profile.

Stage 3. Identification of group analysis elements: participatory activities were carried out in groups with a view to developing a diagnosis and recognition of key variables. A modified process of Delphi method was used following the phases proposed by Ortega [25].

Stage 4. Plenary for the identification of priority elements: the results of the groups were socialised, consolidated, and discussed in a plenary session. A final group of relevant elements was defined, identified collectively and with a participatory approach, through prioritisation by importance and governance criteria. We followed the methodology proposed by Mojica [26] for variables, in order to find an approximation for the possible variables, and the process for finding

the strategic variables, based on different forms of prioritisation, such as importance and governance [26, p. 130].

Stage 5. Prioritisation and determination of scenarios: the technique of Schwartz axes was used to elaborate four future scenarios based on the key variables identified, following the process proposed by Rockefeller [27] and Ogilvy & Schwartz [3]. The scenarios were described in a participatory manner and the objectives were established by key variables, to achieve the ideal scenario in a long-term horizon.

The workshops were conducted according to the following calendar in Table 1.

Table 1. Calendar with the dates of the prospective workshops.

Workshop curriculum program	**Date of completion**
Workshop 1 agronomical engineering	December 12, 2016
Workshop 2 agronomical engineering	May 8, 2017
Workshop 1 agricultural engineering	May 15, 2017
Workshop 2 agricultural engineering	August 14, 2017
Workshop 3 agricultural engineering	November 20, 2017
Forestry engineering workshop	June 12, 2017
Animal science workshop	June 28, 2017

Source: prospective workshops.

The delimited system was the training and teaching processes, while the main goal to be achieved was the identification of key variables and scenarios, based on the relevant issues related to the current situation of the system in the respective curricular programmes. Once the key variables were identified in each workshop, they were prioritised using the importance criteria (relevance of the variable rated from 1 to 10 points) and according to the scale used by Rodríguez [28]. Governance (degree of interference to achieve a change in that variable from the academic unit) was rated from 1 to 10 points, so as not to make variations in the rating scale, in the same way as for importance. This manner of prioritisation allowed classifying the key variables into quadrants. This process served as a filter to choose variables for the determination of scenarios using the Schwartz axes technique, which allowed identifying four scenarios.

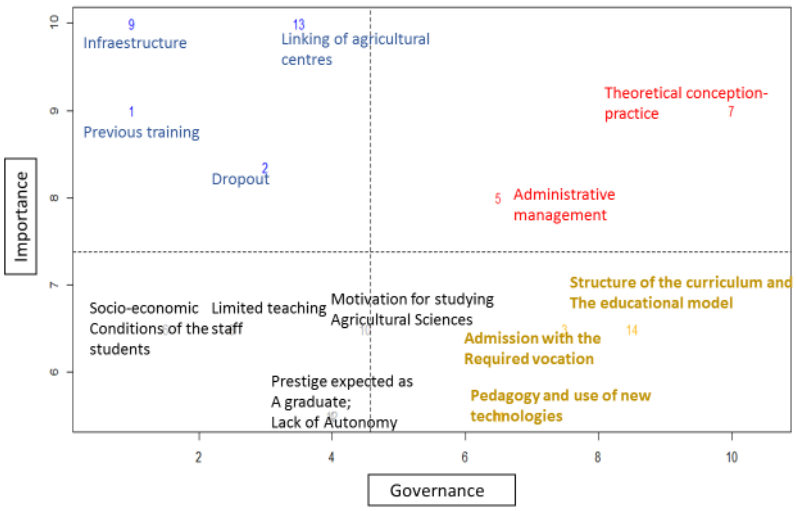
The workshops were organised with the participation of the directorates of the curricular areas and the departments of agronomic sciences, agricultural engineering and food, animal production, and forestry sciences of the faculty of agricultural sciences. After the performance of the workshops, we conducted a cross-sectional review of the results of the variables through a system of points, which allowed identifying the shared elements to configure a value system for the training process.

4. RESULTS AND DISCUSSION

1. Workshop on agronomical engineering scenarios

The key variables identified in the workshops on agronomical engineering were the following, classified according to importance and governance in Challenges (High importance and low governance), strategic elements (high importance and high governance), short term elements (high governance and low importance) and autonomous elements (Low importance and low governance). This classification is shown in figure 5.

Figure 5. Distribution of the key variables according to importance and governance for agronomical engineering.



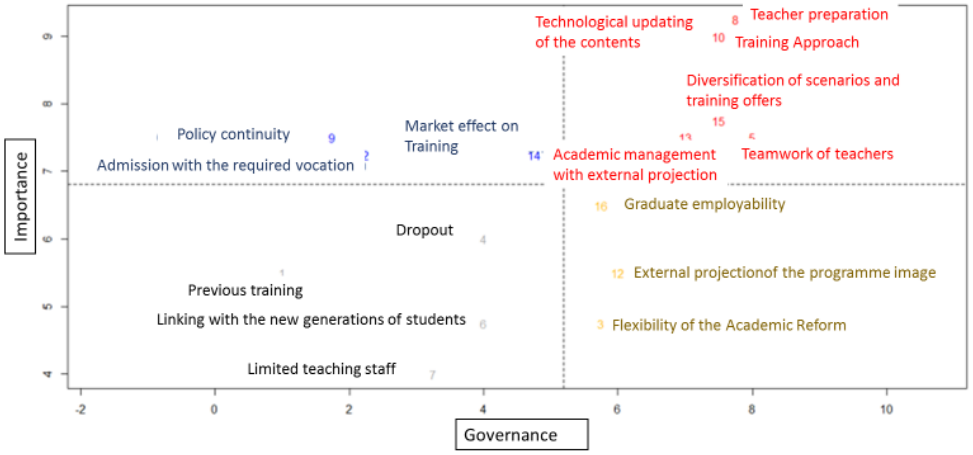
Source: prospective workshops.

The ideal scenario identified implies that, in fifteen years, there will be administrative management linked with the agricultural centres, as well as an adequate programme approach that emphasises training from a theoretical-practical focus addressing prior training issues and dropout rates.

2. Workshop on agricultural engineering scenarios

The distribution of the elements in the quadrants is presented in figure 6.

Figure 6. Distribution of the key variables according to importance and governance for agricultural engineering.



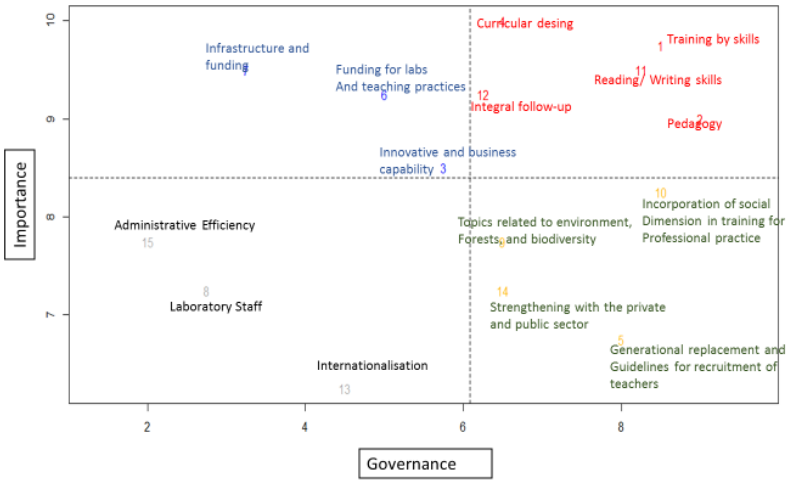
Source: prospective workshops.

The ideal scenario suggests that, in fifteen years, there will be an articulation with the external factors and the programme, as well as an adequate programme approach that emphasises training and addresses the possibility of training diversification. To that end, permanent updating of teachers is required, both regarding the technical components and the economic, social, and political aspects of the country. Decent salaries should be paid to the engineers graduated for their exclusive dedication with evaluation policies.

3. Workshop on forestry engineering scenarios

The key elements identified were classified as shown in Figure 7 according to the importance and governance ascertained.

Figure 7. Distribution of the key variables according to importance and governance for forestry engineering.



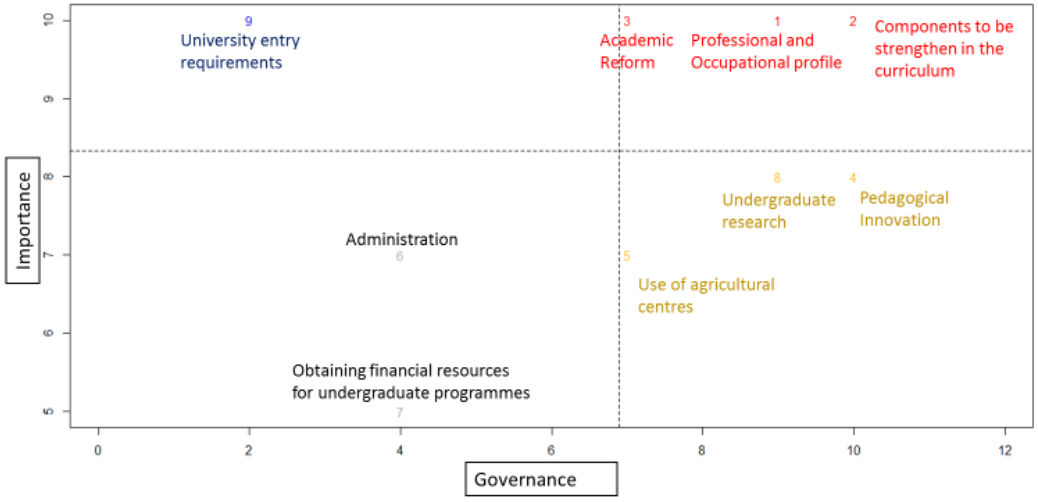
Source: prospective workshops

The ideal scenario implies that, in fifteen years, there will be a curricular design according to skills, with improved pedagogy, skills, and reading and writing skills, as well as innovation and entrepreneurship. These improvements should have full financing and adequate and necessary infrastructure, allowing integral development of students and the strengthening of academic quality.

4. Workshop on animal science scenarios

The figure 8 illustrates the distribution of the key variables according to importance and governance.

Figure 8. Distribution of the key variables according to importance and governance for animal science.



Source: prospective workshops.

The ideal scenario implies that, in 15 years, there will be a clear orientation to applicants, employers, and different interest groups regarding the programme and its possibilities of diversification. Additionally, an academic reform was carried out allowing the incorporation of new components that strengthened and made the curricular programme more attractive, with a more relevant profile for society and industry.

The Results of integration through transversal reading of the workshops: once the results of the workshops were obtained, we addressed the key variables and their descriptions, analysing their content, and grouping them according to their characteristics. Subsequently, we determined the most relevant elements through the scores achieved by importance and governance, configuring two priority groups based on the qualifications provided, which were standardised according to the number of groups configured in the workshops. Next, we present the grouping of the key variables, and, in a set of colours, the different quadrants in which each element was located according to the respective curriculum programme workshop.

Table 2. Cross-sectional grouping of the key variables of the prospective workshops.

Agronomical engineering	*Agricultural engineering*	*Forestry engineering*	*Animal science*
Theoretical conception - practice	Training approach	Training by skills	Undergraduate research
	Market effect on training	Innovative and business capability	
Linking of agricultural centres		Funding for laboratories and teaching practices	Use of agricultural centres
Infrastructure		Infrastructure and funding	Obtaining financial resources for undergraduate programmes
Structure of the curriculum and the educational model	Flexibility of the academic reform	Curricular design	Academic reform
Inadequate administrative management for	Academic management with external projection	Administrative efficiency	Administration

meeting the needs of the programme			
	Diversification of scenarios and training offers	Topics related to environment, forests, and biodiversity	Components to be strengthen in the curriculum
Previous training	Previous training	Reading and writing skills	
admission with the required vocation	Admission with the required vocation		University entry requirements
Dropout	Dropout	Integral follow-up	
	Policy continuity		
	Teamwork of teachers		
	Teacher preparation for new training scenarios	Generational replacement and guidelines for recruitment of teachers	
Pedagogy and use of new technologies		Pedagogy	Pedagogical innovation
	Technological updating of the contents and training processes		
Limited teaching staff	Limited teaching staff		
Motivation for studying agricultural sciences			Professional and occupational profile
Prestige expected as a graduate	External projection of the programme image	Strengthening with the private and public sector	
Socio-economic conditions of the students			
	Linking with the new generations of students		
		Laboratory staff	

	Graduate employability		
Strong dependence and lack of autonomy of the programme of other faculties			
		Internationalisation	
		Incorporation of the social dimension in training for professional practice	

Challenges	
Strategic	
Short term	
Autonomous	

Source: prepared by the authors.

Note. The different colours identify the elements in the quadrants, according to each workshop on the curricular programmes.

The prioritised key variables in the priority groups are presented in the following table:

Table 3. Group of key variables obtained by the cross-sectional analysis.

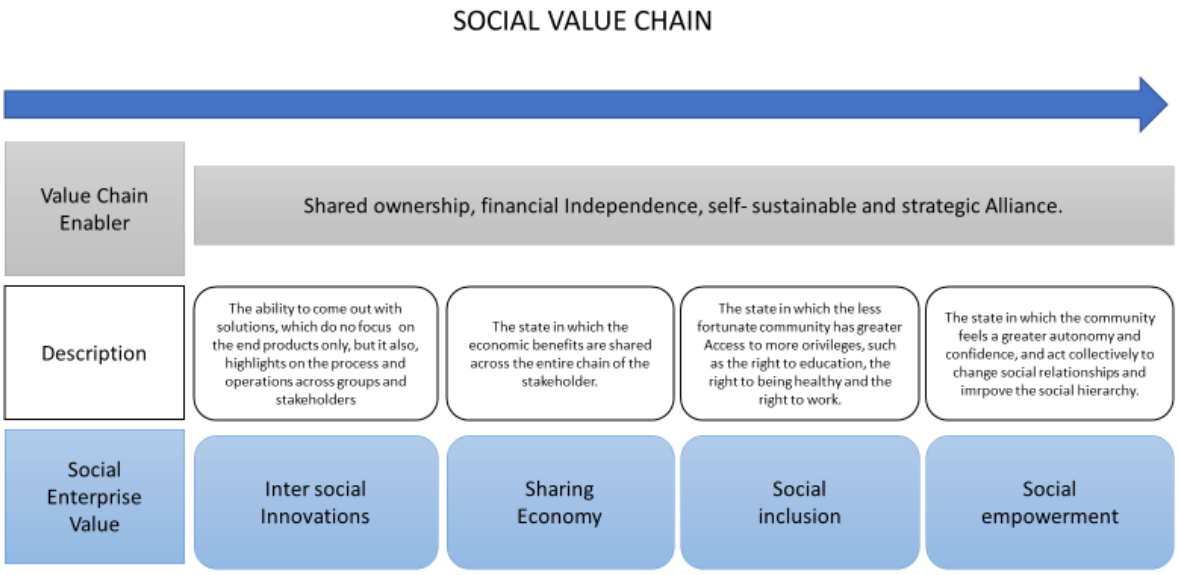
Group 1 – Most relevant variables
Training approach
Admission with the required vocation
Academic reform and curricular redesign
Agricultural centres, laboratories, and practices
Infrastructure and funding
Previous training
Dropout and follow-up
Administrative management
Diversification of training offers
Market effect and innovative and business capability
Pedagogy and use of new technologies

Source: prepared by the authors.

Porter [29] states that the value system of an organisation is embedded in a greater flow of activities, with a linear flow that covers the process from the organisational system inputs to obtaining products and results for the community, constituting a primary set of main activities. Porter's value system was used as a template, based on the explanations provided by Schilling & Shankar [30]. Value creation systems have evolved towards the concept of shared value [31]: organizations can achieve higher performance by focusing on socially advantageous actions. These actions integrate both social and economic value creation.

Kassim & Habib [32], using the Porter´s value chain model and shared values contributions, they suggest that the work of value chain was further advanced by Porter [33] in order to leverage the unique resources and expertise of the organization to create economic value by creating social value. This social value comprises economic and societal benefits relative to cost, joint company, and community value creation, integral to profit maximization [32]. This shared values [31], they focus on connections between societal and economic progress and eventually has the potential to release a new pathway for global growth. According with the research led by Kassim & Habib [32], social enterprises (where it is possible to include educational organizations) produce social values; from inter social innovations to sharing economy, social inclusion, and social empowerment. So, creation of the social value chain is made possible with supports from shared ownership, financial independence, self-sustainable and strategic alliance, which can be achieved by generating value creation processes through the Porter´s value system [32]. Figure 9 depicts this social value chain, made by social enterprises, playing roles in shaping value creation.

Figure 9. Social value chain according to Kassim & Habib [32].



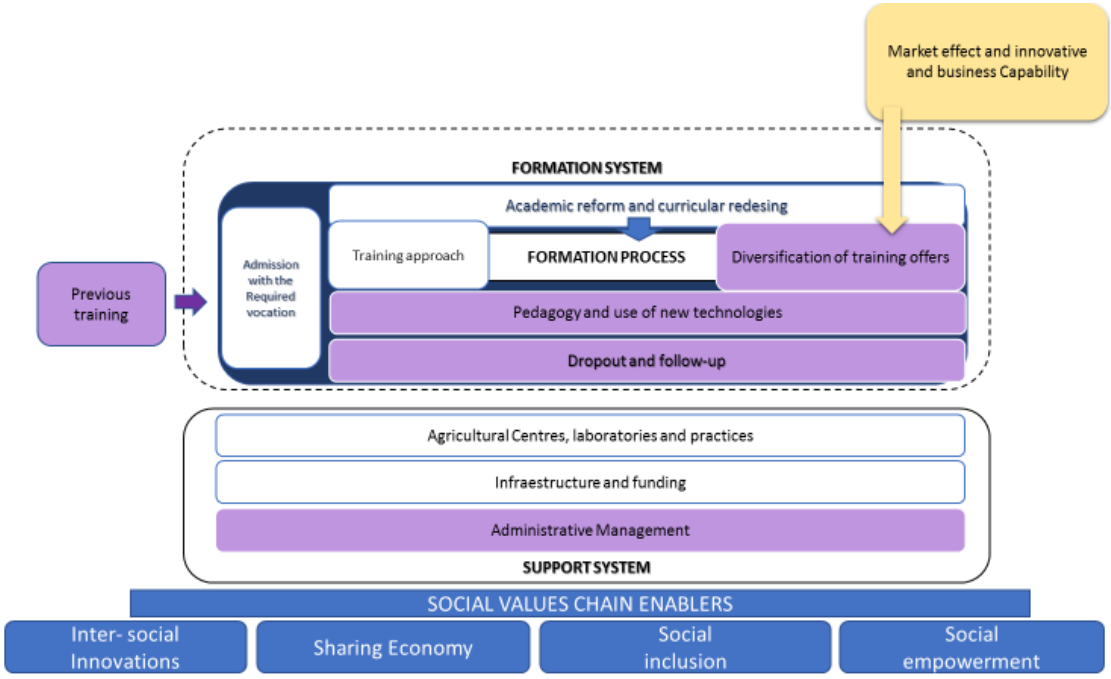
Source: [32, p. 209].

By articulating these contributions, through the analysis performed by a group of experts, the variables of the priority group obtained through the prospective exercises were determined.

Regarding the training and teaching processes, which were assimilated to the Porter's value system, it could be observed that many of the key variables were integrated into them, the previous training activity being a precondition for entry into the system, which would be articulated with the activity of admission with the required vocation, expressed through the curricular programme, its novelties and innovations (academic reform and curricular redesign), and the training approach. After establishing the training basis for the students, the system provided alternatives for diversification of training offers, at the same time that this process was influenced by students' dropout and follow-up, and the use of new technologies for the pedagogical processes. The primary system of activities benefited from the participation of support activities, which were usually related to physical infrastructure, human talent management, purchasing and procurement management, and technological development. The other variables of the priority group, which had no place in the primary system for generating training and teaching value, according to experts, could easily be placed in the set of support activities.

The variable called the effect of the market on innovative and business capabilities was a guide for the diversification process of training offers. The set of primary value creation systems in training, and the support system led to the following training value system.

Figure 10. Integrated system (primary and support) of value creation in training and teaching, based on the key variables and porter's value system [29].



Source: prepared by the authors based on the panel of experts.

5. CONCLUSIONS

A value creation system for the training and teaching processes was set up from the elements provided, in a participatory manner, by the different work teams that performed the prospective analyses. This prospective exercise was made to approximate the approaches of the teachers who worked on value creation processes to understand the possibilities for academic development of programs in agricultural sciences. The prospective analysis allowed to find relevant elements that must be influent to create value for a curricular update. This value creation system in a higher education organization also has the purpose of creating shared value, as suggested by Porter, & Kramer [31]. According to what was found by Kassim & Habib [32], the creation of value Shared implies development and growth in social values such as those suggested: inter-social innovations, sharing of economic benefits, social inclusion, and promotion of entrepreneurship. These values of the social organization (where educational organizations can be included), serve as a platform for the purpose of creating value, which was associated in the support system to the issues of infrastructure, activity in agricultural stations, practices and laboratories, while in the training system itself, the training approach, dropout and accompaniment, the diversification of training offers and the incorporation of pedagogical novelties associated with the use of new technologies were seen as key.

Recommendations and proposals: The prospective process presented, originated with the purpose of contributing to a particular action of the university plan, not only contributed to the anticipatory purpose offered by prospective planning through scenarios, but was also useful due to the

participation of a group of experts, who elucidated aspects about value creation in the training process, based on the set of key priority variables. The cross-sectional analysis of the key variables allowed the development of proposal for the training process, which can be useful for the deployment of the strategy in the structural design for generating value.

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