ELECTRE TRI-based approach for sorting projects portfolio: focus on the European strategy

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Abstract: The European Framework Programme for Research and Innovation aims to facilitate the collaboration between public and private sectors in delivering innovation. To achieve this goal, Union Research and Innovation Programme provides various financial instruments, among which the Horizon 2020 is one of the most significant. Since its implementation, the Horizon 2020 has stimulated the interest of several research organizations making the partnerships among companies their core business for improving local economy. In this context, technological districts are the main proponents of research and innovation spreading in the local territory. In Sicily, the AgroBioPesca district exploited these opportunities, undertaking the strategic "Call for ideas" proposal with the aim of building its own roadmap for research and innovation. To such an aim, AgroBioPesca collected several innovative project ideas coherent with some Technological Trajectories (TT) provided by Horizon 2020 and in line with the national and local operational programmes. These project ideas have been evaluated by a technical and scientific committee, taking into account specific criteria related to the Horizon 2020 technical guidelines. This paper aims to select the AgroBioPesca best projects portfolio by applying the multiple criteria sorting method (MCSM) ELECTRE TRI. A sensitivity analysis has lastly been conducted in order to verify the robustness of the solutions obtained.

Keywords: Project Management, Project Portfolio, Multi Criteria Decision Making, ELECTRE TRI approach.

1. Introduction

In the European context, the collaboration between public and private sectors in delivering innovation is encouraged by EU Research and Innovation Programme that provides various financial instruments, such as Horizon 2020 (H2020). This programme is EU's biggest one for research and innovation and, since its implementation, has strongly motivated many investors of various business sectors. The participation of companies has increased compared to H2020's predecessor programme (the Seventh Framework Programme for Research), thanks to the focus of the last one on research and innovation and on their deployment and application.

In this context, technological districts, that have been created to promote territorial development by means of research and innovation (Lerro and Jacobone, 2014), find opportunities of funding at national level (e.g. Programma Operativo Nazionale Ricerca&Innovazione 2014 – 2020- PON R&I 2014-2020) and international one (e.g. H2020) in order to develop their core business' activities. They represent a fundamental component of the Italian research system and have contributed significantly to the development and competitiveness of the country (Lerro and Schiuma, 2015). In Sicily, the AgroBioPesca Technological District (TD) aims to promote the networking between private companies and public research institutions in order to create a network able to increase the competitiveness of the Sicilian territory in the key agri-food sector.

In order to take the funding opportunities made available by the EU, the TD has organised meetings between the main players in the regional agri-food sector to identify new and concrete solutions to promote innovation. In order to reach this goal the TD has identified the research topics on which the project ideas will be developed by means of a careful analysis of strategies at both European, national and local level.

In particular, starting from the analysis of the documents of H2020 (The Framework Programme for Research and Innovation. Brussels, 2011) and considering the peculiarities of the Sicilian territory (Strategia Regionale dell'Innovazione, SRI-3), six technological trajectories (TT) have been identified.

For each TT many players, belonging to private or public organizations, have presented several project ideas. These project ideas have been analysed by a technical and scientific committee in order to identify the most significant proposals with which the TD will participate in the funding calls provided with the 2014-2020 programming. The proposals have been assessed by taking into account several evaluation criteria defined in accordance with the H2020's assessment guidelines and forms. In specific the criteria considered in the following paper are Impact, Excellence, Quality and Efficiency. The criteria weights were determined by using the value reported in the H2020's assessment form, instead the sub-criteria weights have been calculated by considering pillars' budgets allocated by the European Commission (EC).

Therefore, the study is a preliminary analysis that allows the TD to focus its attention only on project ideas with the most similar characteristics to H2020 standards by means of the application of a structured approach. The aim of the paper is to provide a methodology able to sort project ideas into three classes in order to define TD project portfolio: Rejected Project Ideas (RPI),

Reviewable Project Ideas (RwPI) and Eligible Project Ideas (EPI).
The study conducted in this paper is dealt with a multi criteria methodology named ELECTRE TRI (Mousseau et al., 2000). This method, belonging to ELECTRE family methods (Roy, 1991), allows to sort alternatives/projects into predefined and ordered classes separated by reference profiles. These profiles have been defined by following H2020's assessment forms. Indifference, preference and veto thresholds, necessary to implement the methodology, have been defined by TD's board. This approach allows decision makers to select a solution by tackling the complexity and uncertainty that could characterize the decision-making process. Moreover, ELECTRE TRI method has been used in literature to provide decision support in several kinds of problems. Reginaldo (2015) proposes to assess a portfolio of projects with the support of ELECTRE TRI approach by using the identification of the companies' latent need for improvement in the portfolio management process. Sánchez-Lozano et al. (2014) use the same method to identify and classify the best plots for installing photovoltaic solar farms in the Municipality of Torre Pacheco, in the southeast of Spain. Mavrotas et al. (2003) address the selection of projects for funding from the competent Greek authority for the installation of renewable wind energy plants in different regions of Greece. The selection among these projects is a multi criteria problem that has been solved with the support of a Decision-Aid tool combining the multi criteria classification method ELECTRE-TRI and Integer Linear Programming. Mota et al. (2012) propose a decision model for helping project managers to focus on the main tasks of a project network during its life cycle. The model assigns priorities classes and it's solved by means ELECTRE TRI-C method. Silva et al. (2014) study the assessment of the environmental sustainability of agricultural infrastructures of dairy farms in the Entre-Douro-e-Minho (EDM) Region by developing a Web MC-SDSS, named ELECTRE TRI in ArcGIS with which the system GIS is integrated with the results of multiple criteria decision-aid (MCDA) ELECTRE TRI method. This paper aims at providing a structured, objective and transparent methodology (ELECTRE TRI approach) able to help the decision maker (AgroBioPesca TD) to focus on the most valuable received project ideas. In particular, the main goal is to create a project portfolio as objective as possible in compliance with H2020's guidelines. The ELECTRE TRI method applied in this paper guarantees the TD to include the EC policy for selecting the project ideas. In fact, the more coherent the proposals to H2020's objective are, the greater the probability of the proposal to be financed are. In order to fulfil these goals, the parameters required by ELECTRE TRI, such as criteria weights and reference profiles are derived by H2020's programme. The use of parameters recognized at European level permits the standardization of the main input necessary for methodology implementation avoiding errors that are in the nature of subjective evaluations. However, the methodology takes into account the TD preferences by means of the definition of the ELECTRE TRI thresholds' values. These values are, in fact, set by the TD board. Since these values are affected by a certain degree of subjectivity, a sensitivity analysis based on them is performed in order to test the robustness of the method. In specific, the sensitivity analysis is carried out on veto threshold in order to prove the robustness of the eligible project ideas (i.e. Project ideas in the EPI class) because this is the most critical parameter that influences the outranking relations (Dias and Mousseau, 2005). The clustering of projects has been carried out several times with a slight variation in the veto threshold.
Ultimately, the proposed study is a valid support for all organizations wishing to define their competitive project portfolio in the European founding context. The methodology proposed is replicable; in fact, the input parameters are objective because they reflect in detail the directives of the H2020 programme. Finally, the study conducted in this work proposes to identify not only the best proposals but also those that could be improved.

2. Materials and methods

In this section the Technological Trajectories chosen, the criteria selected and the methodology implemented are described.

2.1 Technological Trajectories

In order to effectively pursue the objectives of TD, an analysis has been conducted to identify the most promising areas for research activities. TT's definition has been made considering the most important areas of action for the Region of Sicily concerning agro-food system. In particular, TD has focused its attention on six TTs derived from H2020, PON R&I 2014-2020 and POR 2014-2020 programmes.

TT_1: Health and Wellness
H2020's Framework Programme for Research and Innovation fully supports the promotion of health, prevention of disease and improvement of physical and mental wellness of the population. Nutrition is one of the factors that most affects people's quality life and psycho-physical conditions (Barr and Schumacher, 2003). Several researches (Ohrnberger et al., 2017; Xu et., 2010) demonstrate the presence of a correlation between different lifestyle aspects and physical/mental health. In recent years, changes in eating habits due to globalisation have led to an increase in chronic diseases such as obesity, cardiovascular diseases, type 2 diabetes, metabolic syndrome, hypertension and certain types of cancer (Cecchini et al., 2010). According to the World Health Organisation, around one third of cardiovascular diseases and cancers could be prevented through a balanced and healthy diet. Therefore, it is necessary to provide consumers with the opportunity to buy healthy and attractive foods in order to follow a balanced diet. According to above statements, TD decides to invest in this area to ensure that the increasing demand of healthy food is met.

TT_2: Food Safety
The EU's food safety policy aims to ensure that, nowadays and in the future, citizens are provided with

safety food. Protecting the health of humans, animals and plants at every stage of production is a key priority for the public health and the economy of the country. In order to guarantee food safety for consumers and to safeguard the agri-food sector, the EU has adopted the global "from farm to fork" intervention strategy, which focuses on the concept of traceability of both incoming and outgoing food flows (Bánáti, 2014). The EU's food safety policy has established rules and mandatory controls to guarantee the safety of the agri-food supply chain in order to ensure that plant and animal products are healthy, that food and feed are safe, of high quality, properly labelled and complied with stringent EU standards (Regulation (eu) no 1169/2011.)

TT_3: Production processes for food quality

The increasing demand of products with a high added value in terms of quality, safety and sustainability has pushed industry and research to employ new processes able to preserve food's organoleptic and nutritional characteristics. The main goal of this trajectory is the development of advanced technologies able to improve the quality food and its shelf life. Another aspect taken into account in this trajectory is the use of advanced technologies in order to obtain a food that meets the specific needs of the consumer (tailor-made food). Several researches are oriented on these topics, in (São José et al., 2014) the ultrasound is used such as sanitization technology on fruits and vegetables. Perishable foods are generally stored at controlled temperature and/or they are packaged under modified atmosphere (MAP) in order to extend their shelf-life (Holley and Patel, 2005). Finally the fortification of different types of foods and beverages with omega-3 fatty acid are reported in (Jacobsen, 2013).

TT_4: Sustainable and competitive food production

In the "World Population Prospects" document (World Population Prospects: the 2017 revision – Key finding and advanced tables, 2017) offered by the United Nations it is estimated that the world population will be of about 9.8 billion in the 2050. The population growth will imply a greater consumption of food. It will be hence necessary to produce more food trying to reduce more and more the use of natural resources such as water and soil. This increase of food production will contribute to climate change, scarcity water, soil degradation and destruction biodiversity (Foresight. The Future of Food and Farming Final Project Report, 2011). Global food production methods must change to minimise environmental impact and support capacity of the world to produce food in the future. Therefore, the challenge facing the food sector is to increase production, reducing environmental impact and the use of natural resources such as water and soil, while producing healthy, safe foodstuffs (Melnyk et al., 2003).

TT_5: Blue growth: enhancing the potential of living aquatic resources

Blue growth is the long-term strategy to support sustainable growth in the marine and maritime sectors. Blue growth concept satisfies the need of more holistic management of complex marine social-ecological systems (Eikeset et al., 2018). The strategy recognises that the seas and oceans are a driving force for the European economy, with enormous potential for innovation and growth, but given the fragile nature of the marine environment, the blue economy must be sustainable and respect potential environmental problems. The management of relevant economic sectors related to maritime environment is a crucial aspect. The growth of these sectors, like capture fisheries, in fact could lead substantial damages to marine ecosystems (Boonstra et al., 2018). In order to achieve smart, sustainable and inclusive growth, an appropriate action is also necessary to reduce the negative environmental impacts of maritime activities, such as pollutant emissions and discharges of harmful substances.

TT_6: Use and valorisation of by-products from agri-food production

One of the most serious problems that characterized agri-food sector, is the waste productions. Their reduction and valorisation are themes strongly promoted by institutions and legislative bodies and widely discussed by the scientific community (Rebitzer et al., 2004). The recovery of substances with high value from the waste could lead benefits as solving the problem of waste disposal and reducing the environmental impact of waste. The problem of the waste reduction and the recovery of functional substances that can be used to enrich food is showed in La Scalia et al., 2017. In this paper the authors highlighted the possibility to recover substances with a high added value (phenolic compounds) from the olive oil wastewater to enrich the extra virgin olive oil with the consequent reduction of the waste. Then, the primary objective of this TT is the valorisation of the by-products and the waste from agricultural production and the food industry. This implies the reduction of the environmental impact due to their disposal, through the application of biochemical/chemical processes that allow to convert by-products and waste into raw materials for the production of chemical compounds, materials and energy.

2.2 Criteria definition

According to the H2020 guidelines and forms a set of criteria, have been defined. In particular, H2020 evaluates grant proposals on the basis of the following criteria: Impact, Excellence and Quality & Efficiency. In this paper, the definition of the evaluation criteria has been carried out by means of a careful study of H2020 documents related to different type of actions. The evaluation criteria are described below.

Criterion 1: Impact

One of the main goals of H2020 programme is to integrate the Research, Development & Innovation between public and private players to increase companies' innovation capacity, by underpinning the Europe 2020 strategy for smart, inclusive and sustainable growth.

Impact criterion is considered in order to evaluate if a project idea is able to produce effects on citizens which are the beneficiaries of the investment programmes output. Therefore, this criterion stresses the importance of how the commercialisation plan will be developed further (in house development, licensing strategy, etc.) but also how much project outputs will contribute to the expected impacts and the need for innovation and sustainable growth of the companies. The study of the entire H2020 programme has shown that the concepts of innovation and competitiveness reflect the notions set out in Industrial "Leadership's fundamentals", because the aim of this pillar is to create industrial leadership in a competitive framework that makes Europe a more attractive place to invest in research and innovation.

On the other hand, the concept of sustainable growth is addressed in "Societal challenges" pillar. The "Societal challenges" priority responds to the key needs identified by the Europe 2020 strategy and addresses issues of major socio-economic impact with the aim of ensuring that research and innovation efforts allow the socio-economic development of the EU health, demographic change and wellness; food security, sustainable agriculture, marine and maritime research and bio-economy; safe, clean and efficient energy.

By taking into account the assumptions above, Impact criterion has been divided into the two sub-criteria $C_{1.1}$ Industrial Leadership and $C_{1.2}$ Societal challenges.

Criterion 2: Excellence

The criterion Excellence takes into account the degree of innovation of the project idea and the risks associated with its possible placing on the market. In particular, Excellence evaluates:

- innovation of solutions in comparison with existing ones;
- technical feasibility of the proposal.

Criterion 3: Quality & efficiency

The criterion Quality and efficiency takes into account the technical/business experience of the team including their managing capacity. It evaluates the availability of the resource required (personnel, facilities, network, etc.) to develop the project activities, ensuring that all the participants have a valid role and adequate capabilities to fulfil that role.

2.3 The methodological approach

2.3.1 ELECTRE TRI

ELECTRE TRI is a Multiple Criteria Sorting Method (MCSM) that defines the Decision Maker's (DM) preference model through the assignment of project alternatives $a_m \in A = \{a_1, a_2, \ldots, a_m\}$, to ascending ordered classes $C_h \in Z = \{1, 2, \ldots, h, \ldots, z\}$. The performance of each alternative is given on the basis of qualitative and/or quantitative criteria g_j where $j \in \{1, 2, \ldots, J\}$. Compared to other ELECTRE methods, which aim to establish a ranking of alternatives, ELECTRE TRI is designed to assign the alternatives to classes C_h that must be *a priori* defined by means of references profile p_h. The set of the classes are ordered by the worst to the best one and each one is characterized by a lower profile p_{h-1} and an upper profile p_h (Kadziński and Słowiński, 2015). The procedure of ELECTRE TRI method for assigning a given potential alternative to a certain class consists of the following phases:

1. the definition of outranking relations S between alternatives and reference profiles (i.e. $a_m\ S\ p_h$) and vice versa (i.e. $p_h\ S\ a_m$);
2. the attribution of each project alternative a_m to a predefined class.

In particular, the meaning of relation $a_m\ S\ p_h$ is "a_m is at least good as p_h" on a majority of criteria (concordance principle) whereas the minority of criteria does not support this assertion (discordance principle) (Mousseau et al., 2001).

The outranking relation is obtained developing the *credibility index of outranking* $\sigma(a_m, p_h) \in [0,1]$ (and vice versa) as provided by the ELECTR III algorithm (Roy and Bouyssou, 1993).

At the end of the first phase the methodology converts the fuzzy outranking relations into crisp ones by means of a parameter named λ - cutting level ($\lambda \in [0,1]$) that represents the smallest value of the credibility index compatible with the assertion $a_m\ S\ p_h$.

The comparison between $\sigma(a_m, p_h)$ (and vice versa) and λ-cut allows to determine the preference relation between a_m and p_h. In particular, let $\succ$, I and R denote respectively the preference, indifference and incomparability relation, the alternative a_m and the profile p_h may be correlated with the following binary relations:

- $a_m\ I\ p_h$ iff $a_m\ S\ p_h$ and $p_h\ S\ a_m$,
- $a_m \succ p_h$ iff $a_m\ S\ p_h$ and not $p_h\ S\ a_m$,
- $p_h \succ a_m$ iff $p_h\ S\ a_m$ and not $a_m\ S\ p_h$,
- $a_m\ R\ p_h$ iff not $a_m\ S\ p_h$ and not $p_h\ S\ a_m$.

The second phase of the method consists in the exploitation of the outranking relations with the aim of assign an alternative to a defined class. The method suggests two assignment procedures: the optimistic and the pessimistic. Specifically, the rules' generalization mentioned above is the following:

Pessimistic rule: by comparing the alternative a_m with the best reference profile p_i $(i = z, z\text{-}1, \ldots, 1)$, the alternative a_m will be assigned to the highest class C_{h+1} such that ($a_m\ S\ p_h$).

Optimistic rule: by comparing the alternative a_m with the worst reference profile p_i $(i=1, 2, \ldots, z)$, the alternative a_m will be assigned to the lowest class C_h such that ($p_h \succ a_m$).

When no incomparability (R) occurs between the alternative and the reference profile the two assignment procedures provide the same output (Figuera et al., 2005).

In this paper, ELECRE TRI method is applied for sorting collected project ideas of each scenario (TT) and, for each of these, the optimistic classifications have been determined.

According to Roy and Bouyssou, 1993, the λ-cut value is belonging the range [0.5; 1].

3. Case Study

The strategic plan "Call for ideas" has allowed the TD to collect several project ideas for each TT. The total number of proposals received by TD for each TT is reported in Table 1.

Table 1: Number of received projects

Technological Trajectories	Number of received proposals
TT1	31
TT_2	31
TT_3	33
TT_4	32
TT_5	26
TT_6	27

TD’s technical and scientific committee has evaluated the project ideas in accordance with criteria and sub-criteria described in paragraph 2.2. According to H2020’s assessment forms, the weights of 0.50, 0.25 and 0.25 to the macro criteria Impact (C_1), Excellence (C_2), Quality and Efficiency (C_3) respectively have been considered. The procedure by which the weights of sub-criteria $C_{1.1}$ and $C_{1.2}$ have been calculated takes into account the budget assigned to “Industrial Leadership” and “Societal Challenges” pillars by H2020’s programme (16,466 and 28,629.6 million € respectively). The weights of criteria and sub-criteria are reported in Table 2:

Table 2: Weights of criteria and sub-criteria

Criteria	Weights
$C_{1.1}$	0.183
$C_{1.2}$	0.317
C_2	0.250
C_3	0.250

As said before, the main goal of this paper is to assign project ideas into three distinct classes: Rejected Project Ideas (RPI), Reviewable Project Ideas (RwPI) and Eligible Project Ideas (EPI). The implementation of ELECTRE TRI requires *a priori* definition of classes, i.e. reference profiles that delimit the boundary between the adjacent classes. The design of these latter has been achieved by means of the evaluation scale (Table 3) provided by H2020’s assessment forms.

Table 3: H2020 evaluation scale

Score	Qualitative judgment	Interpretation
0	Rejected	The proposal fails to address the criterion or cannot be assessed due to missing or incomplete information
1	Poor	The criterion is inadequately addressed, or there are serious inherent weaknesses
2	Fair	The proposal broadly addresses the criterion, but there are significant weaknesses
3	Good	The proposal addresses the criterion well, but a number of shortcomings are present
4	Very Good	The proposal addresses the criterion very well, but a small number of shortcomings are present
5	Excellent	The proposal successfully addresses all relevant aspects of the criterion

For the purpose of this study, the evaluation scale has been linearly normalized in the interval [0,1]. According to authors’ opinion, a project should be evaluated with a qualitative judgement of “Fair” on all criteria in order to not be discarded; otherwise, if the project idea obtains a score of “Good” (or more) on each criterion, coherently with H2020, it would be considered eligible for funding. By following statements above, the reference profiles have been identified at the “Fair” and “Good” levels.
The normalized assessment scale in Table 3, with the addiction of the intermediate levels that symbolize the situations of compromise has been also provided to the technical and scientific committee of TD in order to evaluate the project ideas. Hence, the decision maker has evaluated a project idea with a score in the interval [0;1] in steps of 0.1. The indifference, preference and veto thresholds, defined by TD’s board, are 0.1, 0.2 and 0.4 respectively, whereas the λ - cutting level considered is 0.55.

4. Results and discussions

4.1 Sorting procedure

The procedure for sorting project ideas to the classes has been performed by ELECTRE TRI method. Since the case study analyzed is related to TD’s initial stage of evaluating proposals, a higher number of project ideas could increase the social impact of “Call for ideas” strategic plan from a political point of view. For this reason, the optimistic procedure, which tends to oversize the best class of projects eligible for funding, has been considered. Let $P_{i,j}$ be the project idea *j* belonging to the TT_i, Table 4 shows the results of the classification methodology.

Table 4: Sorting of classic ELECTRE TRI method

	RPI	RwPI	EPI
TT_1	$P_{1.2}$, $P_{1.5}$, $P_{1.15}$, $P_{1.18}$, $P_{1.20}$, $P_{1.21}$, $P_{1.22}$, $P_{1.23}$, $P_{1.26}$, $P_{1.27}$, $P_{1.29}$	$P_{1.7}$, $P_{1.9}$, $P_{1.10}$, $P_{1.12}$, $P_{1.13}$, $P_{1.14}$, $P_{1.16}$, $P_{1.19}$, $P_{1.24}$, $P_{1.30}$	$P_{1.1}$, $P_{1.3}$, $P_{1.4}$, $P_{1.6}$, $P_{1.8}$, $P_{1.11}$, $P_{1.17}$, $P_{1.25}$, $P_{1.28}$, $P_{1.31}$
TT_2	$P_{2.5}$, $P_{2.18}$, $P_{2.24}$, $P_{2.27}$, $P_{2.30}$	$P_{2.3}$, $P_{2.4}$, $P_{2.8}$, $P_{2.10}$, $P_{2.11}$, $P_{2.14}$, $P_{2.15}$, $P_{2.17}$, $P_{2.20}$, $P_{2.23}$, $P_{2.28}$	$P_{2.1}$, $P_{2.2}$, $P_{2.6}$, $P_{2.7}$, $P_{2.9}$, $P_{2.12}$, $P_{2.13}$, $P_{2.16}$, $P_{2.19}$, $P_{2.21}$, $P_{2.22}$, $P_{2.25}$, $P_{2.26}$, $P_{2.29}$
TT_3	$P_{3.3}$, $P_{3.10}$, $P_{3.16}$, $P_{3.30}$, $P_{3.33}$	$P_{3.5}$, $P_{3.6}$, $P_{3.18}$, $P_{3.20}$, $P_{3.21}$, $P_{3.22}$, $P_{3.24}$, $P_{3.26}$, $P_{3.27}$	$P_{3.1}$, $P_{3.2}$, $P_{3.4}$, $P_{3.7}$, $P_{3.8}$, $P_{3.9}$, $P_{3.11}$, $P_{3.12}$, $P_{3.13}$, $P_{3.14}$, $P_{3.15}$, $P_{3.17}$, $P_{3.19}$, $P_{3.23}$, $P_{3.25}$, $P_{3.28}$, $P_{3.29}$, $P_{3.31}$, $P_{3.32}$
TT_4	$P_{4.7}$, $P_{4.12}$, $P_{4.13}$, $P_{4.15}$, $P_{4.25}$, $P_{4.29}$, $P_{4.32}$	$P_{4.1}$, $P_{4.9}$, $P_{4.22}$, $P_{4.23}$, $P_{4.24}$, $P_{4.26}$, $P_{4.28}$, $P_{4.31}$	$P_{4.2}$, $P_{4.3}$, $P_{4.4}$, $P_{4.5}$, $P_{4.8}$, $P_{4.10}$, $P_{4.11}$, $P_{4.14}$, $P_{4.16}$, $P_{4.17}$, $P_{4.18}$, $P_{4.19}$, $P_{4.20}$, $P_{4.21}$, $P_{4.27}$, $P_{4.30}$
TT_5	$P_{5.3}$, $P_{5.4}$, $P_{5.14}$, $P_{5.15}$, $P_{5.17}$, $P_{5.20}$	$P_{5.1}$, $P_{5.2}$, $P_{5.6}$, $P_{5.12}$, $P_{5.13}$, $P_{5.21}$, $P_{5.22}$, $P_{5.26}$	$P_{5.5}$, $P_{5.7}$, $P_{5.8}$, $P_{5.9}$, $P_{5.10}$, $P_{5.11}$, $P_{5.16}$, $P_{5.18}$, $P_{5.19}$, $P_{5.23}$, $P_{5.24}$, $P_{5.25}$
TT_6	$P_{6.1}$, $P_{6.4}$, $P_{6.5}$, $P_{6.6}$, $P_{6.8}$, $P_{6.12}$, $P_{6.16}$, $P_{6.19}$, $P_{6.22}$, $P_{6.24}$	$P_{6.2}$, $P_{6.9}$, $P_{6.20}$, $P_{6.23}$, $P_{6.26}$	$P_{6.3}$, $P_{6.7}$, $P_{6.10}$, $P_{6.11}$, $P_{6.13}$, $P_{6.14}$, $P_{6.15}$, $P_{6.17}$, $P_{6.18}$, $P_{6.21}$, $P_{6.25}$, $P_{6.27}$

Furthermore, Table 5 shows the percentage values of the project ideas belonging to the three defined classes. This table shows that, for all TTs, the EPI class is the most numerous, with the exception of TT_1 for which the number of rejected project ideas is greater than these eligible for funding.

Table 5: Percentage of projects in the classes

	RPI	RwPI	EPI
TT_1	36%	32%	32%
TT_2	16%	35%	49%
TT_3	15%	27%	58%
TT_4	22%	25%	53%
TT_5	23%	31%	46%
TT_6	37%	19%	44%

4.2 Sensitivity analysis

In order to test the robustness of the system, the authors have decided to perform further studies concerning the threshold values selected for the implementation of the method. In fact, while the evaluation criteria and the corresponding weights have been extrapolated from the H2020 documentation the values of indifference, preference and veto thresholds have been defined in a subjective way by TD's project board. In particular, it has decided to pay more attention on the veto threshold. For this purpose, the sensitivity analysis has carried out by means of the application of ELECTRE TRI method by adopting veto threshold's values of 0.5 and 0.6 respectively. Table 6 shows the robust project ideas that are the proposals whose class has been unchanged in the three classifications. In particular, the project ideas belonging to EPI class of TT_2, TT_3 and TT_4 are all robust. As regards TT_1, the proposals of EPI class are all robust, even if five project ideas of RwPI class have moved in the RPI class. In TT_5, all proposals are robust except the $P_{5.11}$, $P_{5.16}$, $P_{5.23}$ and $P_{5.24}$ that belong to the EPI class and finally for TT6 all the project ideas are robust with the exception of $P_{6.17}$ and $P_{6.26}$, belonging to EPI and RwPI classes respectively. Moreover, Table 6 shows the robust project ideas that belong to EPI class.

Table 6: Robust project ideas

	EPI
TT_1	$P_{1.1}$, $P_{1.3}$, $P_{1.4}$, $P_{1.6}$, $P_{1.8}$, $P_{1.11}$, $P_{1.17}$, $P_{1.25}$, $P_{1.28}$, $P_{1.31}$
TT_2	$P_{2.1}$, $P_{2.2}$, $P_{2.6}$, $P_{2.7}$, $P_{2.9}$, $P_{2.12}$, $P_{2.13}$, $P_{2.16}$, $P_{2.19}$, $P_{2.21}$, $P_{2.22}$, $P_{2.25}$, $P_{2.26}$, $P_{2.29}$, $P_{2.31}$
TT_3	$P_{3.1}$, $P_{3.2}$, $P_{3.4}$, $P_{3.7}$, $P_{3.8}$, $P_{3.9}$, $P_{3.11}$, $P_{3.12}$, $P_{3.13}$, $P_{3.14}$, $P_{3.15}$, $P_{3.17}$, $P_{3.19}$, $P_{3.23}$, $P_{3.25}$, $P_{3.28}$, $P_{3.29}$, $P_{3.31}$, $P_{3.32}$
TT_4	$P_{4.2}$, $P_{4.3}$, $P_{4.4}$, $P_{4.5}$, $P_{4.6}$, $P_{4.8}$, $P_{4.10}$, $P_{4.11}$, $P_{4.14}$, $P_{4.16}$, $P_{4.17}$, $P_{4.18}$, $P_{4.19}$, $P_{4.20}$, $P_{4.21}$, $P_{4.27}$, $P_{4.30}$
TT_5	$P_{5.5}$, $P_{5.7}$, $P_{5.8}$, $P_{5.9}$, $P_{5.10}$, $P_{5.18}$, $P_{5.19}$, $P_{5.25}$
TT_6	$P_{6.3}$, $P_{6.7}$, $P_{6.10}$, $P_{6.11}$, $P_{6.13}$, $P_{6.14}$, $P_{6.15}$, $P_{6.18}$, $P_{6.21}$, $P_{6.25}$, $P_{6.27}$

5. Conclusions

In the light of the new global economic scenario and the increasing competitiveness among companies, it has become necessary to focus more and more on technological innovation. These challenges have led the establishment of technological districts that are organizations characterized by a high technological footprint and by a local concentration, where players are networked in order to share know how. The objective to raise the level of innovation in the Sicilian agri-food sector is pursued by the AgroBioPesca Technological District. In particular, the study deals with the evaluation and classification of project ideas received by TD in six different TTs. In this paper, to satisfy this goal, the ELECTRE TRI sorting method, that allows to assign proposals into ordered and defined classes on the basis of different evaluation criteria, was used.

The identified criteria (Impact, Excellence and Quality and Efficiency) have been chosen, together with their weights, by means of a careful study of H2020's guidelines and forms. The boundary of the three identified class ("Rejected project ideas", "Reviewable project ideas" and "Eligible project ideas") have been specified by two reference profiles whose values have been defined by the authors by means of the evaluation scale provided by the H2020's assessment forms. The score of each project ideas and ELECTRE TRI thresholds values have been decided by the technical and scientific committee and the board of the TD respectively. The TD has collected 180 project ideas belonging to the different TTs. The results obtained show that the 47%, 28% and 25% of these proposals belong to the EPI, RwPI and RPI class respectively.

Finally, in order to test the robustness of the system, a sensitivity analysis has been performed on veto threshold's value that is the most significant for the formalization of outranking relations. By adopting a value of 0.5 and 0.6 respectively, compared to the original value of 0.4, only the 6% of project ideas are not robust.

Further studies in this field could concern the definition of several Key Performance Indicators able to provide the decision maker with clear (objective) indications about the proposals' features to be improved in order to make them suitable for funding. Finally, the degree of uncertainty associated with decision makers' judgments should be also taken into account.

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