Special Economic Zones Planning for Sustainable Ports: The Role of Research and Training in the Calabria Region

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Abstract. Special Economic Zones (SEZs) play a relevant role for countries to attract foreign investment and increase economic development. A Special Economic Zone (SEZ) can influence production efficiency through various channels. Different factors can contribute to increase the production of value-added other than the one linked with economic activities.

This paper focuses on the possible contribution of research and training for increasing value-added in a SEZ context. Research Centres, and Universities, have to interchange with all productive sectors operating in the Special Economic Zones (SEZs). Systematic connections between research and production are needed. For this reason, in a strategic perspective, a set of actions can be planned and implemented with the aim to activate and consolidate interchanges of knowledge and skills among public administrations and private companies.

The paper studies the role of research and training to realize a SEZ in the Calabria region (Italy). The specific SEZ constitutes an opportunity for the economic development of the existing industrial areas of the region, and particularly the transhipment hub of Gioia Tauro. The Special Economic Zone (SEZ) can support and be a booster for the potentialities of the hub port, in relation with the research centres and universities operating in the area of influence of the SEZ.

Keywords: Special economic zone · Innovation · Research and development · Training · Strategic plan · Logistics · Ports

1 Introduction

Special Economic Zones (SEZs) play a relevant role for countries to attract foreign investment and increase economic development. A SEZ can influence production process and relative efficiency through various ways [1, 2].

In 2019 there were 5,383 SEZs active in 147 countries around the world; three quarters of these are relate to countries characterized by developing economies. The need to realize a SEZ is often linked to the necessity to support sustainable development, especially in depressed areas [3].

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It is possible to identify different factors that characterise a SEZ. One of the best-known factors is related to special conditions for enterprises defined in terms of simplification of administrative processes and favorable tax regimes [4]. Often, the final aim is to support the increase the production of added value (AV), linked with economic activities [5, 6]. This paper investigates the role of innovation as a way of economic growth in a depressed area. There is a wide variety of innovation incentive policies, such as awarding enterprises' applications for patents and patent-related honors, and awarding cooperation among enterprises, universities and research institutions (see for instance the case of China illustrated by [7]). This paper focuses on the immaterial factors related to research and training aimed to increase AV of the production processes in a port area. Here, AV is related to logistics port function, in a perspective of fourth generation [8, 9]. In this case, policies to encourage innovation are aimed to increase efficiency of port operations [10] and productive processes located in the areas near maritime terminal [8]. These policies result from a planning process that identifies different SEZ structural factors [11] that can produce impacts on the sustainability components [12].

The specific case study is the planning process that configured the SEZ in the Calabria Region, in the south of Italy [13, 14].

The paper, after this introduction, has three sections. Section 2 describes a general framework of a Special Economic Zone strategic planning process; the same section illustrates the role of the research and training (R&T) for port development and a procedure to individuate innovation gaps and interventions aimed to reduce these gaps. According to Sect. 2, Sect. 3 describes the R&T interventions provided to develop the SEZ in the Gioia Tauro port.

2 SEZ Strategic Planning

2.1 The General Framework

Literature individuates structural factors that can be the contents of a strategic plan for defining SEZ configuration. It is possible to individuate the following classes of structural factors [15, 16]:

- material factors, including elements of the territory and relative infrastructures where Special Economic Zones will be located (e.g. transport infrastructures for accessibility);
- immaterial factors, including two sub classes,
  - technologies to support productive processes, from traditional tools to emerging Information and Communication Technologies (ICTs) (e.g. IoT and monitoring tools);
  - research and training to support innovation and increase know-how about productive processes (e.g. methods and models to increase effectiveness and efficiency);
- institutional factors, including rules for introducing special conditions for business operating inside SEZs (e.g. simplification of administrative procedures).

Each factor and their combination have a specific role in order to increase sustainable development in each component (economic, social and environment sustainability). It is possible to express each factor as a quantitative variable of a function for estimating contribution to sustainable development. Note that sustainability constitutes the final goals of SEZ strategic planning process and relative implementations (Fig. 1).

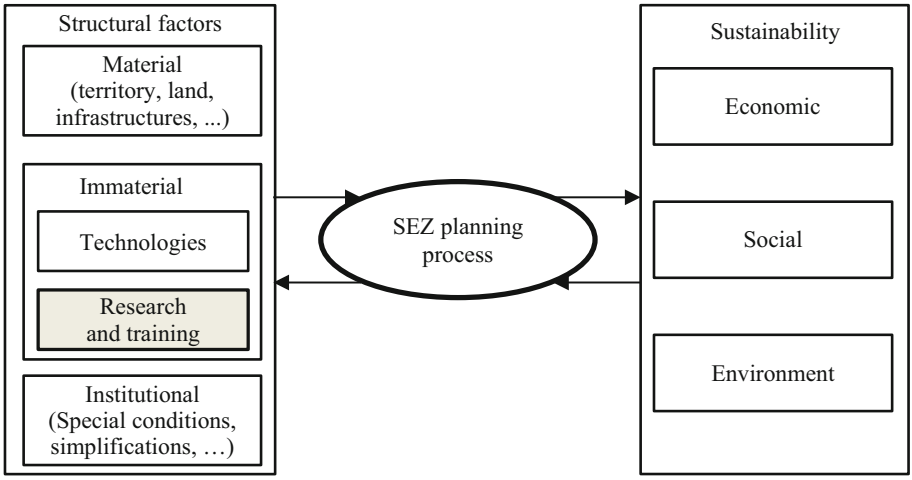

Fig. 1. SEZ planning process for sustainable development

2.2 Research and Training (R&T) Role for Port Development

The paper focuses on the Research and Training structural factor (R&T) inside the Special Economic Zone (SEZ) planning process represented in Fig. 1. The specific context regards a SEZ in a port area with a focus on the role of R&T for developing a port towards the third and fourth generation perspective [15–17].

In general, R&T offers a contribution for increasing regional sustainable development. In the specific case of a SEZ realised in a port area, R&T supports the port's activities, contributing to the increase of the added value (AV). In literature, AV is the measure of the increase in value that occurs in the production and distribution of final goods and services thanks to the intervention of production factors. In the specific maritime transport sector, the AV's generation depends on processes introduced in the supply chain of goods production. Ports play a relevant role in the supply chain and this implies the necessity of knowledge about internal and external activities that characterise all nodes distributed at global level [18]. It requires innovation in the productive processes that generate competition among ports at global level.

For participating to the competition at global level, operators have to optimize all the internal characteristics of the port area, considering almost "adiabatic" compared to the outside territory. Moreover, ports belonging to the third generation interact with the external territory, in order to increase AV.

The potential optimal situation for a third-generation port can be written as:

$$\text{costs (generalized by transport)} < \text{benefits (added value)} \quad (1)$$

It should be noted that as long as the port remains a place of transit for goods, the management will try to improve the performance of transport, trying to reduce costs more and more. In this case, it is necessary to underline that there will always be the probability that another port, in the same area, will be able to give better performance. Therefore, by considering a potential competition between two ports named *a* and *b*, it could happen that:

$$\text{costs in the port } b \text{ (by transport)} < \text{costs in the port } a \text{ (by transport)} \quad (2)$$

The added value created in the port *a* plays a relevant role in the competition. If its absolute value is greater than the transport costs, the benefits produced by the port *a* can overcome those produced by the port *b.* This means that the port *a* is more competitive than the port *b.*

In any case, as the difference in absolute value between benefits and costs (Eq. 1) increases, the port will tend to become increasingly non-replaceable in the supply chain.

The R&T's structural factor of a SEZ located in a port area support the increase of knowledge of:

- internal companies inside the SEZ area;
- business network inside the economic district where the SEZ area is located;
- research centres located in the external territory located in proximity of the SEZ area.

With the other structural factors, R&T contributes to the activation of virtuous processes characterised by mutual interactions among all stakeholders involved in the SEZ planning process. The final aim is to create good conditions for activating innovation processes inside and outside the port. At the medium terms, the expected effect is the increase of the AV in a port of third generation. At long term, SEZ becomes the opportunity to increase sustainable development of the in the entre territory around the port.

For achieving these objectives, literature underlines, from one side, the necessity to increase performances levels in transport operations. For instance, Russo and Chilà [15] analyse the potential effects produced by interventions inside a port area. From other side, it is necessary to improve performance's operations on goods in transit, that increase their added value. Pellicanò and Trecozzi [4] propose a general approach for SEZ planning and for defining administrative simplifications in a SEZ context. An even more important effect derives from the external conditions. It is necessary that the external territory also provides conditions, both material and immaterial, so that the costs of transit decrease and the added value increases [11]. By considering the European and global scales, in many cases the big transport nodes have been created "ex-novo" and are completely free of interactions with the territory: high-speed railway stations, international airports, third generation intercontinental ports. In this context, the immaterial structural factors related to R&T can contribute to increase AV, creating conditions to the achievement of sustainable development. For this reason, it is necessary to consider the interventions connected to the increase in added value connected to manipulation of goods in transit

in a port. In particular, this paper focuses on the interventions on R&T aimed to supports activities of economic operators in the SEZ located in a port area. The final aim is to increase knowledge about processes and products related to goods in transit in a port in order to increase the AV. Next section proposes a procedure to individuate innovation gaps and the contexts a R&T interventions programme to fill them, with a specific focus on a port area.

2.3 Innovation Gaps and R&T Interventions

By focusing on a planning process aimed to define SEZ characteristics in a port area, it is necessary to individuate innovation gaps and plan a set of R&T interventions to overcome current limits. A possible procedure to face this issue consists of the following steps:

1. selection of the present and future economic sectors operating in the SEZ area, directly involved in the port activities that potentially increase the AV; the generic sector is indicated with s, belonging to the set of all sectors, S:

$$s_{SEZ} \in S_{SEZ} \tag{3}$$

2. analysis of the existing research centers operating near to SEZ area; the generic center is indicated with r, belonging to the set of all research center, R_{SEZ} operating in the territory near to the SEZ area:

$$r \in R_{SEZ} \tag{4}$$

3. individuation of the centers that can support the development of the port and in particular the economic sectors s_{SEZ}; the generic center is indicated with r_{AV}, belonging to the set R_{AV} that is obtained by the intersection between S_{SEZ} and R_{SEZ}:

$$r_{AV} \in R_{AV} = S_{SEZ} \cap R_{SEZ} \tag{5}$$

4. starting from the identification of the set R_{AV}, individuation of R&T interventions, to support existing research centers and cover the innovation gaps, with the final aim to increase the AV; at long term, the economic sectors s_{SEZ}, supported by the centers r_{AV} produce impacts in all sustainability components.

3 The Case Study: SEZ in the Gioia Tauro Port

3.1 The Strategic Plan of the Calabria Region for SEZ

The Italian government regulated the procedures, conditions and methods for the realization of Special Economic Zone (SEZ) in Italy [19]. According to national legislation, the economic current and future enterprises operating in the SEZ areas will be able to benefit from special conditions, in relation to the incremental nature of investments and business development activities.

According to the national laws, the Calabria Region started the activities for the creation of a Special Economic Zone producing a Strategic Development Plan [14]. The

plan identifies specific actions aimed at attracting investors who will be able to operate in the Calabrian SEZ.

The Calabrian SEZ is based on the Gioia Tauro port that is a core node of the TEN-T network. SEZ integrates further area connected to the core port in physical and functional terms. SEZ area are located inside to airports and ports and in the area near the transport terminals (Table 1).

Table 1. SEZ areas: location and surface

SEZ area	Location	Surface (ha)
Ports	**Gioia Tauro**	**402**
	Reggio Calabria	10
	Villa San Giovanni	4
	Crotone	26
	Vibo Valentia	16
	Corigliano Calabro	52
Dry port area	**Gioia Tauro, San Ferdinando, Rosarno**	**607**
	Crotone	380
	Porto Salvo Vibo Valentia	184
	Schiavonea Corigliano	340
Airports	Lamezia Terme	26
	Reggio Calabria	27
	Crotone	22

Source: Strategic Development Plan [14]

This paper focuses on the SEZ areas located in the Gioia Tauro port and dry port areas (Fig. 2).

According to the classification introduced in Sect. 2.1, Gioia Tauro SEZs area presents the following structural factors:

- material factors including facilities available in the port and in the surrounding area, including transport infrastructures.
  - a quay over 3 km long with depths of up to 18 m;
  - a dry port area of 1007 ha;
  - railway and road connections to the TEN-T network;
- immaterial factors including technological connections to telematics networks and a set of programmed financial resources to invest on research and training aimed to support innovation processes and, more in general, to increase the level of knowledge of existing and future economic operators;

- institutional factors including the introduction of special conditions with the introduction of a one-stop shop for productive activities, comprehending simplification of administrative processes.

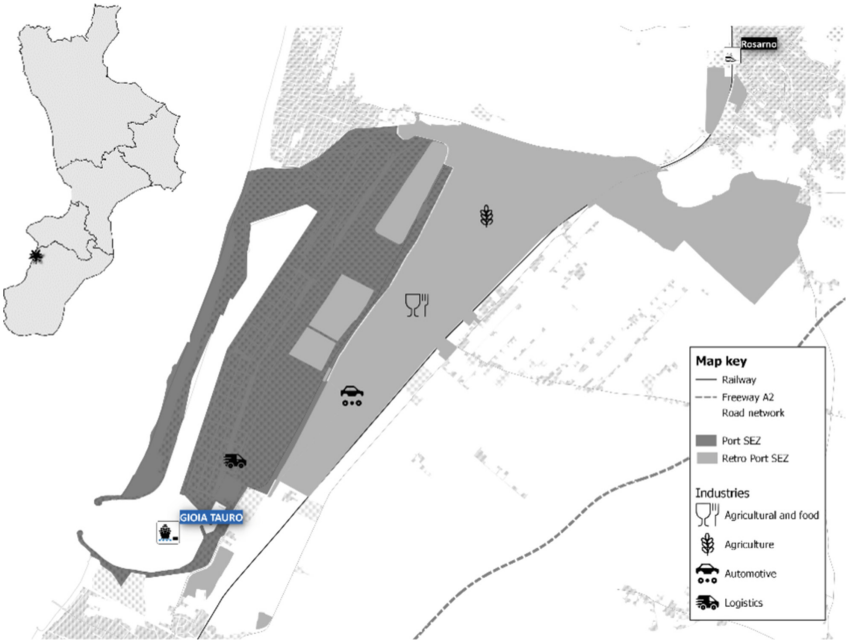

Fig. 2. SEZ in the Gioia Tauro port and in the surrounding area (source elaboration from [14])

Currently the prevailing function of the Gioia Tauro port is the transshipment. The railway gateway has recently been activated and railway connections are being improved, aiming to the European corridors dedicated to the transport of freight (Rail Freight Corridors). This represents an opportunity for the development of the Port of Gioia Tauro. It is necessary to focus on the development of the logistic function promoting economic activities that can increase the added value of goods in transit in the port.

3.2 R&T Investments for Gioia Tauro Port Development

The specific attention of this paper is on the R&T investments defined adopting the procedure illustrated in Sect. 2.3. Each subsection represents a step of the procedure.

3.2.1 Economic Sectors Selection

Calabria SEZ planning and implementation promote existing economic activities and that are intended to be promoted as a result of modeling for the estimation of the impacts expected from the SEZ. From the conducted analyses [5], it emerges that the Calabrian

economy is based on small and medium-sized enterprises. There are also some major players operating at the international level with production sites concentrated in the industrial areas of the four provinces of the region. The prevalent economic sectors are manufacturing, with reference to the agri-food sector [20], also correlated to the agriculture sector and the automotive sector [21]. Related activities are transport, logistics and warehousing (Table 2). The enterprises represent the element of the set S_{SEZ} introduced in Sect. 2.3. The agri-food sector drives regional exports, mainly directed towards the countries of the European Union. At a sub-regional level, although it is not possible to identify strong specializations relating to individual production sectors, it is still possible to identify those with the highest relative density of employees and companies: agri-food that characterizes Cosenza; energy that characterizes Vibo Valentia, Crotone and Catanzaro; mechanics, transport and warehousing that characterize Reggio Calabria.

Table 2. Relevant economic sectors in each province (S_{SEZ})

Province	Mechanic/automotive	Agriculture	Agri-Food	Transport and logistics
Cosenza	X	X	X	
Crotone			X	
Catanzaro			X	X
Vibo V.		X	X	
Reggio Cal.	X		X	X

3.2.2 Existing Research Centers

By referring to the province of Reggio Calabria that is the territory where is located the Gioia Tauro port, the set named R_{SEZ} in Sect. 2.3 comprehends the Mediterranea University of Reggio Calabria. The University comprehends six departments, and it develops research in engineering, architecture, agriculture, economics, law and human sciences.

3.2.3 Research Center for Supporting Port's Development

Note that the current expenses on research and development in the Calabria constitute the 0.7% of the total at national level, by considering enterprises, universities, public and private institutions. The great part (near to 60%) is represented by universities (Table 3).

By considering the focus of this paper, and the universities near the SEZ area of the Gioia Tauro (R_{SEZ}), the Mediterranea university of Reggio Calabria has been selected. Inside the Mediterranea university departments, specific laboratories operate developing research themes related to material and services port's activities. Among these, there are a set of laboratories (set intersection R_{AV}) that are working on research's topics of interest for the Gioia Tauro port:

- LAST works in the field of intelligent transportation systems applied in different contexts of sustainable mobility;
- Noel works on research about ocean/marine engineering, focusing on wave modelling related aspects and wave energy harvesting;
- NeuroLab works in the field of remote with applications in the health context.
- FoodTec works on advanced technologies to support food industry;
- ARTS works on research about protocols and applications for advanced telecommunication systems and services;
- LEMMA works on research about of inverse synthesis problems, high-performance antennas and advanced microwave devices design;

LOGICA works on interdisciplinary research related to the development of the Technological District of the Logistics in Gioia Tauro.

Table 3. Expenditure on intra-muros research and development (thousands of euro) Year 2019

Sector		Enterprises (a)	Public institutions (b)	University (c)	Private institutions (d)	Total	
Territory						v.a	%
Calabria	v.a.	56.360	19.942	112.879	746	189.927	0,7%
	%	30%	10%	59%	0%	100%	
Italy	v.a.	16.589.218	3.306.719	5.897.530	466.194	26.259.661	96,7%
	%	63%	13%	22%	2%	100%	

(a) excluding private universities; (b) excluding public universities; (c) public and private; (d) private non-profit. Source: Elaborations from ISTAT [22]

3.2.4 Planned R&T Interventions and Expected Impacts

Research and training represent a main objective of the Regional Transport Plan of the Calabria Region (Objective 1: Training and Research). Furthermore, Objective 6 is dedicated to the "*Gioia Tauro System*". In order to pursue this objective, the plan has set the specific measure "6.9 *Research and operational applications*", which provides for the activation of a research center on transport and logistics to support the main sectors established in the zone.

The objectives, actions and measures of the Regional Transport Plan are strongly connected to the realization of the SEZ in Calabria and in particular in the port and dry port of Gioia Tauro [15]. Specific actions of the strategic plan encourage research and development through research and innovation programs dedicated to universities and businesses. The information desk supports businesses by establishing contacts with University Research Centers and Technological Poles.

The main national and regional planning products provide for the development of Gioia Tauro port a set of interventions [23]: the activation of a research center on transport and logistics; the creation of a Campus for Innovation; the implementation of basic research lines functional to economic activities; the promotion of start-ups and spin-offs, the training and retraining of the workforce and the strengthening of phytosanitary controls. The planned research center should deal with the main operational applications concerning the port and the rear port, contributing to the transformation of the Port of Gioia Tauro into a fourth-generation port. The center could also develop research activities in transport and logistics to support the main sectors established: 1. agri-food, 2. external logistics, 3. manufacturing with particular reference to metal-mechanical, 4. energy, 5. ICT. In order to implement these interventions, it is necessary to promote agreements between enterprises and university departments, having a qualification of excellence recognized by national or international organizations. In this context, it is possible to use the opportunities offered by structural funds of European Commission. The research programs must be based on context analysis and preventive evaluation of the impacts (ex-ante conditionalities/enabling conditions). It is mandatory to verify the correspondence of the actions with the areas provided for by the "Smart specialization strategy for research and innovation of the Calabria Region" (S3 areas). The areas that mostly concern the SEZ of Gioia Tauro are: agriculture 4.0 and agri-food (AA); sustainable construction, energy and climate (EE); ICT, digital technologies and innovative service sector; smart manufacturing (SM); logistics and sustainable mobility (LO).

Table 4, for each economic sector that characterizes the SEZ's area of the Gioia Tauro, reports the corresponding S3 area and research laboratories of the Mediterranea University that could develop university compliant research programmer.

Table 4. Economic sectors in the Gioia Tauro SEZ, S3 areas and reference laboratories

Economic sectors (s_{SEZ})	S3 area	Laboratory (r_{AV})
1. Agri-food	AA	FoodTec
2. Logistics	LO	LAST, LOGICA
3. manufacturing / mechanical	SM	Lemma
4. Energy	EE	Noel
5. ICT	ICT	ARTS

AA: agriculture 4.0 and agri-food; EE: eco-sustainable construction, energy and climate; ICT: digital technologies and innovative service sector; SM: smart manufacturing; LO: logistics and sustainable mobility

The strategic plan for the SEZ specifies investments in R&T. The forecast of the impact of investments in R&T present in the strategic plan highlights the functional economic link between the integrated areas of the SEZ (ports, airports and industrial settlements), and the activities of territorial specialization and those that are intended to be promoted. According to the strategic plan, the activation of the SEZ has an impact on all components of sustainability.

With regard to economic sustainability, one of the main expected impacts is the increase in the AV. The activation of the research centre supports current and expected companies in order to activate the function of regional port that can potentially perform the port of Gioia Tauro in a fourth-generation perspective.

With regard to environmental sustainability, one of the main expected impacts is the increase in green production. An example is the APEA (Ecologically Equipped Production Area), consisting of a set of industrial, craft, commercial and agricultural companies. The APEA is characterized by the integrated management of infrastructures, centralized services and resources to increase sustainable development. Through the collective management of processes and technologies, the aim is to improve the competitiveness and green innovation of production systems and of the settlement as a whole [14].

With regard to social sustainability, one of the impacts expected from the establishment of the SEZ is the retraining of the workforce and the growth of skills through training. In order to pursue objective 1 of the PRT, specific measures are envisaged for the promotion of training in the fields of transport and logistics, in compulsory education, in secondary school and in institutes dealing with education and vocational training. through specialization of the processes of the good school with the activation of specific paths. The activation of paths aimed at increasing knowledge and skills in transport and logistics are aimed at improving the connections of the Calabria Region with the sea system.

4 Conclusive Remarks

Special Economic Zones (SEZs) represent an opportunity to increase economic growth in a depressed area. Different factors can contribute to the growth producing and increase of added value (AV) in the productive processes. Material factors and special conditions offered by a traditional SEZ need a further contribution to pursue sustainable development in all components (economic, social and environment).

In this context, this paper has investigated the role of immaterial factors for incentivizing innovation process, by means of investments on research and training in a SEZ area located in a port.

The paper presents limits connected to the lack of modeling tools for evaluating expected impacts produces by R&T interventions.

Future developments of this research regard two main directions. This first concerns insights about research topics and their expected impacts in relation to port development in a fourth-generation perspectives. The second direction concerns the extension of the case study to entire Calabria region, by considering the other research centers, or the other Italian SEZs, in order to evaluate strengths and weakness of the national planning process.

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