

Cartography and Security. Port Security: Trends and Perspectives

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Abstract. Safety and security represent central elements of policies at local, national and international levels. They are recalled particularly to-date in light of issues related to major threats as terrorism and, recently health-related events as global pandemics and epidemics. These two concepts are particularly relevant and become central in choices dealing with social and economical aspects. With a particular focus on Geographical Information Technologies and the Information and Communication Technologies (ICT), the paper hereby presented focuses on cartographic and geographic aspects on security, particularly related to the port areas and to the relations these have with the rest of the transport systems and cities with which, at least in more mature economies, they share spaces and issues. Starting from more general considerations that links cartography and security, in the present work we examine the topic by means of recent research projects dealing with the Port of Trieste and the perspectives related to security.

Keywords: Port security · Smart ports · ICT · Trieste

1 Introduction

Cartography and security represent a combination that can dates back to the beginning of the history of cartography and geographical representations. From the very beginning, maps, charts and all the tools related to geographical representation, as well as the processing and analysis of geographical data - then, especially in the most current period of development and expansion of Information and Communication Technologies - have had a strong link with security in the broadest sense.

Cartography was always related to issues of security, protection and military control. In particular, geodetic cartography was born and facilitates the determination of borders, the correct positioning of natural and anthropogenic elements on the ground, effectively supporting the armed forces of the various countries [1–4]. Knowledge of a state's own territory, as well as that of others, of potential adversaries or enemies, becomes both a tactical and strategic element of survival or dominion by a state - or an alliance between states [5, 6].

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In particular, the basic topographic cartography is made, for a good part of the modern period, by military institutes - the British Ordnance Survey and the Italian Military Geographical Institute are just two of the examples in which the military and the presence of terms attributable to these are verifiable [1, 2].

The most recent period is undoubtedly the one in which the technological impact was disruptive and decisive, in relation to the spread of geographic information technologies [7–10]. Modern smartphones, a technological tool for information and communication within everyone's reach, represent a concentration of technology [11], available until a few decades ago only to selected categories of users and professionals, often characterized by very high levels of secrecy.

Furthermore, we can say that the high-speed Internet connection, our real-time positioning via smartphone equipped with GPS, access to navigable geographic databases and satellite images, functions now considered basic in common mobile phone applications, all have a military origin from the beginning linked to security.

In fact, these applications are largely the offspring of the Cold War: the Internet network - originally DARPA-Net - was designed to connect research centers and military bases by land with redundancy systems in communications, in the event of multiple nuclear attacks on US soil. GPS was conceived (https://www.nasa.gov/directorates/heo/scan/communications/policy/GPS_History.html; https://www.gps.gov/systems/gps/modernization/sa/) as a way to identify - today we would say geolocalize - in a precise manner the submarines capable of launching ICBM missiles (Intercontinental Ballistic Missiles). Geographic data, and satellite images in particular, used in spy satellites in the acquisition of data relating to the opponent's or enemy's terrain, through remote acquisition technologies, mainly from satellite - but today with a return to air vehicles, thanks, above all, to drones.

The end of the 90s and the beginning of the 2000s probably represent the turning point: from the cartographic and Geo-informatic side we witnessed the flourishing of most applications in the field of software, data architecture and publishing in the cartographic field and geo-informatics [9]. To-date we are witnessing an unprecedented integration of the geographic information substrate with that of other sciences and applications: hard sciences, but also human sciences, including social ones, often with reference to issues such as urban security and analysis. Geolocalized criminal events for their prevention and mitigation towards an increase in security [12].

On the operational side, the continuous increase in data transmission speed on the Internet, the gradual declassification of historical satellite images, together with the development of private producers of high-resolution satellite images, simplify the use of data and content, including geographical ones. A major boost was given during the Clinton-Gore administration in the United States.

A major boost was given during the Clinton-Gore administration in the United States. In the course of 2000, the decision to 'turn off' the SA (Selective Availability) from the GPS signal must be attributed to this administration, thus significantly increasing the accuracy of positioning and navigation even for civilian uses, and therefore not limiting it to military ones.

In the same administration, the then Vice President Al Gore [13] launched the idea of the 'Digital Earth'. This was a virtual, geo-referenced environment in which anyone,

from children to adults, can navigate, explore and learn about the Earth, through a virtual globe [8], recalling a whole series of information and news, and a possible meeting place for onlookers, scientists, looking for solutions to technological and social problems.

Consideration on the use of charts and maps as real information weapons - or disinformation - as they have often been used to convey certain messages, would deserve a separate chapter and an in-depth study, implicitly or explicitly linked to the security of a country or a given context [5, 6].

More recently, with reference to the Covid-19 outbreak, the issues related to health and the quest for tackling human life has put many expectations and doubts at the same time on the geo-technologies as means for identifying hotspots of disease spreading and in helping tracking and tracing of cases for containing diffusion.

The rest of the paper is organized as it follows. In Sect. 2, the city-port relationships are analysed, in terms of the characteristics joining these two spatial areas. Section 3 tackles the case study of the project SECNET, with particular reference to its geographical aspects and the implications on security. Concluding remarks in Sect. 4 summarize the main findings and open issues still to be tackled.

2 City-Port: Relationships, Flows and Security

The relationship between city and port is complex due to important and interesting challenges in terms of safety (movement of people and goods), both on the sea-side and long connections (extra regional and national), and in the city and operation [14, 15].

An important consideration concerns the port location and the development of cities. In a period in which navigation took place mainly by sail, the geographical position in the shelter became important, combined with that including still and mobile waters (streams, such as rivers or streams), useful for washing and cleaning the basins [16].

This was useful to avoid water stagnation, and therefore the dilution of possible pollutants and the reduction of the formation of concretions of algae and other living organisms on the keel of the boats. Port locations linked to internal water systems were therefore privileged, for reasons related to cleaning and purification given by mobile water as well as, in subsequent phases, thanks to the potential, in some contexts, of the internal navigability of water courses, which therefore performed a dual role (of decontamination of the waters of the basin and of internal connection) [17].

The same idea is valid for industrial production, often located in the close proximity of ports. Where there is industry, there is a need for a receptor basin, and, always, for a system, a network of rivers or dilution streams. The development of canal ports, just remember the best known in Europe, in the North Sea, such as Hamburg and Rotterdam, can therefore be linked to these logics [18].

The following and recent evolutions of transport have changed the logic: the railway - subsequently the road and today, again the railway - has led the port systems to settle on deeply different logics and arrangements as regards the permeability of crossing and relations between territories [19, 20].

The more mature economies, in the oldest industrialized countries, have often had the key to commercial and industrial success in ports. During the early stages of a port's

development the relationship between infrastructure - and related activities - and the city is very close, and the city and port almost overlap in spatial location [21].

With the evolution of ports, first looking for more numerous docks and larger warehouses, then above all for piers and open spaces for positioning and handling goods, the relationship between port and city becomes less strong, nonetheless relevant in terms of induced traffic and congestion, but also in terms of the economic spillovers. Major European ports today - i.e., Rotterdam, Hamburg, etc. - are located far from the most historical and active part of the city, in areas where goods can be moved and stored, transferring them to the final markets, thanks to a strong integration with different modes of transport (Fig. 1).



Fig. 1. The city and port of Trieste (Italy). Highlighted, in the left centre of the image the earlier port areas (yellow). On the left, part of the 'Old Port' (in pale blue, now to be converted to light port operations), on the right, the 'New Port' with container, multipurpose and oil terminals, shunting areas included. Red lines indicate the early city - port expansions. (Color figure online)

The city and its port, in fact, in most cases do not become the final destination of the goods that are moved there, but increasingly as a place of transit and modal exchange, towards destinations - and, in the case of gateway ports, maritime, in the case of the hub ports - further away, in a process of evolution of the relations between them from setting, through expansion, to specialization [26] That becomes important particularly with the transformation of port functions to serve vast hinterlands with destinations deep into it.

In this sense, the relationship becomes above all one of coexistence of proximity, however, the network or the separation wall between the two areas, when located in proximity to each other, which actually divide two worlds that travel at different speeds and with different relationships. The case is different in which, instead of goods, passengers are considered [22].

In this case, the link with the city is stronger. Both for cruise transport and for ferries, the urban locations of the ports are preferable: often associated with the "image" of the city, due to the scenic impact of arriving in the city's central part, instead of docking at an anonymous commercial pier, and for the same connection with the passenger transport system (rail, car, bus, etc.) [23].

Here the permeability is stronger, as it is the coexistence between urban and port functions. Users of passenger transport services also become users of the city, either in the form of tourists - and therefore of urban functions - or as users of part of the same transport and support infrastructures for port operations aimed at passenger transport.

From the point of view of safety, the consequences are of various type: the goods follow the logic of long networks, where therefore the traceability and controls at the origin and at the final destination make it more complex a timely monitoring and control of what actually transits, more than stationing in port facilities [24].

Different, and in some respects more delicate, given its urban implications, the characters and implications of passenger transport. If cruise transport has operating modes directly borrowed from air transport, and therefore with a series of access controls for people and goods on cruise ships which in fact limits connections with the surrounding environment to points of well monitored access, in the case of passenger transport by ferry the issue becomes more complex.

Here the main pressures with urban environments are formed in a short time frame, and the continuous movement of people and vehicles makes it difficult to control precisely. A common consideration that can be developed is that the spaces involved in port operations, both relating to goods and passengers, require precise territorial references, and therefore increasingly precise and punctual cartographic and geographical supports.

3 Port Security. The Case of the SECNET - GIS Project

From these assumptions, a reasoning and a subsequent application of advanced 3D visualization and modeling systems and 360° images were developed to support port security. The Italy - Slovenia project called SECNET (https://www.ita-slo.eu/it/secnet) saw the participation of various subjects linked to the issue of cross-border security, with particular reference to IT, involving, among others, the three ports of the North Adriatic (Venice, Trieste and Koper), in addition to two universities (Trieste and Koper) [25]. The main objective of SECNET was to strengthen the institutional capacity of the ports of the Program Area (North Adriatic Port: Venice, Trieste and Koper), as well as to create the basis for a coordinated and permanent governance of port security at cross-border level. This can be done thanks to innovative ICT tools, jointly developing plans for long-term actions and strategies, increasing coordination and cooperation between ports to strengthen their security and competitiveness. From the identification of weaknesses present in the port security of the partner realities, concrete pilot actions were defined and implemented for the application of ICT in the field of perimeter surveillance and cyber-security of the systems, which allowed to standardize port security measures, such as to consolidate the safety and competitiveness of these ports of the Program Area.

The University of Trieste had the task of drafting various documents, such as the survey on best practices in the field of port security; the cross-border action plan on port

security, including the final text of a memorandum of understanding by the various ports involved on common and shared commitments in terms of security. In addition to this, understanding the importance of the geographical and territorial component, has led to strengthening the GIS component by supporting the harmonization of data related to the port facilities, these including the development plans of the area. Although not initially considered within the project itself, the research unit considered relevant keeping the geographical databases and assets homogeneous in order to provide a solid and viable backbone for the geolocalized solutions tested and to host further evolutions (Fig. 2).

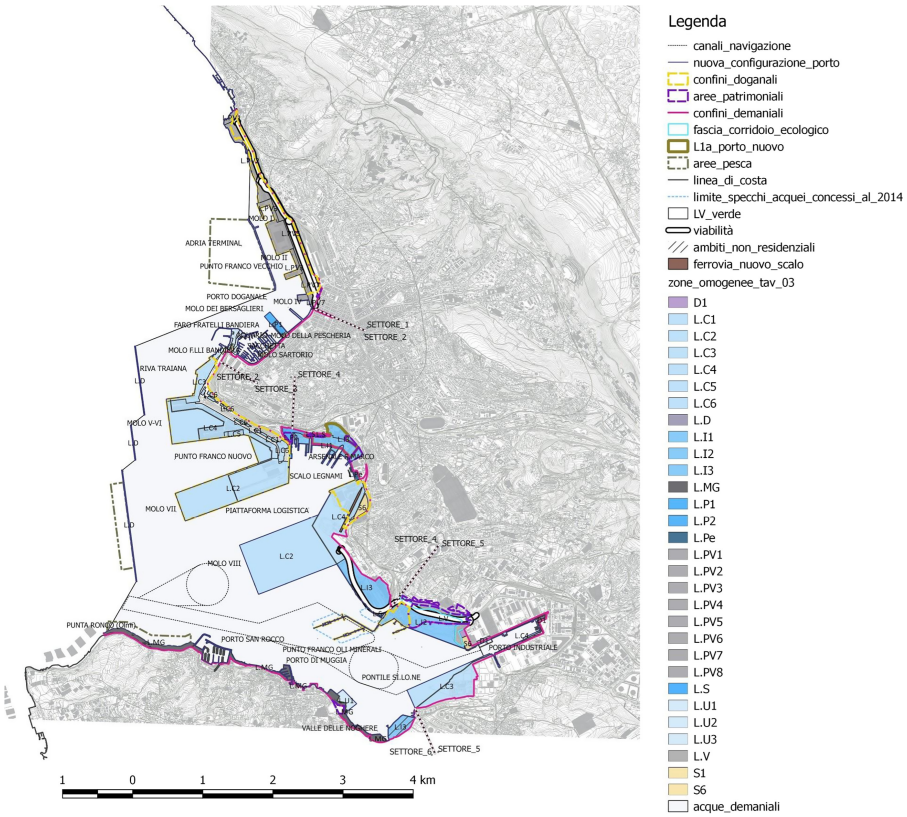


Fig. 2. Port urban plan of Trieste Harbour (source: GIS elaboration from Trieste port authority data) https://www.porto.trieste.it/

In collaboration with Tosolini Productions, it was possible to develop some geolocalized 360° images, which can be integrated with virtual and augmented reality systems. These are the Logistics Platform, located in the southern part of the Port of Trieste (Fig. 3, pin marker 1) and the newly established Free zone, named FreeEste, located in a rear port area (Fig. 3, pin marker 2).

The places chosen are particularly significant: the Logistics Platform (operational from 22 April 2021) and the Free Zone (operational from January 2019), which led to a

reorganization of the accesses for security reasons. Figures 4 and 5 illustrate the platform developed to combine the 360° view (on the left of the image) and the geographical location (on the right of the image, represented by the spherical photo icon).

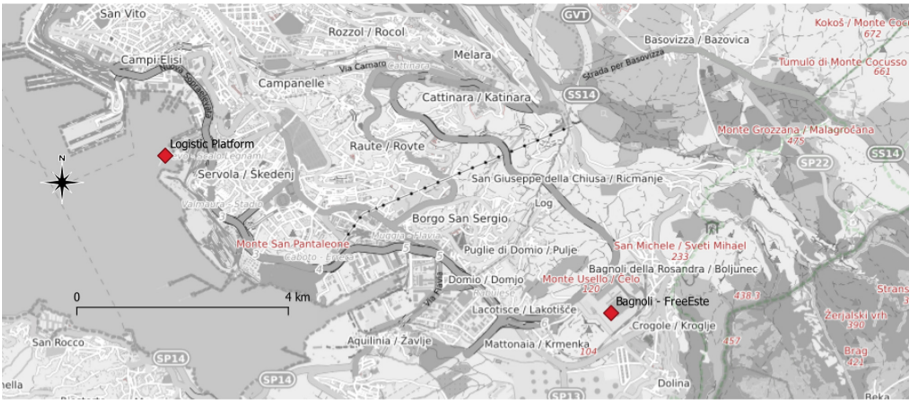


Fig. 3. Positions of the two points of 360° photos acquisition in port and port-related areas: the new logistic platform (left) and the free port - inland terminal FreeEste.

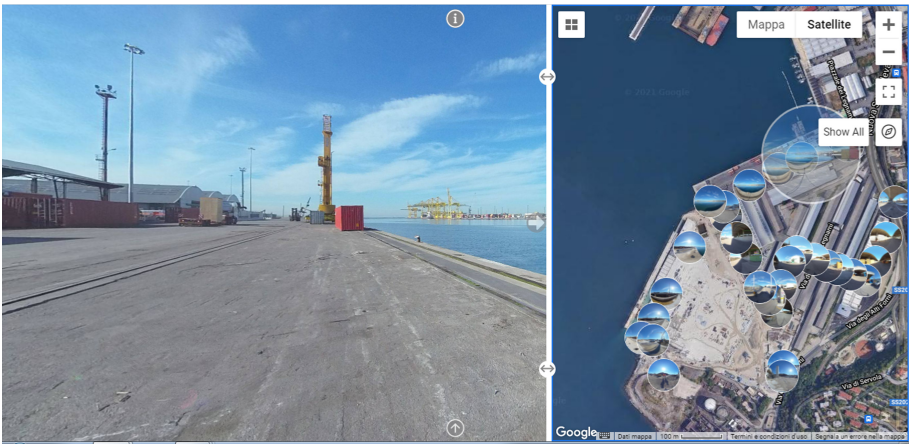


Fig. 4. 360° views at logistic platform (Port of Trieste) https://seekbeak.com/v/vYD1GPOozby

Such applications represent a demonstration of the potentials given by these tools to implement monitoring systems for a situation awareness of facilities. Also, the possibility of linking this kind of imagery with other hyper textual tools (images, video, link to other applications) can help in integrating information from different sources, guaranteeing situational awareness of an area, other than allowing to create and present scenarios for simulating different cases.

Future and further evolutions of the system will imply a test of the integration of such systems into security systems and geographical databases, experimenting also the possibility to implement real time monitoring systems.



Fig. 5. 360° views at FreeEste (Trieste free zone) https://seekbeak.com/v/KV6zareVjeZ

4 Concluding Remarks

Security and cartography are united by a strong bond. Security has a link with the territory, similarly with cartography, meaning both the traditional and the most modern forms of representation. In fact, cartography represents probably the most important tool for visualization, understanding, acquisition of awareness and planning of actions aimed at reducing risks and unexpected events. Today, the main challenges concerning security have to do more and more with globalization, based on increasingly frequent movements of people and goods. The nodes of these flows are therefore the most sensitive places, and therefore often the most vulnerable, in which it is necessary to intervene to increase aspects related to safety, including health [27].

Furthermore, these places host most economic activities of different use and purpose [28]. Among these nodes, the ports (together with the airports) are the places where the commitment is directed the most. Systems based on ICT - Information and Communication Technology - are increasingly developed to increase security, both the more traditional and the IT type. In this sense, the most interesting prospects seem to be those in which different systems are integrated with each other, multiplying the effect of the technologies involved. The experimentation developed as part of SECNET - GIS research goes in this direction: combining a relatively traditional geographical information base with a series of applications aimed at improving visualization and understanding aspects, such as the use of 360° images and VR/AR tools (virtual and augmented reality). These, in the present phase developed for demonstration purposes, can in subsequent applications find development in dynamic systems, able to connect data and information in large and updated images of a sensitive territorial area.

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