In a major technology upgrade to ramp up security and disaster management efforts, the port of Stockton undertook a program to integrate all of its geospatial technologies across the enterprise. **Daniel Elroi** and **Chief George Lerner** give an account of how the port authorities went about the process

PORT OF STOCKTON EMBARKS ON TECHNOLOGY UPGRADE

What happens when a small river port gets classified as a high-risk critical infrastructure by a national security risk model? And how does a port in response to this assessment cope with the need to rapidly ramp up its security stance and implement a wide variety of the latest technologies in an otherwise out-of-date technology environment? And how do geospatial technologies aid in accomplishing these goals across the entire enterprise?

The Port of Stockton is located at the end of a narrow, man-made deep water channel, providing ocean freighters with access to markets over 100 km inland from the San Francisco Bay, deep in the San Joaquin Valley of California. The port, established 80 years ago, provides a marine "highway" directly into the heart of the most productive agricultural region of the United States of America, and trades directly with such faraway nations as in China, Japan, Trinidad, and Norway. Until very recently it has focused on bulk and break bulk cargo, such as fertilizer, rice, cement, sulfur, iron ore, and scrap metal, and now it has begun to handle transshipped containers as well. It is an important economic "engine" to its region, and provides several advantages to shippers as it is located on the main Pacific Coast north-south rail and highway corridors, while its much larger sister ports in the San Francisco Bay, particularly Oakland, are significantly removed from this corridor. Finally, while a small port by standard seaport measures, it has the distinction of being the only net-export port in California, and is a major land owner, with over 49per cent of its operating revenues derived from its properties rather than its maritime operations. All that said, it is surprising to most casual observers that this modest inland port was classified by the US Department of Homeland Security as a Tier 1 port after September 11, 2001, when the criticality and vulnerability of US ports was evaluated. Tier 1 ports receive the majority of government funding for strengthening their resiliency to both attack and disaster, as they are perceived to be particularly important to the security and/or economy of the US. This classification has valid and logical reasoning, and as a consequence this port has seen an influx of requirements and funding for improving its security.

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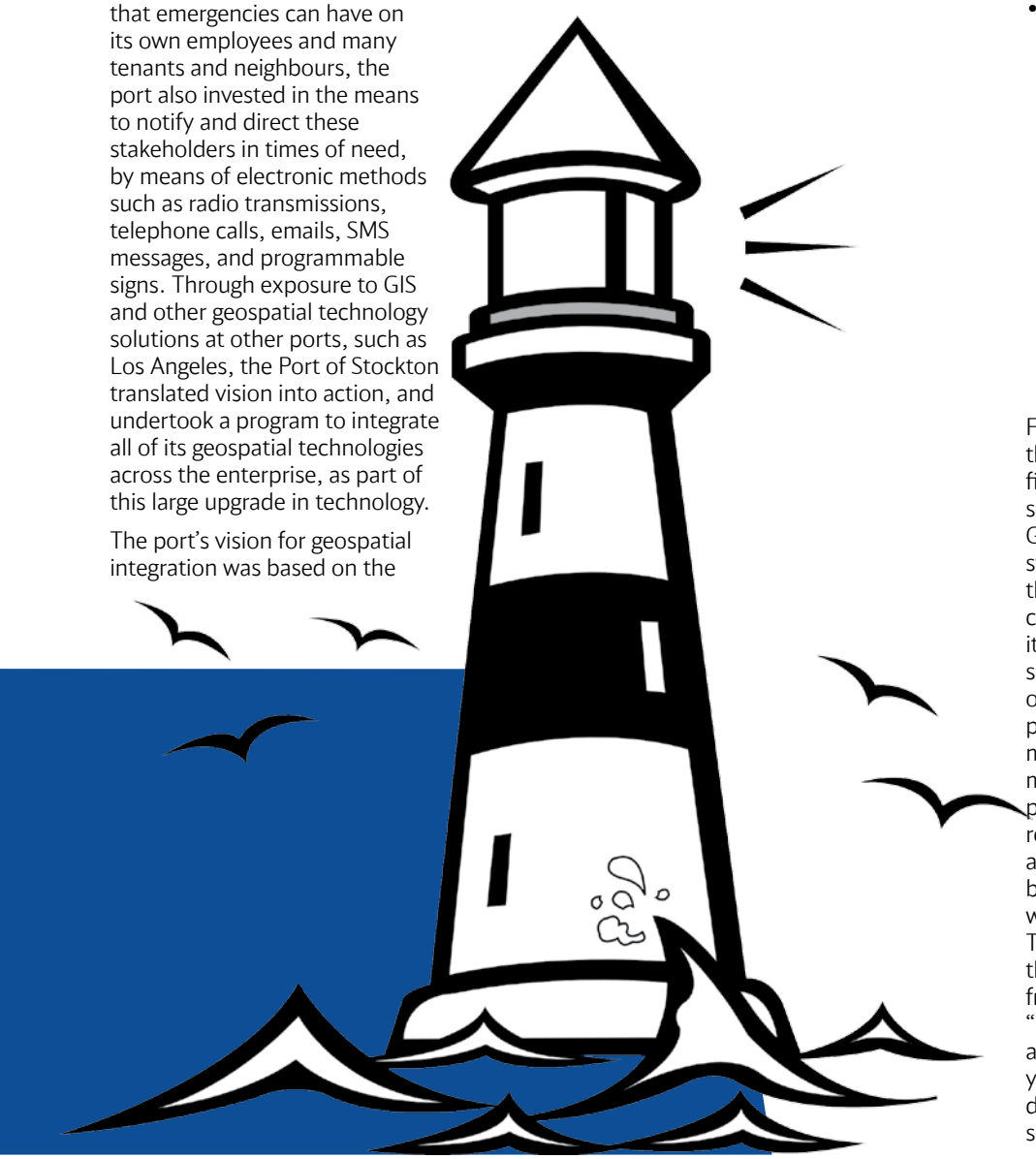
Much of the improvement in security at the Port of Stockton has involved the upgrading of the means for monitoring activities in the port via closed circuit television (video surveillance), the means for controlling access to restricted areas via electronic locks and personal identification devices, and the tools and data used to provide the port police with improved

situational awareness. However, the port's inland location and large land holdings also make the port an excellent disaster recovery site for other ports in the region, such as Oakland, and the smaller ports of San Francisco, Redwood City, Richmond, and Sacramento, as well for other regional disaster recovery needs. In order to fulfill these requirements, the port also invested in greatly improved networking, communications, and IT resiliency infrastructure. Finally, in recognition of its own vulnerabilities and the impact that emergencies can have on its own employees and many tenants and neighbours, the port also invested in the means to notify and direct these stakeholders in times of need, by means of electronic methods such as radio transmissions, telephone calls, emails, SMS messages, and programmable signs. Through exposure to GIS and other geospatial technology solutions at other ports, such as Los Angeles, the Port of Stockton translated vision into action, and undertook a program to integrate all of its geospatial technologies across the enterprise, as part of this large upgrade in technology.

The port's vision for geospatial integration was based on the following precepts:

- Visual, spatial representation of security related information, such as the viewing of video imagery in the context of the location of the imagery, especially for Pan-Tilt-Zoom (PTZ) cameras, is critical for interpreting and reacting to emergencies.
- The ability to see a digital map of port property boundaries, buildings, docks, railroads, and roads, is just as important as seeing security features, such as fences, cameras, gates, and evacuation routes on these maps.
- Situational awareness is deepened by context, and such context can best be accomplished through the collection and map-based presentation of as many of the port's physical assets as possible, including visible and buried utilities, environmental hazard areas, underwater hydrography, and port tenant information.
- Much of the data that is of great use in port security is present in the port's own organisation, such as within the Departments of Maintenance, Environment, Real Estate, and Operations, but is inaccessible to Port Security, or between those departments, due to a lack of common base map, a base map against which a variety of other information can be displayed, queried or reported.

At its core the port's system is an Esri ArcGIS for Server enterprise geodatabase, combined with procedures and documentation for close two-way interaction with AutoCAD so that the port's CAD-based users and contractors can benefit from, and contribute to, the port's data.



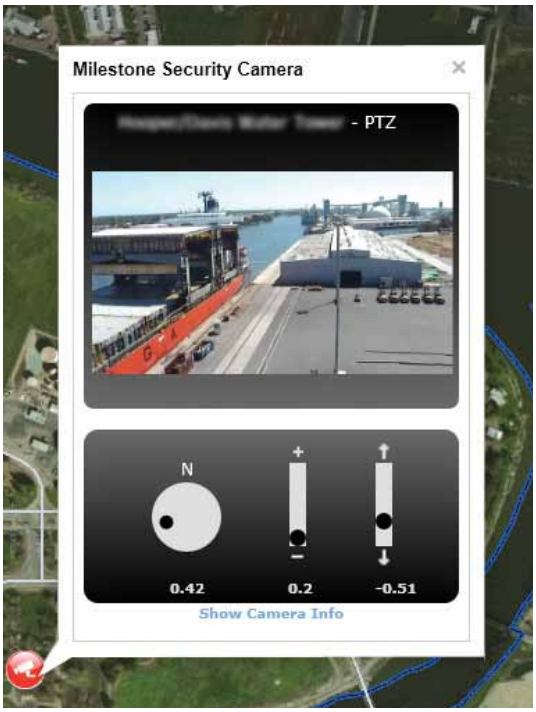
For these and other reasons, the port hired an international firm specialising in geospatial solutions in ports, NorthSouth GIS, to create the enterprise systems infrastructure to help the port mine its own data; to collect, organise and manage its spatial data in a way that supports and enhances security of the port. NorthSouth GIS's philosophy – that different members of the port are most likely to collaborate and participate in data sharing if they receive benefit from that activity, and that this then collectively benefits port security – agreed with the port's own philosophy. This translated into an approach that actively sought participation from all port members, asking "how will adding your data to a central geodatabase benefit your job?" rather than "which data can you contribute to port security?" Combined with on-

going stakeholder engagement and training during and after the building of the system, has resulted in the integration of GIS, GPS, AIS, CAD, and Mass Notification in such a way that it supports most port employees.

At its core the port's system is an Esri ArcGIS for Server enterprise geodatabase, combined with procedures and documentation for close two-way interaction with AutoCAD so that the port's CAD-based users and contractors can benefit from, and contribute to, the port's data. The geodatabase itself contains over 100 image and map layers, mostly from the port's own data, but also including data imported from outside sources on a regular basis. Some of the data was converted from scanned documents; some was kept in georeferenced by scanned-only format for background reference; some was converted from CAD or GIS files; and other data was digitized from aerial photos, or captured with GPS.

The data is presented to users through a powerful and intuitive Web map browser, called the Stockton geoPORTal, developed using Latitude Geographics' Geocortex Essentials development platform. The viewer has a full-featured in-office version, and a lightweight version intended for use on tablets and smartphones, enabled through the port's wireless mesh network. The viewers are configured to allow the collaborative use of maps for communicating development plans, emergency response, and other events between port users. Different users are directed to different versions of the viewers, which appropriate to their data and tool needs, and to their permissions, and in this way each user gets what they need and what is appropriate for their role at the port. The software, which makes use of automated workflows and reports, and interfaces with the port's mass notification system and electronic public address systems, is used to inform port employees and tenants of upcoming events or of emergencies. Furthermore, the mobile version of the viewer can be used to record incident reports and condition assessments in the field.

One of the important aspects of the system is its ability to integrate other systems that contain spatial aspects but lack the spatial componentry. For example, the GIS integrates with the port's lease management systems, which manages the port's 2,000 acres (8.1 km^2) of waterfront, industrial and commercial properties. The system is now accessible through geoPORTal, and allows reports and maps to be easily created, proposed leases to be sketched and shared with new tenants or brokers, and for a snapshot of the port's holdings to be communicated with port management. Other integrations, such as with the port's command and control software, also strengthen these systems by sharing a common base map and "revealing" information from around the port that would otherwise be inaccessible in separate systems or even non-digital format.



Port of Stockton PTZ camera

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Beyond system integration, geoPORTal also integrates real-time data with the map layers. Live feeds direct from security cameras, electronically controlled doors, moving ships, weather stations, and nearby road traffic, are integrated with map layers. This integrated

approach allows live data such as a moving vessel location and identification, to be viewed with a video camera, and then viewed in the context of its surrounding data. In such an example, a vessel than runs ashore can be viewed with a camera, determined to be within or outside the port's jurisdiction, and assessed for risk to nearby gas lines, from a single interface.

The port's geospatial integration program would not be successful without recognition of several critical factors:

- People do not adopt technology just because it is available or theoretically good for them. They require incentive, on-going training and outreach, reminders, and adaptation. Technology implementations are all about people.
- The quality of data is more important than the number of features in a software. Therefore, a rigorous method for keeping data updated, using the resources and people available to the port, is of utmost importance. But so is the ability to communicate data quality and its current condition, and the ability to solicit, receive and respond to data correction from system users.

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Daniel Elroi
President, NorthSouth GIS LLC
Los Angeles, California
info@northsouthgis.com

Chief George Lerner
Director of Homeland Security
Port of Stockton, California
portmail@stocktonport.com