TERMINAL AUTOMATION SYSTEM

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ABSTRACT

The "terminal of the future" certainly invokes images of flawless operations and on-time schedules with high volumes and low cost. With the current increases in cargo volumes, expanding global economies, and new emerging markets, the future is bright. Every terminal operator, carrier, and steamship line will be totally immersed in competing for market share. Differentiated service is and will be increasing in importance as a key factor for successful companies in the near future. At Sea-Land we believe the terminal infrastructure will play a major role in that differentiation.

But what is the terminal of the future? Clearly, there is no single answer. Will it be a different place from what we know today? Without a doubt! How we manage these facilities to provide a differentiated service to our customers will be a key to future success. Handling higher volumes, reducing costs with increasing budgetary pressures, while markedly improving the level of service will dictate major changes in process, physical plant design, and information technologies.

Faster cranes and yard handling equipment are being installed at facilities around the world. Cranes capable of 45 and 50 plus moves per hour are and will become more commonplace. How many of us expect to see marine production levels anywhere near the rated capacities of our shore cranes? Larger and faster vessels are under construction. Can we operate these new vessels and still maintain acceptable and tightening schedules? Will our container yards be efficiently operated to accept the increased volumes without gridlocking these facilities? These questions and many more face each of us in our roles to deliver the terminal of the future.

All of this speaks of things to come. To be successful, a new set of tools will be necessary to realize the goals we have or will be asked to set in the near future. Unfortunately, the future is not 5 years away. It's happening right now. The tools I speak of take on two forms with a single objective. First, new processes must be developed to improve the work flow in every operational area of the terminal. Second, new information systems and technologies will be required to support the revised work flows at a pace unheard of before. Although this may sound somewhat trite, the days of the paper terminal must disappear. The question is, when and how?

At Sea-Land we believe the future is at hand and the Terminal Automated System (TAS) is delivering the first true operating improvements, combining new processes and technologies in an integrated set of solutions, from the gate to the water and back. The concept behind TAS is actually quite simple: know precisely where each container is at all times and have it in the most optimum place to actively support the operations. Given the dynamics of daily terminal operations, this concept takes on monumental proportions. Slot parking 6,000 containers, whether stacked or wheeled, is a formidable task for both the operators and systems.

Traditional information systems for terminal operations are, for the most part, vertical by design. Equipment arrivals and pullouts, yard inventory, maintenance, vessel planning, and stevedoring functions are interrelated with heterogeneous information needs. Each area has a direct impact on the others, and a single process breakdown in any area can significantly affect the operation. With few exceptions, the primary mode of data transfer between the functional areas is paper and represents a constant source of process breakdowns or delays. The degree of systems integration between the key functional areas is critical to attaining meaningful productivity and cost-reduction goals necessary to justify the costs of these initiatives.

TAS was developed as a mission-critical initiative to automate and standardize operating processes at Sea-Land terminals. In addition, TAS will provide a mechanism to enhance the flow of data between the major functional areas of the terminal. Existing processes and legacy systems did not support the expeditious movement of information to adequately facilitate the movement of cargo through the marine terminal.

TAS is envisioned as a complete and integrated operating system linking mission-critical functional areas of the marine terminal with interactive tools and information processing. Key areas addressed are gate, yard, maintenance, and marine. Each area can be further broken down into finite components. Each of these components is designed to improve and/or automate the information or work flow and to reduce

processing time to effectively control the movement of cargo in and out of the facility.

TAS is a total terminal system providing a horizontal structure through each area in the terminal hub. Timely information is a key element of TAS for successful management decision making and ongoing analysis for continuous productivity improvement.

OPERATING METHODOLOGY

The basic philosophy of TAS is to approach terminal operations from a hierarchical design. The concept, although simple, comprises the underpinnings of all TAS modules and is best explained as follows:

- VEHICLE (truck, vessel, train, etc.);
- VISITS a facility (truck—gate in, vessel—discharge) and identifies;
- MISSIONS (drop off load, pick up empty) which establish a predefined set of goals; leading to
- EVENTS (gate arrival input, inspection, park, pickup inspection, gate out).

Perhaps the most unique element of this design is its ability to modify or enhance processes as business needs dictate. Events (process steps) can be added to single or multiple missions. Each event can be measured discreetly or multiple events can be added to reflect the performance of an entire process. Using this approach provides a medium for continuous measurement and improvement and eliminates the need to manually compile statistical data for process improvement.

SYSTEM OVERVIEW

TAS consists of a series of modules to facilitate the operating processes and the collection of data pertinent to a visit to a terminal. The modules follow:

- *GATE IN* captures trucker, visit type, missions, and equipment information. All data are edited locally with supplemental edits/information sourced from IOS and added to the TAS data base. The gate process accesses several subfunction modules, including inbound cargo release, inspection, and empty dispatch, depending on the visit-mission combination established by the gate process. Successful completion of the gate-in process results in the generation of a bar coded gate pass printed in the gate area without requiring the trucker to leave the cab of the truck.

- *GATE OUT* provides real-time, pullout confirmation updates to maintain accurate equipment status and inventory control. The process is fully automated for bobtail trucks exiting the facility, using bar coded gate passes issued originally at gate in. A railer interchange receipt (TIR) is automatically generated using inspection and equipment data stored in the TAS data base. Gate out also is fully synchronized with IOS, providing it with real-time updates of information.

- *INSPECTION* captures equipment damage information, truckers' signatures, and other optional data (seal number, placard information, and receiving temperature), using a hand-held, pen-based computer. Data are transmitted via radio frequency communications to the TAS data base. Inspections are performed at gate in and gate out as well as in the yard to provide and fully integrate processes and with the other TAS modules. Results of the inspection process are used to prepare the TIR and feed the Maintenance Repair Control System (MRCS). The result of this process is real-time notification of equipment condition and status to gate and maintenance operations.

- *MRCS* receives detailed information about equipment condition from inspection and estimates the time and materials needed for any repairs, through a number of local and mainframe-based processes. The result of the MRCS process is a seamless flow of information between the gate, inspection, and maintenance facilitating the expeditious return of damaged equipment to revenue service.

- *YARD INVENTORY* captures equipment location information on a real-time basis using vehicle-mounted, portable pen-based computers and radio frequency communications to the TAS data base. Yard inventory provides interactive wheeled (slot parking) and stacked (grounded) operations with direct interfaces to the gate, expert, marine, and workstation stowage functions.

- *MARINE* processes information during vessel discharge and stow operations using a pen-based portable technology and radio frequency communications to confirm equipment discharged and stowed on a vessel. This real-time module provides paperless cargo operations at the terminal. The function also is interfaced with the expert module to provide real-time parking retrieval and placement advice.

- *EXPERT* is a behind-the-scenes module that manages all yard parking activity. This module is updated by the gate, yard inventory, and marine functions. Expert provides parking advice based on predetermined and weighted rules to optimize yard inventory and traffic from the gate to the quay.

- *INBOUND CARGO RELEASE* provides information to the gate-in and gate-out functions regarding the status of inbound cargo. This function maintains the status on all freight releases, including customs, OBL payment, demurrage, and local holds. The module also provides a set of tools for the Freight Release Department to manage this activity exclusively. Interfaces with mainframe release data (Sea-Land and clients) allows TAS to eliminate the majority of the paper currently necessary to complete the process.
- *TAS ARCHIVAL/RETRIEVAL SYSTEM (TARS)* enhances data captured in the TAS system to provide management information to terminal personnel. Various views (reports) pertaining to daily gate activity (by operator by mission, trucker tern time, and activity by operator) can be assembled and displayed to help with day-to-day operations of the terminal. In addiction, TARS maintains a history file with access to TIR data. TIRs are stored and can be retrieved and reproduced quickly and easily by terminal personnel. All paper storage of TIR documents is eliminated. It is envisioned that TARS will evolve into a decision support system, including yard and marine statistics.
- *WORKSTATION STOWAGE* provides a stand-alone vessel stowage facility using a graphical user interface. This module provides complete trim and stability output as stow plans are assembled by the operator as well as a full reporting system to offset input and reports from current mainframe text-based CRT devices.

OPERATING ENVIRONMENT

A number of new and not-so-new technologies were evaluated to determine the optimum facilities to enhance process modifications. TAS represents a merging of process reengineering and state-of-the-art technologies. Further, the design is a fully open architecture providing growth and enhancement flexibility in support of Sea-Land's dynamically changing business environment.

To accomplish design goals, a comprehensive set of hardware and software tools were researched. NCR and Microsoft solutions were selected to form the foundation for the TAS platform. TAS uses client-server architecture to produce a near paperless environment with real-time data update and access via a local data base and interactive mainframe interfaces. New technology solutions include following:

- Microsoft NT Advanced Server Operating System (a registered product of Microsoft Corporation);
- High-volume, peer-to-peer host communications (LU6.2);
- Radio frequency communication;
- 400-MHz narrow band;
- 800-MHz narrow band;
- Spread spectrum;
- Hand-held mobile computing;
- Bar-code with laser scan readers;
- Expert system (artificial intelligence design);
- Thermal transfer high-speed printing;
- Intel Pentium uni/multiple-processor (a registered product of Intel Corporation);
- Fourth-generation development tools; and
- Integrated video and audio communications.

As explained previously, improvements will be realized through state-of-the-art technologies, but more important, through process reengineering. It is only through process reengineering that significant cost savings and productivity enhancements can be realized. Although the leading-edge technology deployed allowed the implementation of these changes, the elimination of work steps will provide real productivity savings that benefit both Sea-Land and its customers. In addition, deploying TAS at facilities worldwide will facilitate standard operating procedures while providing flexibility and accommodating geographic and physical plant differences.

Distributed systems provide significant opportunities because they are scalable, flexible, and cost-effective and provide business solutions. However, because of this architecture, a new set of implementation and support issues must be addressed within the information technology organization. New partnerships between this organization and business units are required to successfully implement new client-server platforms and applications such as TAS.

Local administration, data backup, security access, and first-line support issues transfer to the terminal staff from corporate information technology offices. Attention to this aspect is a major consideration for companies embarking in this direction. Training, documentation, change control, and local "first-line" problem correction must be addressed on the front end of these initiatives.

Both the architecture and the processing philosophy of TAS have proven to be reliable and have provided competitive advantage at the Charleston, South Carolina, pilot facility. Not only has TAS proven to be successful for Sea-Land but also it has attracted significant interest from competitors, other industries, and the technology community. Given the current state of the pilot and the rollout of the application now under way at several sites, Sea-Land believes it is positioning itself for the future and is continuing to provide leadership in the shipping community.

It is anticipated that TAS will provide benefits in many areas of terminal operations. These benefits will be outlined in two basic areas: productivity improvements and cost reduction. In certain cases, the two areas go hand in hand.

- *Reduced labor costs.* Process reengineering and various system features will produce labor savings at certain locations. A prime example is fully automated bobtail lanes in gate out, which eliminate the need for manual intervention entirely when completing the gate-out process. Throughput of gate operations also will accommodate increased volume without the need for additional head count. TAS is designed for pooling gate clerks to handle arrival and pullout procedures, which also allows an increase in the number of lanes to clerk ratio from 1 to 1 to 2 or more to 1 and provides growth I volume.
- *Reduced overtime costs.* Current operating processes delay host system updates until after the close of business, when activity in the operation becomes less hectic. Updates generally are completed on overtime. The discipline and processing speeds designed into TAS preclude the volume from affecting real-time input.
- *Improved marine productivity.* Improving marine productivity is a key goal of the TAS project. It is anticipated that this will take place through enhanced expert parking control, slot-based yard inventory, and interactive stevedoring functions providing real-time updating and communications during vessel operations. Additional benefits will be derived from the implementation of workstation stowage: reduced time required to prepare outbound stow plans, reduced mis-stows through graphical view of the plan, improved identification of hazardous cargo, enhanced output of all trim and stability functions, and module stand-alone capabilities to allow the stowage function to continue during limited, host system outages.
- *Eliminating pneumatic tubes.* Based on certain physical plant design and local operating restrictions, some or all of the pneumatic tubing used in the current gate process can be eliminated. Eliminating the tubing of paper between the trucker and the clerk significantly reduces overall gate processing time and dramatically improves throughput. Although the physical tubes may be necessary to continue operations during system outages, the physical requirements and costs for new gate construction in the future can be reduced.
- *TIR (EIR) automation and generation.* By integrating gate-in data with inspection and gate-out, TAS is able to fully automate TIR/EIR documents, including driver signatures, thereby eliminating manual preparation entirely. Storage and retrieval of TIRs is totally system-based, reducing the labor necessary to handle this filing and retrieval and the physical space and time necessary to locate and reproduce these documents.
- *Automated selection of empties for dispatch.* The automatic implementation of dispatching empties in the TAS gate process will eliminate the intense manual efforts expended in current operations. Additional benefits will include reduced gate processing time for empty pickup and support for a reservation/appointment methodology for locations capable of operating in this manner. Empties fed automatically to the gate via the inspection and MRCS functions as part of the integration process is a key element of TAS. This function effectively eliminates the current manual oversight and tracking of empty equipment and ensures uninterrupted gate operations.

All equipment inspected in TAS will be evalutated automatically and returned to the dispatch system when no damages are noted within 5 minutes of the equipment's arrival. This feature ensures a steady stream of empties to the gate for dispatch and eliminates the duplication of inspections that take place in many operations today.

- *Elimination of paper.* One of the key goals of TAS is to eliminate paper. The current design of the gate system allows a gate pass and the TIR to be produced in hard-copy output. As part of the process, both of these documents leave the terminal with the trucker. Additional TAS modules will eliminate documents such as load/unload sequence sheets, yard inventory reports, yard temperature reports, and garage repair orders.
- *Enhanced maintenance and repair.* Another TAS goal is to reduce time needed to return damaged equipment to service through early identification of damage and timely notification of garage supervisors. MRCS and yard inspection in Charleston have shown excellent results in terms of timely identification/notification of equipment status. Reduction in update timing by 4 or more hours is commonplace. The integration of the gate, yard inventory, and inspection modules provides a fully automated flow of critical information among the three aforementioned areas, forming the basis for improving productivity, reducing costs, and improving service.

THE PROOF

Our Charleston pilot has produced a number of benefits that align with the items highlighted in the aforementioned list. Since October 1993, gate volumes have doubled with no increase in labor hours, overtime has been eliminated from gate operations, and the

average trucker turn time has been reduced from 50 minutes to less than 30 minutes.

Since January 1994, more than 80,000 TIRs have been stored electronically, and all paper in the gate operation has been eliminated. Community, shipper, and trucking feedback has been excellent and continues to improve. Reliability of the platform is consistently more than 99.5 percent, as measured during operating hours.

For Sea-Land and its terminal infrastructure, the pilot experience has reinforced the company's position that the TAS direction and initiative are correct. TAS represents a significant departure from past practices. Change is never easy, but for those who can stay the course, it will pay dividends. The terminal of the future is an exciting concept for those involved. Whatever course you choose, I leave you with this advice: there are no problems in terminals—just opportunities. Ask, why are things done the way they are? Then ask, why can't they be changed? The paradigms are many, but the future may depend on how well we can break them and adopt new ways of doing business.