

The Benefits of Collaborative Manufacturing and Logistics Execution Solutions from Apriso

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	Key Idea
Tools and best practices allow companies and their trading partners to eliminate non-value activities and waste throughout the entire value network.	

Executive Overview

You can yield major cost savings and improve corporate profitability by implementing collaborative manufacturing and logistics execution solutions from Apriso. Companies and their trading partners can eliminate non-value activities and waste throughout the entire value network by using tools and best practices for standardizing work, sequencing and dispatching tasks, automating operations, identifying material and resources, and collecting data and sharing information in real time. Although there are several benefits noted within this document, each enterprise must evaluate the actual benefits according to its unique situation.

An in-depth assessment of current operations must be undertaken in order to develop an accurate justification for project costs. For example, map material and information flow and compare them. Typically, there will be a poor correlation between the two –material goes one way, and information goes another. This disparity creates a time lag that decreases both the visibility and the accuracy of information about your inventories and resources. Poor visibility leads to mistakes that ultimately impact your company's profitability, and most importantly, your company's customers.

Identifying and Quantifying Hard Benefits

The hard benefits of manufacturing and supply chain execution solutions are straightforward to identify and quantify. They include:

- Lower capital investments for space, equipment, and maintenance;
- Inventory reductions through faster inventory turnover, reduction in out-of-stock conditions, improved product tracking and recall capabilities, reductions in scrap and reductions in inventory shrinkage;
- Labor savings, inclusive of wages, premiums, benefits, and payroll taxes;
- Better utilization, shorter cycle times and lower cost of goods sold through optimal deployment of productive capacity at least cost; sequencing and consolidating setup and teardown work; immediate scheduling and dispatching of tasks, higher productivity; elimination of paperwork and redundant data entry; fewer “fire-fighting” activities; and elimination of physical inventories;
- Acceleration and growth of sales revenue resulting from reductions in unexpected production stoppages and downtime caused by labor shortages, material shortages, equipment breakdowns and quality problems; and
- Lower shipping and transportation costs through optimal customer order consolidation; improved order fill rates and fulfillment accuracy; fewer back orders, reduced

expediting and faster shipping throughput using electronic interfaces with manifesting systems; real-time shipment confirmation; accurate shipping documentation and accurate compliance labeling.

Drawn from years of studies conducted by industry analysts such as Gartner, AMR Research, Venture Research, Forrester and the Manufacturing Execution Systems Association (MESA), the following hard benefits demonstrate the return on investment (ROI) from implementing a logistics execution solution:

Table 1

Warehousing and Order Fulfillment Benefits		
Measure	Description	Improvement
Picking and Put-Away Productivity	Goods picked or put away per unit of material handling resource capacity	16 – 25% average 21%
Picking Accuracy	Proportion of goods picked correctly, and on time	15 – 25% average 20%
Returns	Proportion of goods deliveries returned from customers or production due to errors	11 – 25% average 18%
Material Handling Productivity	Inventory turnover relative to warehouse capacities and the material handling labor force	10 – 25% average 18%
Inventory Carrying Costs	Capital costs and operating expenses attributable to buffer and safety stocks (often totaling up to one-quarter of inventory value)	0 – 100% average 75%
Inventory Holding Costs	Expenses attributable to storing, insuring, securing, re-testing, counting and auditing inventories, plus write-offs due to inventory obsolescence, scrap, shrinkage and loss	8 – 20% average 14%

Administrative and Data Entry Costs	Costs of collecting, verifying, reconciling, approving and reporting goods movements and task status by warehouse, clerical, administrative, supervisory and management personnel	25 – 100% average 56%
Shipping and Transportation Costs	Costs of packing, labeling, documenting, transferring, loading and unloading shipments, plus freight and outside shipping services	3 – 8% average 6%
Billing Cycle Time	Time required to confirm customer shipments prior to billing and revenue recognition	10 – 25% average 18%
Order-to-Cash Time	Elapsed time between order booking and customer payment for goods received	1 – 3 days
Paperwork	Cost of preparing, verifying, approving, delivering, recording and filing paper documents	0 – 100% average 59%

Apriso logistics execution solutions can deliver immediate benefits in receiving, shipping and warehouse areas. Here are some examples:

- Cross docking reduces inventories and eliminates redundant picking and put-away activity.** When goods arrive from suppliers that are needed immediately in shipping or on production lines, you can use Apriso solutions to transfer them at once instead of delivering them to the warehouse and then moving them to their point of use. Cross docking improves material handling productivity; reduces inventory carrying and holding costs; reduces order-to-cash time; reduces administrative and data entry costs; and minimizes manufacturing lead-time.

- **Warehouse-location profiling, navigation logic and task interleaving eliminate backtracking and deadheading.** Warehouse personnel and equipment often zigzag unnecessarily through the warehouse, and waste capacity by looking for material, finding available space, and needlessly traveling empty from one location to another. Intelligent warehouse visibility, navigation and task sequencing solutions from Apriso can improve picking and put-away productivity; improve material handling productivity; reduce inventory carrying costs; reduce order-to-cash time and minimize manufacturing lead-time.
- **Paperless scan-and-verify logistics execution eliminates picking and shipping errors.** In addition to the loss of customer goodwill and the cost of correcting mistakes, shipping errors cost money where it hurts the most – at invoice and collection time. Customers can't be expected to pay for products shipped in error and, as a result, your invoicing department wastes a great deal of time negotiating credits and returns, adjusting open invoices, and so on. Many customers even refuse to pay any amount owed on an invoice containing errors, which retards your cash flow and unnecessarily ages your accounts receivable. Paperless labeling and scan-and-verify logistics execution solutions from Apriso can maximize picking accuracy; virtually eliminate customer returns; improve material handling productivity; reduce inventory carrying and holding costs; minimize transportation and shipping costs; minimize billing cycle times, reduce order-to-cash time; reduce administrative

and data entry costs; and minimize manufacturing lead-time.

- **Accurate, up-to-date inventory visibility maximizes order fill rates, accelerates revenues and minimizes inventory control costs.** Outdated, inaccurate records create phantom inventories and false shortages, making it difficult or impossible to meet customer and production requirements on time. Often the only way to keep book inventories in line with reality is to implement costly cycle counting and physical inventory programs. Materials management solutions from Apriso can maximize picking productivity; improve material handling productivity; reduce inventory holding costs; reduce order-to-cash time; reduce administrative and data entry costs, improve labor and overhead productivity; and minimize manufacturing cycle times as well as lead-times.

Similar benefits accrue from optimally sequencing work and eliminating defects and waste throughout production processes. Your management team is committed to operating the business on a “demand-pull” basis in the future (with a “make-to-order” and not a “make-to-stock” philosophy) in order to minimize inventories, improve quality, and enhance productivity. The bottom line: you need manufacturing execution solutions that make value-added manufacturing processes more efficient while streamlining, automating, and eliminating non-value added work. This allows you to satisfy customer demands faster, with higher quality, and at a lower cost to you –allowing you to offer the most competitive price to your customers.

Table 2

Production and Quality Control Benefits		
Measure	Description	Improvement
Rejects	Proportion of gross production that does not meet specification	0 – 65% average 19%
Direct Labor Productivity	Good (net) production relative to utilization of the production line labor force	10 – 25% average 18%
Indirect Labor Productivity	Good (net) production relative to capacities of the labor force not stationed on production lines	15 – 40% average 28%
Overhead Productivity	Good (net) production relative to the capacities of plants, machinery, tooling and equipment	5 – 30% average 18%
Quality Control Costs	Operating expenses attributable to sampling, testing, grading and certifying product against specification	75 – 99% average 89%
Work-in-Process Carrying Costs	Capital costs and operating expenses attributable to work-in-process plus production line buffer and safety stocks	0 – 100% average 32%
Work-in-Process Holding Costs	Expenses attributable to securing, counting and auditing work-in-process and production line inventories, plus write-offs due to scrap, shrinkage and loss	10 – 25% average 18%
Administrative and Data Entry Costs	Costs of collecting, verifying, reconciling, approving and reporting production quantities, quality characteristics, labor, machine times and operation status by production line, clerical, administrative, supervisory and management personnel	25 – 100% average 56%
Cost of Goods Sold	The total of direct and indirect costs for material, labor and overhead attributed to the manufacture and warehousing of a product	5 – 20% average 13%
Manufacturing Cycle Time	Time required to manufacture a product, from start to finish	2 – 80% average 40%
Manufacturing Lead Time	Elapsed time between order booking and product delivery	0 – 80% average 27%
Paperwork	Cost of finding, retrieving, verifying, approving, delivering and recording paper drawings, blueprints and documents	0 – 100% average 59%

Source: Manufacturing Execution Systems Association (MESA)

Apriso manufacturing execution solutions can deliver immediate benefits in production, quality control and maintenance areas. Here are some examples:

- **Order consolidation and sequencing eliminate redundant setups and teardowns.** The time and cost of setups and teardowns is fixed no matter how large or small the production requirement. Consolidating work orders to take advantage of common setups can save manufacturers tremendous amounts of time and money. Intelligent work order consolidation and sequencing solutions from Apriso can improve direct labor as well as overhead productivity, cut work-in-process carrying costs, reduce the cost of goods sold and minimize manufacturing lead-time.
- **Immediate visibility of production operations warns of small defects before they create major problems.** If they aren't detected early, small defects – and their root causes – can grow into major quality problems downstream. This not only increases the risk of rejects but also diminishes yields while inflating scrap and rework costs geometrically. Real-time quality management solutions from Apriso can reduce finished good rejects; improve labor as well as overhead productivity; reduce work-in-process carrying and holding costs; reduce the cost of goods sold; minimize manufacturing cycle times and reduce order-to-cash times by pinpointing the location of potentially defective in-process materials and suspect products; and reduce customer complaints resulting from shipment of defective products.

Figure 1

Dynamic Sample Sizing: An Illustration

Assume that the standard specification for a product allows a defect tolerance of $\pm 3\%$.

The minimum sample size is **1,067 units** using the normal probability distribution (at 95% confidence) and an unknown production quantity.

When a specific customer's tolerance is $\pm 6\%$, then the necessary sample size falls by **75% to 267 units**.

If recent history reveals a 2% defect rate, then the necessary sample size for the standard specification ($\pm 3\%$ tolerance) falls by **92% to 84 units** (assuming an unknown production quantity), or by over **99% to 5 units** (assuming a production quantity of 300).

Conclusion: under these circumstances, dynamic sample sizing techniques can

- **Dynamic sample sizing minimizes the cost of quality.** Statistically, the need to inspect production diminishes with the actual defect rate. But many manufacturers lack the flexibility – or confidence – to vary their inspection rates according to quality performance. As a result, they tend to over-inspect which not only spawns redundant inspection activity, but also diminishes yields when product is destroyed in the process. Dynamic sample sizing and quality management solutions from Apriso can cut quality control as well as work-in-process holding costs, reduce the cost of goods sold, and minimize manufacturing lead times (see Figure 1, above). And, they automatically generate increasing dividends, as actual quality performance improves due to continuous improvement initiatives.
- **Immediate dispatching and visibility of material and production operations eliminates downtime.**

Production downtime costs plenty of money, not to mention the goodwill lost when customers don't receive shipments on time. Better work center scheduling, quicker dispatching, improved material visibility, and earlier detection of quality problems can help minimize production downtime. Real-time production management solutions from Apriso can improve labor as well as overhead productivity, reduce work-in-process carrying and holding costs, reduce the cost of goods sold, minimize manufacturing cycle times and reduce order-to-cash times.

- **Paperless manufacturing execution eliminates paperwork costs and maximizes quality.** Shop floor paperwork and its associated errors not only breed defects but also diminish productivity and inflate costs. In many plants, for example, it could take up to one month for manual engineering change notices to arrive on the shop floor. Production management solutions from Apriso can eliminate paperwork, cut rejects as well as quality control costs, cut work-in-process holding as well as carrying costs, and minimize manufacturing lead times.

Identifying Soft Benefits

Soft benefits are often more difficult to identify, and they are also a bit more difficult to quantify. They might include, for instance:

- **Improved customer satisfaction** resulting from better responsiveness to customer needs, shipping accuracy and billing accuracy; or
- **Improved operational efficiencies** such as real-time inquiry and reporting, improved flexibility, higher employee morale and less “fire-fighting.”

The savings generated from soft benefits involves more conjecture than the savings from hard benefits. Nevertheless, one should not ignore them or assume a zero value. Intangible benefits should be identified in order to increase management’s confidence in the cost justification, and to reduce the perceived risk of failure to earn other hard benefits. **Relying too heavily on tangible savings when making investment decisions generally leads to a focus on cost reduction at the expense of profit improvement.**

The following kinds of soft benefits emerge from numerous studies by leading research firms:

Table 3

Soft Benefits of Manufacturing and Logistics Execution Systems	
Benefit	Description
Start-up	Faster training and start-up time for new employees
Morale	Higher employee morale through work force empowerment
Sales and Revenue	Higher sales, revenue and cash flow from better information management, decision making, quality and responsiveness to customer needs
Accountability	Accountability through clean audit trails provided by the system
Regulatory Compliance	Improved ability to meet applicable FDA, GMP, cGMP, DoD (Milspec), environmental health, safety and customer compliance requirements
Visibility of Operations	Immediate, accurate visibility of inventories and the status of in-process production, quality control and warehousing tasks
Zero Latency	Using real-time information access to compete profitably on the basis of time, price and quality
Benchmarks and Feedback	The ability to collect, sift and analyze myriad production, quality and fulfillment details in order to continually set improvement goals, and measure progress against plan

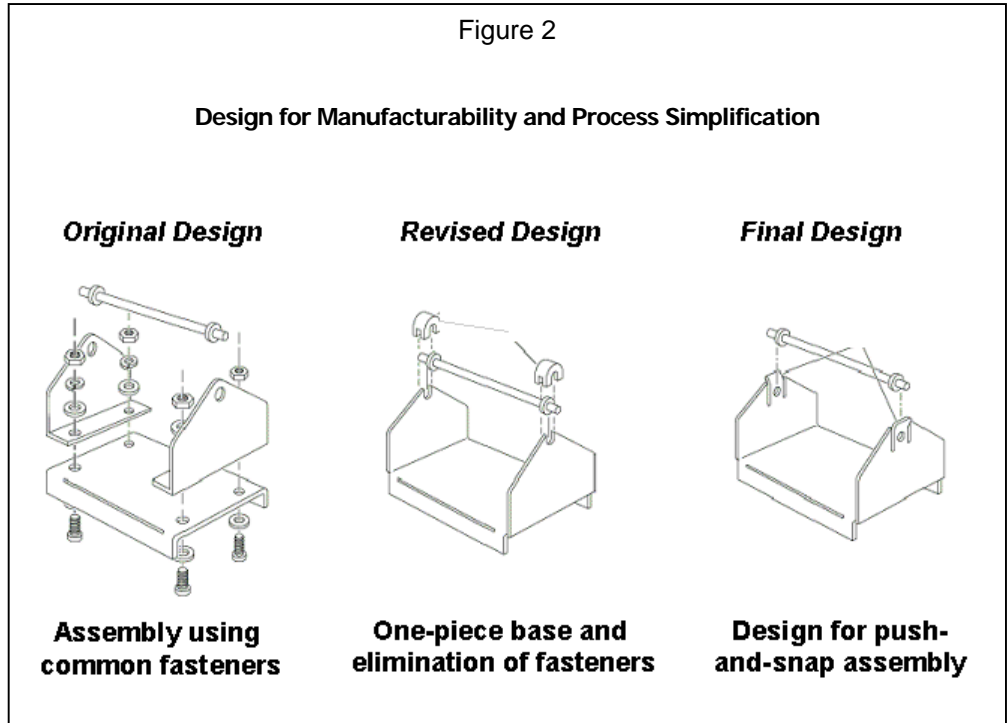
Benefits from Process Standardization

One of the many dilemmas that manufacturers confront in the fiercely competitive global marketplace is that product life cycles are too short to warrant investment in traditional, fixed production lines. A manufacturing process will not be used long enough to provide a high enough return on investment.

A second dilemma is that production lines must be fully operational within a short time to coincide with the narrow window of opportunity for product sales. Design time for traditional production lines is too long. The life cycle of many products, such as that of mobile telephones, is less than one year.

One solution is to use systems based on processes rather than the end products. Most products can be broken down according to the processes used to make them, such as dispensing, mixing, welding or pressing. These processes are typically repeated from one product to the next. In a traditional, fixed system, these processes are rigidly timed and located to make a specific product. In a process-based system, this work is done according to flexible, standard procedures. When the processes are invoked by a common control system, they can be arranged quickly and easily in any order, at any time.

Products must be designed around standard processes for this strategy to work. Ideally, manufacturers would reuse these core processes as often as possible. For years, industry experts have preached about the merits of design for manufacturability and using the simplest processes possible to assemble a product.



(see Figure 2, above). That subject is not new. What is new is the technology available for realizing these goals.

In a process-based system like Apriso's, collaborative manufacturing and logistics execution software oversees the entire plant and determines what processes are needed when. Because processes are standardized, manufacturers can configure production lines and routings so products are made correctly without totally redesigning production lines and routings from scratch. This approach saves manufacturers tremendous time and money. Process standardization also means that operator interfaces, mechanical designs, work instructions and software have a common look and feel, reducing training and operation expenses.

The key is replacing fixed production routings and work processes with flexible ones that can build a product for a few

weeks or months, and then be easily reconfigured to build the next product. The ability to reuse the process engineering investment over several years can provide a substantial return. For example, a process standardization assessment by the American Defense Preparedness Association revealed the following relative improvements from a random sample of 193 process standardization changes:

Table 4

Process Standardization Benefits		
Measure	Description	Improvement
Producibility	Ease of repeatable manufacture	82%
Production Lead Time	Elimination, standardization or simplification of operations or materials	78%
Quality	Conformance to specification	71%
Maintainability	Ease of repair or replacement	64%
Reliability	Ability to meet performance requirements	63%
Human Factors	Acceptability of change related to necessary education or dexterity	58%
Parts Availability	Ease in obtaining or manufacturing simplified or standardized parts	58%
Logistics	Complexity of fulfillment and field support	55%
Weight	Lighter product weight	37%
Performance	Ability of the change to carry out the extended function at time of initial test or qualification	33%
Engineering	Ease of developing and maintaining process designs, specifications and procedures	25%
Packaging	Ease of protecting parts until ready for use	24%

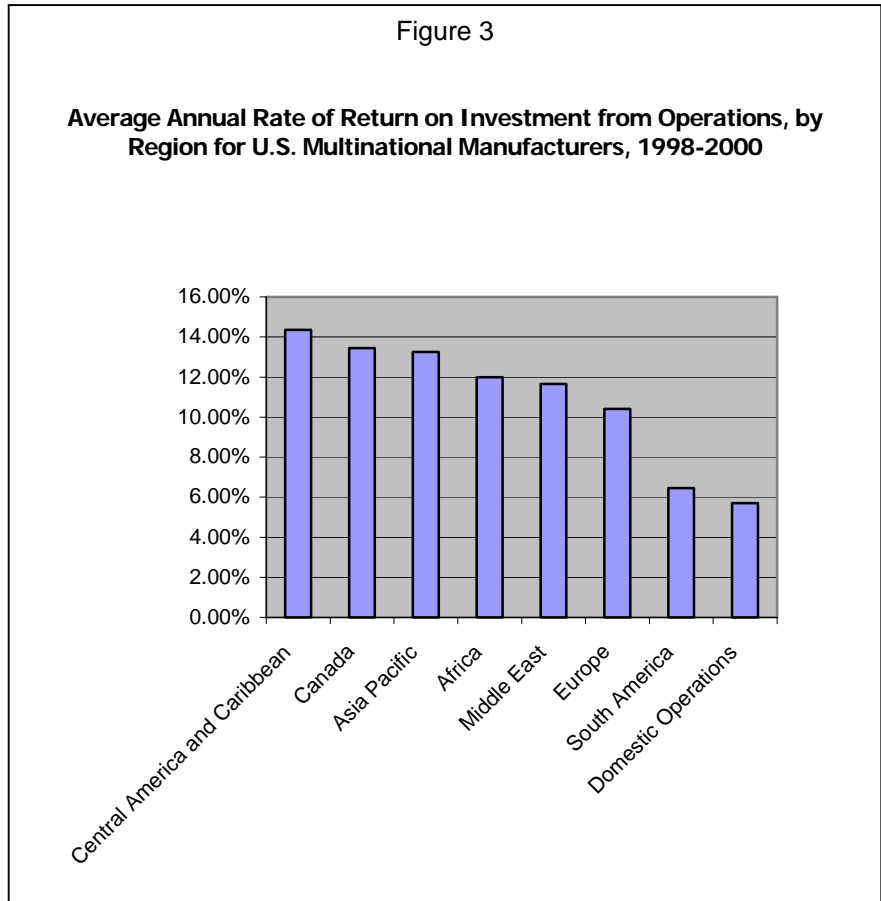
Source: U.S. Department of Defense

The Globalization Multiplier

The aforementioned benefits rely largely upon data gathered from manufacturers in the United States and Western Europe. As such, they do not reflect any differences in return on investment between the world's industrialized and developing regions.

Recent evidence strongly suggests that returns in developing regions could be 2 to 2½ times than what they are in industrialized regions. Figure 3, below, shows the average annual rate of return from operations by region for United States multinational manufacturers between 1998 and 2000. Not surprisingly, returns are highest in Mexico and Canada on account of the North American Free Trade Agreement (NAFTA), but they are almost as high in the Asia-Pacific region. Altogether, U.S. multinational manufacturers earned a 14% annual rate of return from their foreign operations in these regions, 2½ times the 6% annual rate of return from their domestic operations.

We call this difference the “globalization multiplier” that yields additional benefit to manufacturers who operate facilities offshore according to uniform best practices.

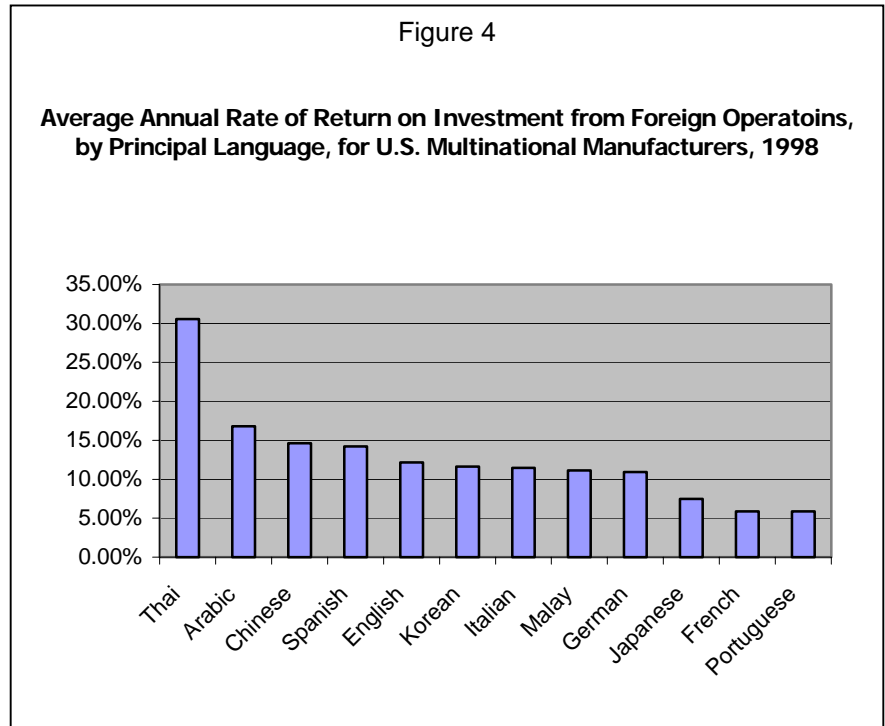


Source: U.S. Department of Commerce, Bureau of Economic Analysis, 1998-2000

To earn this benefit, manufacturers must recognize that no matter how much they standardize their product configurations and work methods, they still need to operate in multiple written and spoken languages. This is especially true for operations on the plant and warehouse floor, where workers are much less likely to understand English than their supervisors and managers.

Figure 4, below, shows that ROI is highest in locales where Spanish, Chinese, Arabic and Thai are spoken. Using translation and text-to-speech capabilities that are built into all Apriso solutions, manufacturers can take full advantage of the

globalization multiplier by implementing manufacturing and logistics execution systems that operate simultaneously in these and other languages as well as English.



Source: U.S. Department of Commerce, Bureau of Economic Analysis, 1998-2000

Benefits from Implementing a Single Collaborative Solution at All Facilities

In the past, industrial companies focused on standardizing their accounting and supply chain planning systems across all their operations, while leaving the selection and deployment of manufacturing and logistics execution systems up to the discretion of individual plants and warehouses.

Today, however, they are discovering that “point” execution solutions are expensive to implement and maintain, not only because the inherent difficulty to integrate disparate systems and technologies, but also because of the considerable time and effort it takes to keep these systems integrated from one version to the next. Manufacturers need ways to attach their software solutions together as if with Velcro instead of tediously “gluing” them together using programmer-intensive processes. It would be best to share a common repository of processes, business rules and historical events that adapts easily to different business needs.

Apriso offers a complete suite of collaborative manufacturing and logistics execution solutions that integrates flexibly with other business systems – over the Internet or intranet – using state-of-the-art Web services technology. The functional breadth and connectivity of our applications make systems integration faster and less expensive than conventional client-server solutions. Lower systems integration costs translate into a higher benefit-cost ratio, resulting in dramatically faster payback – even if you are only implementing Apriso solutions at a single plant or warehouse.

This dividend grows geometrically when you decide to implement a standard Apriso solution at multiple plants and warehouses spanning the globe. For example, consider a solution that costs USD 150,000 per facility for licensing and deployment and which requires one-time investment of USD 300,000 for process standardization, systems integration and business rules modeling. Assume further that the average annual benefit of this system is quantified at USD 600,000 per facility.

Table 5

The Apriso Multi-Site Implementation Dividend					
Number of Facilities	Average Cost per Facility (000)	Average Annual Benefit per Facility (000)	Average Payback Months	Total Cost (000)	Total Annual Benefit (000)
1	450	600	9	450	600
10	180	600	4	1,800	6,000
50	156	600	3	7,800	30,000
100	153	600	3	15,300	60,000

Table 5, above, shows the cost, benefit and payback months on a per-facility average and aggregate basis when implementing the standard Apriso solution at 1, 10, 50 and 100 facilities, respectively.

Note that Apriso, with 13 direct sales and support offices in 12 countries – spanning 5 continents – is in better position than virtually any other provider of manufacturing and logistics execution solutions to provide on-site implementation support and 24x7 Customer Care that “follows the sun.”

Conclusions

On the basis of independent research conducted by government agencies and leading industry analysts, it is clear that collaborative manufacturing and logistics execution solutions from Apriso can yield major cost savings as well as improve corporate profitability.

The hard benefits of implementing one instance of Apriso software at a single plant or warehouse suggest a payback potential of anywhere from 6 to 24 months, with an average payback period of 14 months. Benefits would accrue mostly from reductions in manufacturing and fulfillment cycle times averaging nearly 50 percent.

Return on investment could be 2½ times greater when implementing one instance of Apriso software at a single plant or *warehouse* situated in Canada, Mexico or the Asia-Pacific region. This globalization multiplier reduces payback periods to anywhere from 2 to 10 months at facilities outside of the United States and Western Europe, with an average payback period of 6 months. **Globalization benefits are available only to users of Apriso software: Apriso offers the *only* manufacturing and logistics execution software on the market with built-in language translation and text-to-speech capabilities.**

And finally, return on investment could grow up to an additional 3 times when implementing *one or more* standard instances of Apriso software at *multiple plants and warehouses* throughout the world. This is because each facility accrues only its pro-rata share of the one-time investment for process standardization, systems integration and business rules modeling. It could further

reduce payback periods to anywhere from 1 to 3 months per facility, with an average payback period of 2 months per facility. As with globalization benefits, this dividend is available only when you choose a software developer who maintains numerous sales and support locations around the world. With 13 direct sales and support offices in 12 countries, Apriso is in better position than virtually any other provider of manufacturing and logistics execution solutions to provide worldwide implementation support.

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