

The Benefits of MES: A Report from the Field

Updated and Revised 5/97

Executive Summary

“The biggest benefit to (our company) is that accurate, real-time data improves the decision-making process, and the resulting decisions/actions improve customer service and decrease cycle time for all MES related information.”

— *Teledyne Allvac*

“(MES) dramatically improved plant operations.”

— *R. B. Royal Industries*

For several years, developers and vendors of Manufacturing Execution Systems (MES) have been working to build a case for this new category of manufacturing software. Their case initially rested more on what MES has the potential to do for manufacturers than on available data taken from actual users.

As the installed base of MES applications grows, potential and new users are asking vendors to support their claims with quantifiable evidence that MES does have a positive impact on the financial performance, the corporate mission, and on day-to-day operations within manufacturing companies.

Proof is in the results

The proof for prospective users is in the experience of current users and early MES adopters. Documented results as well as anecdotal evidence are now available. With the surveys that contributed to the creation of this paper, MESA International undertook a compilation of data to accumulate, analyze and publish for the first time

from the field on the documented results and anecdotal benefits generated by MES installations. For MESA's first study of MES benefits, a small but representative group of manufacturers was queried in 1993.

The specific objectives of the study were:

- to identify the most common benefits to the manufacturing process;
- to quantify these benefits wherever possible;
- to extrapolate and verify the larger business and/or financial benefits these installations are generating;
- to summarize these findings in a report that will help manufacturers assess the total potential impact of integrated MES on their operations.

Manufacturers representing seven different industries were surveyed via a questionnaire developed by MESA. The responses to the questionnaire provided a “snapshot” of benefits received as of the end of the first quarter of 1994. Subject companies were asked to identify and quantify, where possible, specific benefits creating improvements in: 1) manufacturing/ production operations; 2) manufacturing planning; and 3) corporate financial performance.

As anticipated, respondents identified multiple benefits to both discrete and batch/processing manufacturing operations, but the importance of each benefit to the specific company varied considerably, as did the quantifiable results. For example, the most frequently cited “important” benefit was *reduces manufacturing cycle*

Contents

Executive Summary	1
Introduction	3
Study Purpose and Objectives	4
Study Methodology	4
Respondent Profile	5
Conclusions	5
Summary Conclusions	9
Appendix A	10
Appendix B	10

time. Ninety-two percent (92%) of the respondents reported that this benefit was very important to their operations. The average reduction in manufacturing cycle time achieved by these respondents was 45 percent.

Benefits to the planning process tended to be more anecdotal than statistical, but extremely important nevertheless. A majority of these that responded cited *flexibility to respond to customer demands* and *provides agile manufacturing* as the most important benefits in this category.

The benefits to the business/financial level were defined as *ROI/payback period* and a marked *improvement in customer service* (and as a result, a stronger competitive and financial position). Half of the respondents provided a measurable payback period. The actual figures provided ranged from six months to two years, with the average being 14 months.

Interestingly, *improves customer service* was cited as being more important as a benefit than *ROI/payback period*. This question elicited many subjective comments attributing a number of positive results to the use of MES, including a marked reduction in past dues, increased market share due to on-time performance gains and total adherence to customer order schedules and shipment quantities.

A second group of companies was interviewed in 1996 with a similar set of questions (Appendix B). The findings of the second survey substantiate those of the first. [The results of this research are included in this updated report, but are not aggregated with survey one.]

In summary, from the information supplied by the respondents to both MESA questionnaires, it is evident that virtually all of the manufacturers who have installed integrated MES over the last seven years are receiving *measurable* benefits to the production process. Furthermore, this study indicates that these benefits can carry over to the planning and business phases of manufacturing.

The study supports the position that because each manufacturing application is unique, the list of benefits and quantifiable results will be different for each user. Moreover, there are many benefits that are common to a high percentage of all manufacturers surveyed.

As more companies enter the MES domain and track their results, a comprehensive database on MES benefits

will be created and the full import of the technology will become even clearer. MESA will continue to provide leadership in this effort.

Introduction

MES or Manufacturing Execution Systems is a recently defined category of industrial software for the shop floor/manufacturing environment. Market reports show that it has been adopted in a number of discrete, batch and continuous process manufacturing industries, especially aerospace, automotive, semiconductor, pharmaceuticals and petrochemical, and increasingly is being applied in sectors such as metals, plastics and medical equipment.

MES is considered to be a key technology set in the drive to improve manufacturing performance capability in the fiercely competitive global marketplace. While corporate management is naturally concerned with long-term objectives, there is a growing realization that MES can have considerable short-term impact on mission and performance as well.

Most Manufacturers Can Benefit

In spite of its brief history (the term MES was first used in 1990), the industry position is that virtually every manufacturing operation, regardless of size, complexity and type of product, could benefit in some way from integrated MES. With MES the manufacturing process becomes information driven and a stronger contributor both to overall productivity and to the financial viability of the company.

In fact, all manufacturers already use some form of manufacturing execution system, whether it be by manual means, computer point solution or fully integrated system. The MES being discussed in this study is integrated MES, which is a relational computer software application that 1) provides a real-time look at manufacturing operations, and 2) makes it possible to integrate the real-time data with other information systems such as production planning and distributed control systems.

The potential benefits to a user are significant. When specific shop floor functions can be improved, the resulting benefits can have a positive impact on more fundamental corporate objectives such as increased market share, profitability and improved global competitiveness.

These corporate objectives can be realized only if specified improvements such as shorter production runs, improved quality, lower costs and improved customer response can be first addressed in the manufacturing phase. MES makes it possible to achieve these goals. The immediate need, as MESA sees it, is to identify and define these benefits, quantify them where possible and translate them into general business benefits.

MESA International

MESA International was formed in 1992 as a trade association representing developers and vendors of MES software. The Association is in a unique position to conduct this study because its member companies are on the leading edge of MES development and application, and have installed systems throughout North America and around the world.

This study of benefits is part of MESA's aggressive research and analysis program designed to support developers/vendors of MES technology and manufacturers who use the technology or are planning to use it. Through a series of industry surveys, studies, reports, published articles and papers, and through industry events such as the MES Roundtable, the Association is helping to advance a technology that will have a profound impact on manufacturing into the next century.

The MES industry is growing rapidly. According to Advanced Manufacturing Research (AMR), and a study done by MESA members, the total MES market was \$150 million in 1993 and increased by approximately 30 percent in both 1994 and 1995. Growth rates are projected to continue at 30 percent or greater through the end of the decade.

Study Purposes and Objectives

Perhaps the most frequently asked questions from manufacturing and financial management considering installing MES today are these:

- Are manufacturers who are using MES receiving the expected benefits?
- How did existing MES users approach and justify the investment?
- What are these benefits to begin with?

This study is intended to provide some answers to these questions and to point the direction for a comprehensive

MES benefits model. While a number of articles and reports have been published describing results obtained by individual manufacturers, this is one of the first studies to compile comparable data from a representative but diverse group of actual users, and to attempt to arrive at some commonality of experience.

Each individual manufacturing operation is unique unto itself and has established its own set of priorities and objectives—and even its own terminology. This study seeks to define a list of expected benefits that users generally can recognize and measure.

The “List of Potential Benefits” (see Appendix A) used for this study was developed from a variety of sources, including MES vendors, previously published reports and trade articles, such as those provided by AMR, and selected users who have tracked results and improvements over the last several years.

This report also seeks to:

- Establish some meaningful data on the real benefits of MES for manufacturing and financial managers of manufacturing companies who are considering MES;
- Continue the dialogue between vendors and users to measure and analyze the benefits that MES is providing, and to review the results.

Study Methodology

Two surveys were conducted, one in 1993 and the other in 1996. Information was gathered using two similar questionnaires based on a list of potential and actual manufacturing, planning process and business “benefits” which was developed by MESA members. Recognizing that additional benefits may exist, the questionnaires included an open response section asking respondents to describe “other” experiences.

The first questionnaire asked respondents to check off which benefits applied to them and to rate each by importance to their operations on a scale of 1-5 (with 1 indicating “extremely important”, 5 indicating “little or no importance”).

In addition, users were asked to provide specific quantified data for those benefits that they cited as being most important.

The user's company name, industry group (discrete or batch/processing) and the date the MES system was

installed were requested on each questionnaire. Requests for confidentiality were honored.

The second questionnaire focused on quantifying shop floor operations benefits, asking respondents to indicate the percentage of improvement in seven areas; this survey also gathered comments on planning, business and customer service benefits.

Users Supplied Actual Data

For the first survey, MESA member companies were sent copies of the questionnaires and asked to forward them to a least three customers/users. The information on the questionnaire was supplied directly by the user and not filtered through the vendor in most cases. Data for the second survey was gathered by MESA staff directly from MES production management. Member involvement was limited to review of the survey instrument.

Respondent Profile

The companies who contributed information for this study represent a range of applications and a variety of manufacturing environments. In many ways, they are typical in the user community but have at least one major common characteristic: they invested early in MES and now reaping the benefits.

- 75% of the companies that provided data to MESA for this study describe themselves as “discrete” manufacturers.
- 16% are “batch/process” manufacturers
- 9% are both.
- The companies represent the following industries:
 - Medical Products
 - Plastics and Composites
 - Metals Manufacturing
 - Electrical/Electronics
 - Automotive
 - Fiberglass
 - Communications
- In the first group surveyed, 84% of the user companies installed MES after February, 1990. The average user experience with MES at the time of the survey was 2.3 years. User experience ranged from three months to 5.3 years. This information was not gathered in the second survey.

Conclusions

There are a number of conclusions that can be drawn from information in each of the benefits categories provided by the respondents. The “manufacturing” benefits provided the bulk of the quantifiable data while the “planning” and “business” benefits elicited a number of subjective comments and anecdotal material.

Benefits to Manufacturing Operations

As expected, each user company had its own set of priorities and objectives and therefore a somewhat unique set of benefits. However, commonalities emerged. Also, users were able to quantify most of the benefits they identified.

Some basic observations from the responses received are:

- The benefits list that formed the basis for both questionnaires was comprehensive and valid. Respondents made no additions to the list, except to restate in different terms or slightly modify the original definitions.
- Every manufacturing benefit listed on the questionnaire is rated as “important” by at least one user.

The shop floor benefit most frequently cited by users (92% of all respondents) as “extremely important” or “very important” is “reduces manufacturing cycle time.”

Specific Findings: Survey One

Following is summary information on specific benefits cited by at least 50% of the respondents as being “extremely” or “very important.” The data varied considerably from user to users and cannot reflect a statistically meaningful average or consensus.

Reduces manufacturing cycle time

- 60% of respondents report reduction in cycle time of 40% or better
- Range of reduction: 2 - 80%
- Average reduction of all respondents: 45%

Reduces or eliminates data entry time

- 60% of respondents report reduction of 75% or more
- Range of reduction: 25-100%
- Average reduction of all respondents: 75%

Reduces Work in Progress (WIP)

- 57% of respondents report reduction of 25% or more
- Range of reduction: 25-100%
- Average reduction of all respondents: 17%

Reduces/Eliminates paperwork between shifts

- 63% of respondents report reduction of 50% or more
- Range of reduction: 5-100%
- Average reduction of all respondents: 56%

Reduces lead times

- 50% of respondents report reduction of 30% or more
- Range of reduction: 2-60%
- Average reduction of all respondents: 32%

Improves product quality (reduces defects)

- Average reductions in defects: 15%
- Range of reductions in defects: 5-25%

Eliminates lost paperwork/blueprints

- Average reduction: 57%
- Range of reduction: 10-100%

Specific Findings: Survey Two**Reduction to manufacturing cycle time**

- Average reduction: 35%
- Range of reduction: 10 - 80%

Reduces or eliminates data entry time

- Average reduction: 36%
- Range of reduction: 0 - 90%
- Nearly half reported 50% or greater reduction.

Reduces Work in Progress (WIP)

- Average reduction: 32%
- Range of reduction: 0 - 100%

Reduces/eliminates paperwork between shifts

- Average reduction: 67%
- Range of reduction: 0 - 200%

Reduction to lead time

- Average reduction: 22%
- Range of reduction: 0 - 80%

Improves product quality (reduces defects)

- Average reduction: 22%
- Range of reduction: 0 - 65%

Eliminates lost paperwork/blueprints

- Average reduction: 55%

- Range of reduction: 0 - 100%
- 62% reported reduction of 75% or greater.

Empowers plant operations people (Survey One and Two)

This benefit, while not quantifiable, was cited by the majority of the respondents as being very important.

Subjective comments are instructive:

- An automotive supply manufacturer: "Line employees handle data. Supervisors do their own dispatching of jobs — same on all shifts."
- A fastener systems manufacturer: "Foremen can now approve payroll and schedule work for their people without leaving their offices."
- A medical products manufacturer: "It allows operators to e-mail messages and participate with (not against) the system."
- An electrical devices manufacturer: "Each operator has full access to all order information and process/assembly information. Operators no longer have to ask for wait for information from supervisors."

Additional comments

- "People don't have to ask 'what's next?'"
- "Overall willingness to adapt to new system has been great. Operators have assumed ownership."
- "Better control of orders and inventories"
- "Makes people 'knowledge workers.' They can stay focused. More information available at any one time. Operator is excited about the amount of information. Pipeline into engineering."
- "Foremen have access to better information. No longer manual, all on-line. Freed up foreman to spend more time in management."
- "Run production flow as they see fit. Supervisors are coaches. Give more."
- "Reflects inventory that is usable to everyone: production, financial people. Beneficial for costing, planning production."
- "Much faster reaction time. Production manager can be out on the floor instead of at desk crunching numbers."
- "Enormously empowering. People don't have to wait to get things done. More efficient with information"

available. Can make better decisions.”

- “They know what jobs to run next, and they get better preparation time. Reduction in ‘make ready’ hours.”
- “Improved communication between manufacturing and planning and scheduling.”
- “[Our operation is] highly automated with bar coded containers. Would not be able to run without MES system.”
- “Can get information from desktop. Didn’t have MRP in plant. Reduced paperwork, better accountability.”
- “Enables people to provide information without adding tasks to their jobs. Can see what is available and what needs to be worked on in real time basis.”
- “Went from 10% having access to data to 100% having access.”
- “Total shop floor visibility available to everyone.”

Selected Comments on Other Shop Floor Benefits

- A machine shop reports that MES has helped “reduce its shop floor set-up times” by 50% and that 98% of its domestic deliveries are on schedule. Total inventories reduced by 60%.
- A metal manufacturer, indicating that “fulfillment of regulatory and compliance requirements” is an extremely important benefit, commented: “We are using our MES to start replacing the paperwork required by our customers and quality compliance efforts.”
- An electrical devices manufacturer, citing “elimination of paperwork (and associated errors)” as being an important benefit, adds: “Engineering change notices are executed in less than two days. It used to take up to one month to get changes to the shop floor.”
- “Through-put from 48 hours to 12 hours; Equipment up-time increased by 30%
- “Better able to perform data analysis, due to retrieval of information.”
- “Better shop floor control. Material ware flow and material accounting is better.”
- “Able to integrate produce labeling with bar coding.”
- “Better, more immediate feedback re products and quality.”
- “Communication [greatly improved]. Supervisors have

birds’-eye view of floor, can see what’s happening in previous and past operations. Before had to walk around to get information.”

- “Like using computers. Use as time helping systems. Better reporting, more accurate.”
- “Enables us to track defects to specific operator.”
- “Inventory control better. Accountability of product. Managing yields better.
- “Morale is better. People are enthused. Want it to be in all product lines.
- “Shop floor guys benefit in training. Some old operators found it difficult to let go of paper, so there was some negative impact. Operators are PC literate.”
- “Visibility of what is happening on floor. See what process state things were in.”
- “Reduces supervision. Orders automatically dispatch.”
- “Information available in real time has enabled better planning and scheduling. High visibility, in general, has been a benefit.”
- Operators now have total visibility. Priorities are communicated throughout the shop.”

Benefits to Planning Process

The respondents felt that benefits to the planning process were critical but not as easy to quantify. About 50 percent rated at least one of the five “planning benefits” as being very important to their companies. Since it is difficult to measure these benefits precisely, quantifiable data was not provided in most cases, although subjective comments describing these benefits were offered by several respondents.

- Of the planning benefits, “flexibility to respond to customer demand” and “provides agile manufacturing” were cited most frequently (66% of respondents) as being important to the users.
- One manufacturer of fasteners for the automotive industry commented that MES “allows us to meet higher sales volumes without increased cost” and “supervisors are empowered to make decisions real-time with system information.”
- A manufacturer of electrical devices commented that “MES provides product planning through ability to insert orders and lock-in schedule dates, thus providing firm delivery date.” Agile manufacturing is also

important to this manufacturer, who added that the “cellular approach will allow a number of families of components to be built on each product line.”

- The fact that MES helps fulfill regulatory/compliance requirements was noted by 42% of the respondents, specifically with helping to comply with ISO 9000 standards and approvals.

Business Benefits

The Business Benefits are described in the questionnaire as “ROI payback” and “improvement in customer service.” One third of the respondents provided payback period data but several chose to comment extensively on the impact that MES has had on their business operations.

- Payback periods range from six months to two years, with an average of 14 months.
- The manufacturer of electrical devices reports that MES led to “improvement in margin,” and the decision to install MES was based more on the “financial/performance benefits to the bottom line and product margin gains.” This manufacturer added: “Reduction in cycle time reduces WIP and product quality problems. (The) paperless approach reduces overhead, i.e. eliminates non-value added paper handling and management. Scheduling and order visibility reduced people expediting.”
- A screw machine shop reports that “past dues when from 30% to 2% of current monthly sales” with MES.

Additional comments on ROI/payback

- “Payback every three months. Amazing!”
- “Paid for itself many times over. Analysis of quality is important.”
- “Payback period was 12 months.”
- “6-9 month payback.”
- “Reduced costs by going with commercially available system.”
- “Lower scrap/defect = higher profitability.”
- “Very cost effective solution. Beneficial ‘legacy’ system.”
- “Cumulative savings \$2.2 million. Expecting 2.2 years payback.”
- “Reduction in rework and inspection. Reduction in

post manufacturing rectification. Basis for financial gain.”

- “Not calculated. It is there, but there are too many variables to figure it out.”
- “Initial expense is recovered through seen and unseen improvement.”
- “In the process of conducting an audit. Although not definite, most of all expectations have been met or exceeded, therefore, probably good.”
- “Difficult to quantify.”

Customer Service Cited

The “improvement in customer service” benefit was cited by one third of the respondents as being “extremely important.” Again, subjective comments serve to illustrate this position.

- An electronics manufacturer reports that “decreased cycle time has improved service to the customer.”
- A manufacturer of metal cutting tools for the automotive industry comments that “much improved on-time performance results in increasing market share.”
- The electrical equipment manufacturer reports “100% adherence to customer order schedules and 100% shipment to customer order quantity.”
- A metals manufacturer: MES provides “real time status updates of all orders; we are using our MES to start replacing the paperwork required by our customers and quality compliance efforts.”
- Fastener manufacturer: “Payback comes from empowered employees and reduced indirect employees.”

General comments on Customer Service Benefits

- “Can accurately tell when a product will be available, instead of guessing.”
- “Reorganized customer service and decentralized. MES system to meet customer demand has been a great benefit.”
- “Can tell them where order is in real time. Don’t have to tell customer to wait to get information.”
- “Bottom line: customer gets what he wants when he wants it.”
- “On-time fill rate, cycle time.”

- “We have also included sales/customer service in an inquiry basis.”
- “It’s a ‘requirement’ to have something like this in place because of the efficiencies involved.”
- “Empowerment of people; ability to analyze product quality at high percentage increase over what they could do previously.”
- “Suggest starting off with phases over 8 - 12 month period. Quite pleased. Somewhat of a culture shock from paper-based and home grown data base.”
- “New products - works very well. Can be phased in very easily.”
- “Laid foundation for building other planning systems a top. Key feed for other systems.”
- “Communication is very important. Can schedule entire life of product, as opposed to phased approach.”
- “Tremendous benefit.”
- “Provide customer with data. Enables them to make adjustments.”
- “Has taught them that they need to get the rest of the chain up to par. Inventory is good but the MES points out other weaknesses in the chain.”
- “Ability to display quality assurance information in a clear, concise manner.”
- “Have control of process now. Better documented. Quantum leap in quality.”
- “Inventories much more accurate.”
- “High visibility of information enables them to better foresee problems in meeting demands.”

Summary Conclusion

From the in-depth information provided for this study by the manufacturers, it is apparent that the expectations for MES largely are being fulfilled, especially on the shop floor; this is evidenced by the importance assigned to “reduces manufacturing cycle time.” Moreover, measurable improvements in manufacturing functions and processes are also being transferred to the business/financial level. In addition to actual historical improvement, many of the respondents predicted that they would achieve even better results the longer they worked with MES.

The significance of “reduced manufacturing cycle time” is reflected in a second theme running through the responses: the concept and capability of having data available in real time, a fundamental function of MES. Following are comments from respondents mentioning real-time data when asked to describe the MES functions that had the most impact on their operations:

“Real time order status, equipment status and inventory visibility.”

“. . . real time job prioritization. . . real time information to plant management.”

“Scheduling and dispatching and e-mail to the factory floor.”

“Tracking and traceability of customer orders . . .”

“Real time shop floor data collection.”

A metals manufacturer perhaps best summarized the issue: “The benefits are very difficult to quantify and/or attribute to just one cause. But real time data provide significant advantages in the day-to-day operation of your plant and, of most importance, improved services to your customers.”

An additional significant finding is the benefit of knowledgeable, empowered shop floor personnel.

“Morale is better.” “People are empowered.” “Supervision is reduced.” “Orders automatically dispatch.”

This study represents a step toward further development of the MES industry by adding to the growing body of knowledge of this important technology. The knowledge-building process must be ongoing. MESA International will continue to conduct research and informational programs on behalf of members and manufacturers alike. MES vendors, existing and potential users and others interested in the industry may contact the Association for more information. We invite your comments.

Appendix A - Survey One

Benefits to Shop Floor (Manufacturing) Operation

Reduction to manufacturing cycle time (%)
 Reduces order processing errors (%)
 Reduces set-up times (%)
 Reduces management scheduling time (%)
 Reduces lead times (%)
 Reduces customer order backlog (%)
 Reduces inventory transactions (%)
 Reduces paperwork between shifts (%)
 Reduces lost paperwork/blueprints (%)
 Reduces or eliminates data entry time (%)
 Reduces materials waste (%)
 Reduces in process failures (%)
 Increases production capacity (equipment utilization) (%)
 Reduces WIP (%)
 Reduces finished good and raw material inventories (%)
 Empowers plant operations people
 Reduces operational and other costs
 Other (open response)

Benefits to Planning Process

Fulfills customer orders quickly
 Allows flexibility for responding to customer demands
 Allows users to conduct simulations and “what if”
 scenarios before finalizing production schedule.
 Facilitates agile manufacturing
 Fulfills regulatory/compliance requirements
 Other (open response)

Business Benefits

Fast ROI/Payback
 Improves customer services
 Other (open response)

Appendix B - Survey Two

Benefits to Shop Floor (Manufacturing) Operation

Reduction to manufacturing cycle time (%)
 Reduces or eliminates data entry time (%)
 Reduces Work in Progress (WIP) (%)
 Reduces/eliminates paperwork between shifts
 Reduction to lead time (%)
 Improves product quality (reduces defects) (%)
 Eliminates lost paperwork/blueprints (%)\
 Comments on empowerment of plant operations people
 Comments on other shop floor benefits

Benefits to Planning Process

General Comments on Benefits to the Planning Process

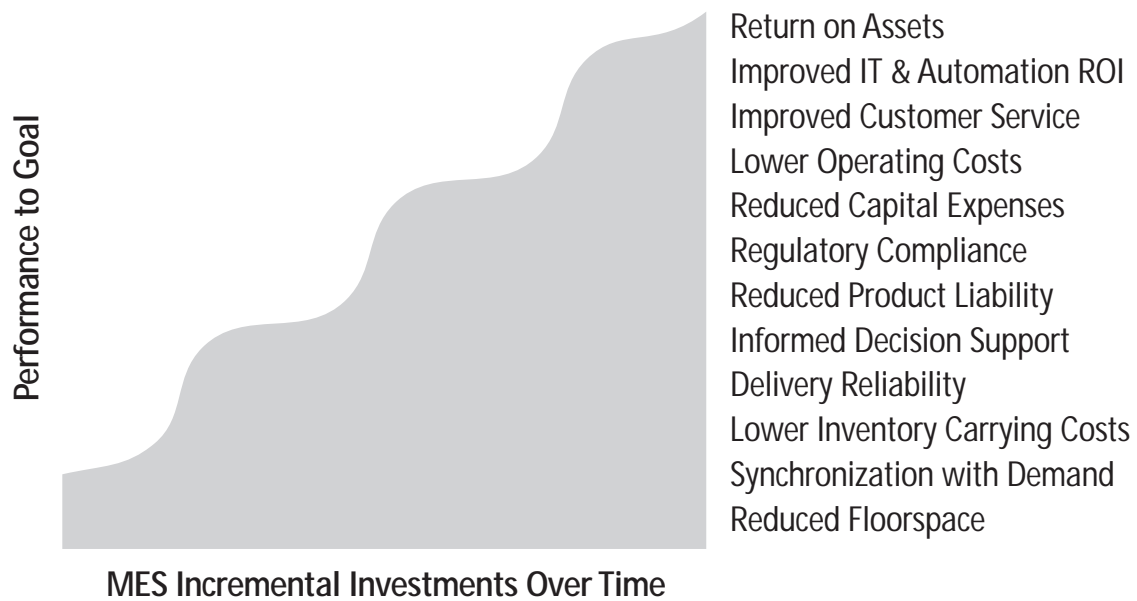
Fulfills customer orders
 Allows flexibility for responding to customer demands
 Allows users to conduct simulations and “what if”
 scenarios before finalizing production schedule.
 Facilitates agile manufacturing
 Fulfills regulatory/compliance requirements
 Other (open response)

Business Benefits

Fast ROI/Payback
 Improves customer services
 Other (open response)

Customer Benefits Cited

General comments as offered



MES contributes to most industries' corporate goals, even for companies that have other systems in place. Several MES solutions or functions may contribute to the strength of a given benefit, and benefits



Manufacturing Execution
Systems Association

MESA International
303 Freeport Road
Pittsburgh, PA 15215 USA
+1 412.781.9511
FAX: +1 412.781.2871
E-mail: info@mesa.org
<http://www.mesa.org>