CHEMICAL PROCESSING

ERP Systems Special Report

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Consider Integrated Technology

An ERP system should be easy to implement, use and upgrade as business evolves

By David Berger, Contributing Editor

THE CHEMICAL processing industry has a unique set of requirements that makes shopping for Enterprise Resource Planning (ERP) systems, and business systems in general, a challenging experience. Although the more advanced business systems continue to add features applicable to functions throughout the enterprise, including operations management, supply chain, finance, and so on, only a few vendors offer systems that meet the particular needs of chemical processors. The chemical processing industry faces numerous challenges that drive these unique requirements, such as availability of supply, ever-changing commodity prices, intensifying global competition, and the growing influence of numerous regulatory bodies.

Process industries such as chemical manufacturing and distribution are highly integrated, from the plant floor to the executive suite, across the many functions and business units of a given enterprise, and all along the supply chain. These companies typically have large capital investments in physical assets and plant automation, for the continuous manufacturing of finished products. This is in contrast to other industries that may be less integrated and more labor-intensive. Chemical processors and shippers also require sophisticated tools for monitoring and managing risk, especially in light of growing regulatory pressure. These and other distinctive characteristics of chemical processors are discussed in more detail below.

VERTICAL INTEGRATION

Most chemical processing plants use technology at every level in the organization. More sophisticated business systems are able to interface with plant automation systems where data is generated, all the way to decision support and executive information systems at the highest level in the organization. Advanced business systems can integrate directly with a variety of plant-floor equipment, in order to maximize the timeliness and accuracy of data. This includes connectivity with programmable controllers (PC), manufacturing execution systems (MES), human-machine interface (HMI) equipment, and even a direct interface with individual production, material handling or safety equipment. Broad categories of data that may be filtered or consolidated

for use in business systems are as follows:

- Product (e.g., production volumes, product quality)
- Process (e.g., schedule/routing compliance, statistical process control)
- Health, Safety and Environment (e.g., incidents, events)
- Asset (e.g., asset availability, performance, reliability)

Fully integrated business systems should provide easy, real-time reporting capability for supervisors and managers. For example, reports should provide planned versus actual data for any relevant categories above, including dashboards to facilitate management by exception for each role (e.g., planner, quality control supervisor, production manager). At the highest level, senior management requires reporting and business intelligence on profitability by product category, business unit, etc., as well as variance reporting on productivity. But ultimately, given the huge investment chemical processors make in physical assets, top management must be able to set targets and track return on assets (ROA), return on capital employed (ROCE), and other high-level measures.

HORIZONTAL INTEGRATION

As the level of automation increases on the plant floor, and the labor pool continues to shrink, chemical processors have witnessed two key trends:

1. A smaller labor pool has moved to more cross-trained and multi-skilled employees working across silos, such as production technicians that have responsibility for process monitoring, some

online product testing, and adjusting/maintaining their equipment, thus combining operations, engineering, maintenance and quality control disciplines.
2. More integrated systems are needed to support this shrinking labor pool across multiple departments within a plant (e.g., production, quality control), in shared service areas (e.g., accounting, HR, supply chain), and across the enterprise (e.g., other plants and business units).

The better software systems provide enterprise-wide business systems that support these trends. This includes facilities, customers or suppliers in multiple countries, which in turn, may necessitate such features as multi-company, multi-language, multi-currency and multi-warehouse capability. Some examples of horizontally integrated software functionality more specific to the chemical processing industry include:

- R&D: ability to analyze, develop, and update ingredients lists, formulas, and their properties.
- Production: convert optimized results of R&D into production bill of materials, lot control for ingredients and finished goods, and yield tracking.
- Quality Control: user-definable test paths that depend on actual vs target pass/fail results for multiple variables, and ability to handle a wide range of test situations such as raw material testing, real-time production quality monitoring, testing customer returns, and finished goods sampling.
- Health, Safety and Environment (HSE): fully integrated library of Globally Harmonized System (GHS) labels and classification of chemicals,

including hazard statements and precautionary statements, safety data sheets (SDS), and regulatory reporting.
• Sales Order Management: integrated sales order entry and shipping, including weight calculation, hazard classification, and industry-approved label and shipping document generation based on multiple export templates.

ASSET- VS LABOR-INTENSIVE
One of the key drivers behind the latest technology wave — the Internet of Things (IoT) — is that assets continue to get smarter, more complex and better integrated. This includes improved hardware (e.g., more powerful processors), telecommunications (e.g., easier access to the internet), and software (e.g., fully-integrated solutions). Even simple assets such as forklift trucks, buildings, and hand tools are riding this wave. For asset-intensive manufacturers such as chemical processors, this trend dramatically increases the importance of a comprehensive enterprise asset management (EAM) system fully integrated with your business systems. Look for features to assist in managing the growing investment in assets across your enterprise including the ability to:
• Develop a comprehensive work program, consisting of job plans for maintenance work triggered by equipment failure, condition, or usage (i.e., time, meter reading or event);
• Manage spare parts inventory, complete with barcode/RFID scanning and integration with material safety data sheets (MSDS);

• Set up, compare and track your calibration results, including calibration sequences, test point data, tolerances, process control limits, "As Found" results, "As Left" results, action taken, and calibration status;
• Monitor equipment history (e.g., maintenance cost summary, failure analysis); and
• Integrate with other modules such as Purchasing (e.g., ordering spare parts, supplier history), HR (e.g., technician qualifications and certification), Finance (e.g., accounts payable, fixed asset accounting), Production (e.g., scheduling equipment downtime), and Engineering (e.g., asset lifecycle management).

CONTINUOUS VS DISCRETE MANUFACTURING
Many types of manufacturing processes exist, from discrete manufacturing where individual products are fabricated and/or assembled, to continuous processing common to chemical processors. There are many hybrid models such as small batch processing adopted by some pharmaceutical and food processors. Continuous processing requires functionality very different from discrete manufacturing. For example, discrete manufacturers focus on material requirements planning (MRP), whereby the bill of materials (BOM) is used to calculate stockroom, purchasing, work centre and shipping schedules for building a product. By contrast, chemical processors typically require software that can handle formulation at every stage in the product lifecycle, from R&D, into production, quality control, and on to shipping.

Some process industries use a least-cost formulation which optimizes inputs and outputs subject to constraints. For example, suppose multiple raw materials can be substituted as a single ingredient for a given formula, differing say by its purity, color, density, and other possible characteristics. Each option may require a differing level of processing to meet specifications. If each of these possible inputs can be purchased and processed at different costs, but ultimately satisfy the same finished product requirements, what is the least-cost formulation? A few advanced business systems integrate with software or have built-in functionality that uses simulation, linear programming and other algorithms to minimize the cost of inputs. Similarly, there is software that uses the same algorithms to maximize the profitability of a mix of finished product outputs subject to constraints.

RISK MANAGEMENT

Chemical processors require comprehensive software tools to effectively manage their operational, environmental, financial and other risks. Your business systems should provide features integrating risk management with lockout/tagout functionality, permitting, incident management, case/event management, and the management of change. Additionally, chemical processors should expect integrated applications that satisfy the requirements of a myriad of regulators, such as

- GHS for hazard statements/phrases,
- OSHA compliance,
- Hazardous material ratings as per the Hazardous Materials Identification System (HMIS) and the National Fire Protection Association (NFPA),
- DOT shipping conventions, and
- Any sales restrictions and requirements of various levels of government.

INTEGRATED DEPLOYMENT

Although chemical processors share many common needs, technology solutions must also incorporate the many differences. Business systems must therefore be highly configurable to accommodate the needs of various organizational roles. For example, on the plant floor, applications should run seamlessly using multiple desktop or mobile devices, browsers, scanners, label printers, etc., whether in the control room, clean room or an intrinsically safe environment. All standard reports, forms, templates, screens and menus should be simple to configure in-house. This includes adding user-definable fields, changing field labels, and using simple arithmetic and Boolean logic. In summary, look for a technology solution that is easy to integrate, implement, use and upgrade as your business continually changes. ●

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Get the Most from Your Data

Research shows how effective ERP systems significantly impact business outcomes

By Janet King, Jen McKean, and Perry Laberis, IDG Research Services

DO COMPANIES with more user-friendly and accessible enterprise resource planning (ERP) systems enjoy more positive business outcomes? Are they more profitable? Do highly effective ERP systems help create a sharper upswing of revenue growth? How much difference does effective data really make to business success?

To answer these questions, Sage commissioned IDG Research Services to conduct a study of medium-sized businesses in North America and Europe to explore the business implications of improving data access and usability, and better understand the associations between the overall effectiveness of the ERP infrastructure and business profitability, revenue, projected growth and so on. In other words, how do key business outcomes change as accessibility, usability and insight into business information improves — even by small increments?

The research explored how investments in ERP solutions that address four data attributes — accessibility, usability, quality and intelligence — can impact key business outcomes, such as revenue growth, profitability, sales (including sales to new customers and of new products/services), operational efficiency and market penetration.

The study validated the theory that improve-ments in the accessibility, usability, quality and intelligence of data have a direct and positive impact on critical business outcomes:

- Companies with more effective data grow 35% faster.
- Only 40% of companies rate their ability to process customer demands on the road as excellent.
- More intelligent data means more revenue — a 20% improvement brings U.S. $9,216 more per employee.
- Companies with better intelligence are 2.2% more profitable.
- Companies with better intelligence are four times more likely to optimize inventory levels.
- Companies with better data improve consistent quality delivery to customers by 9%.
- Companies with more usable data increase productivity by 10%.
- Companies with mobile access to data increase sales of new products by 5%.
- Companies with mobile access to data sell 3% more to new customers.
- Successful companies are 4 times more likely to process orders remotely.

Moreover, companies with highly effective

ERP systems that provide more usable and accessible data are more likely to realize these outcomes. Businesses ranking in the top third for overall data attribute scores consistently achieve higher performance — a fact that should be noted by other companies looking to improve their performance. The return on investment (ROI) in an ERP system that maximizes these data attributes would be significant given the potential impact on business outcomes.

Improving insight into which data attributes positively impact outcomes for medium-sized businesses can help address their pain points. The key findings section of this report further illustrates the effects of data accessibility, usability, quality and intelligence on business performance and outcomes.

CONCEPTUAL MODEL

This study of medium-sized businesses in North America and Europe set out to validate a relationship between improvements in data attributes including accessibility, usability, quality, and intelligence, and one or more business outcomes.

Figure 1 shows the conceptual model developed to assess the impact of data attributes on business outcomes. The components of the model are (i) data attributes and (ii) business outcomes.

When defining the data attributes, IDG Research Services studied four data attributes: accessibility, usability, quality and intelligence. Within each of these multifac-

CONCEPTUAL MODEL

DATA ATTRIBUTES

Accessibility   Usability   Quality   Intelligence

Data

BUSINESS OUTCOMES

– Time to market
– Upsell opportunities
– Resource optimization
– Operating abroad
– Time spent on nonproductive tasks
– Accurate risk evaluation
– Planning and forecasting
– Timely/accurate reporting

– Delivering consistent quality to customers
– Compliance
– Revenue due to new products (innovation)*
– Revenue due to new customers (market penetration)*
– Revenue growth*
– Profitability growth*

*To assess the impact of data attributes on these specific financial business outcomes, researchers used distinct but related financial measures: total revenue, percent of revenue from new/existing customers, and revenue and profitability compared to previous year.

Figure 1. Conceptual model assesses the impact of data attributes on business outcomes.

Accessibility	The extent to which users can access data remotely/outside the office. The extent to which users can access data from mobile devices. The extent to which salespersons can access customer data/process demands from a mobile device.
Usability	The extent to which users can personalize the way data is presented. The ease with which data can be shared with external partners/stakeholders.
Quality	The extent to which data is accurate/error-free. The extent to which data available is sufficient to cover most users' inquiries. The extent to which data is received on time to take action/make decisions. The degree to which data is up to date relative to the event(s) of interest.
Intelligence	The availability of data users need at the time they need it most. Data provides insight into demand patterns. Solutions provide real-time visibility into key performance indicators. On-demand access to business intelligence and reporting.

Table 1. Within each the data attributes are several separate, but related, characteristics that can affect decision making.

eted attributes are several separate, but related, characteristics that significantly affect the ability of decision makers to act quickly and effectively (see Table 1).

The selected business outcomes reflect a comprehensive, well-rounded assessment of how well a business is performing across a variety of key measures, including financial performance, customer-focused issues, and operational effectiveness.

Which attributes do medium-sized businesses consider most important to performance? As illustrated in Figure 2, quality ranks first, while accessibility ranks last.

KEY FINDINGS

The research findings validated the hypothesis: Improved data attributes do lead to superior business outcomes. Business leaders know that data affects performance. But how strong is the association between the data attributes studied and important business outcomes? Here's what the research showed.

Companies with more effective data grow 35% faster. Improving performance on all four data attributes drives positive financial returns. In fact, a high-performing company can expect to gain 35% more in incremental revenue year over year than a low-performing company.

For example, the median annual revenue among the medium-sized businesses surveyed is U.S. $42M. Based on this median, a high-performing company can expect average year-over-year revenue growth of 8.9% or +$3.75M, while a low-performing company can expect average year-over-year revenue growth of 6.6% or +$2.77M. For the typical medium-sized business surveyed, moving from a low-performing to high-performing organization could result in a net gain of roughly $980,000.

In addition to the positive financial impact, top-performing medium-sized businesses consistently achieve higher performance on all operational and customer-focused business outcomes.

Increases in year-to-year revenue and profitability are associated with improvements in each of the data attributes. Companies with high levels of data effectiveness are likely to have increased revenue (or profitability) from one year to the next. This includes both low-revenue and high-revenue companies.

The single data attribute with the strongest positive relationship to revenue/profit growth: intelligence.

According to the research, each of the data attributes has an impact on various business outcomes.

Accessibility: Direct and positive impact on innovation and market penetration.

Usability: Direct and positive impact on

RANKING DATA ATTRIBUTES

Attribute	8 to 10 (Excellent)	5 to 7	1 (Poor) to 4	Category
The data available is sufficient to cover most users' inquiries.	54%	54%	9%	**Quality** Mean 7.3
The extent to which data is accurate/error-free.	50%	43%	7%	
The extent to which data is received on time to take actions/make decisions.	50%	42%	8%	
The degree to which data is up-to-date relative to the event(s) of interest.	49%	45%	6%	
The availability of data users need when they need it most.	45%	44%	11%	**Intelligence** Mean 6.9
On-demand access to business intelligence and reporting.	43%	44%	12%	
Solutions provide real-time visibility into key performance indicators.	43%	47%	11%	
Data provides insight into demand patterns.	40%	49%	11%	
The extent to which users can personalize the way data is presented.	38%	49%	13%	**Usability** Mean 6.7
The ease with which data can be shared with external partners.	38%	49%	13%	
The extent to which users can access data when remote/out-of-office.	40%	48%	12%	**Accessibility** Mean 6.6
The extent to which users can access data from mobile devices.	37%	45%	18%	
The extent to which sales can access customer data/process demands from a mobile device.	35%	50%	15%	

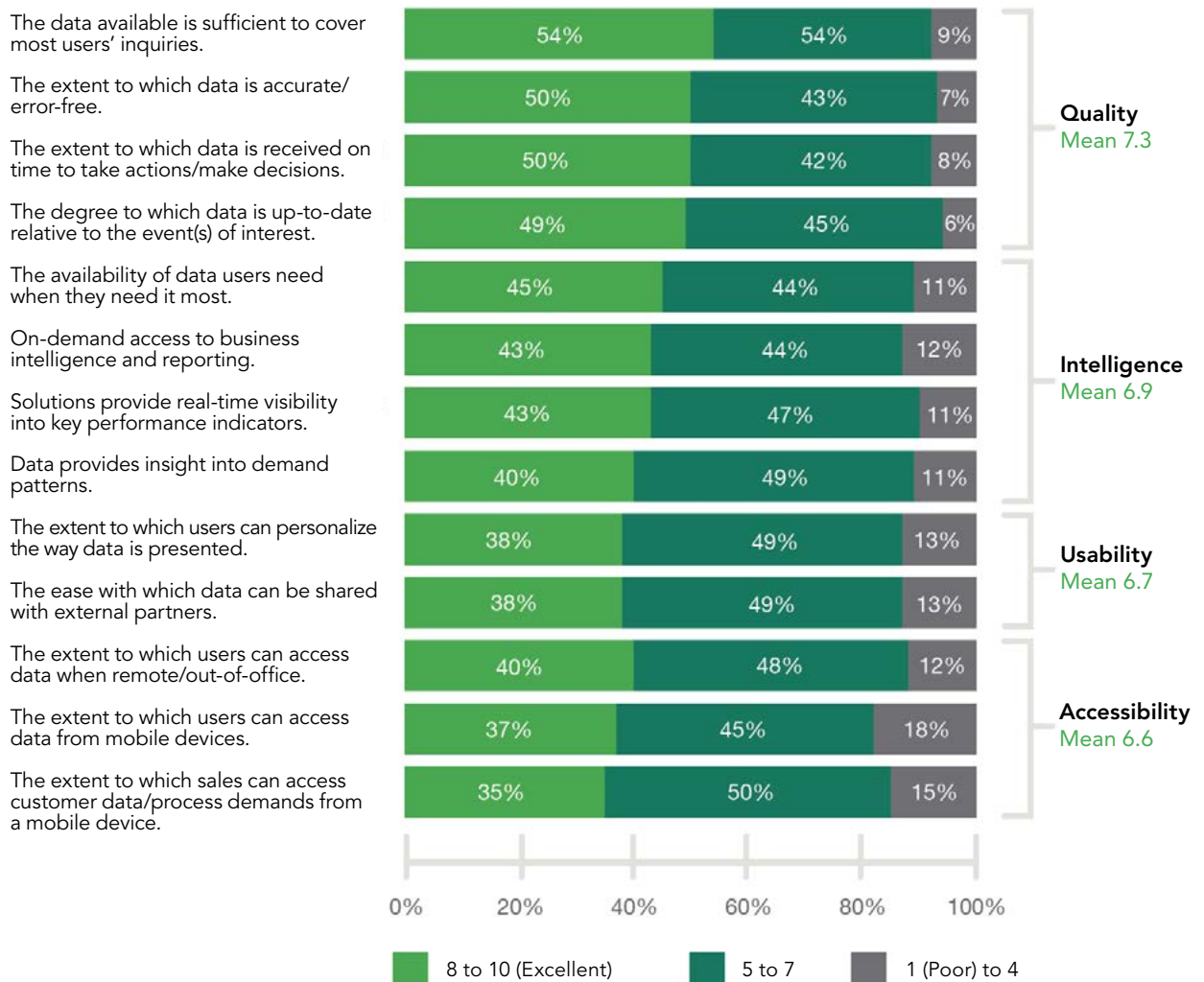Legend: ■ 8 to 10 (Excellent)   ■ 5 to 7   ■ 1 (Poor) to 4

Figure 2. Performance ratings medium-sized companies assign to their data attributes show quality ranks first, while accessibility ranks last.

time spent on nonproductive tasks, resource optimization to improve sales, and operating abroad.

Quality: Direct and positive impact on delivering consistent quality to customers, compliance, risk evaluation, and timely/accurate reporting.

Intelligence: Direct and positive impact on revenue and profitability growth, time to market, mobilizing sales, planning/forecasting accuracy, and upsell opportunities.

It's important to note that there is some degree of interdependency among the four attributes. Data accessibility, for example, does not occur in a void and often occurs in conjunction with usability, quality and intelligence. The close relationship among the four data attributes means that all four will play a role in building a successful environment.

Furthermore, ERP systems that improve data attributes will have a positive impact on the

RANKING BUSINESS OUTCOMES

Consistently meeting regulatory/compliance requirements.

Delivering consistent quality to customers.

Delivering products of services on time to customers.

Operating abroad/in global markets.

Reducing time spent on administration and non-productive tasks.

Enabling sales to directly process customer demands on the road.

Maximizing revenue through up-sell opportunities to existing customers.

Getting new products/services to market quickly.

Optimizing resources or inventory levels to minimize costs.

Forecasting demand and planning for capacity.

Optimizing resources or inventory levels to maximize sales.

Managing exceptional events and business anomalies.

Evaluating risk accurately.

Providing timely and accurate reporting to management.

0%   20%   40%   60%   80%   100%

8 to 10 (Excellent) | Medium Performers | Low Performers
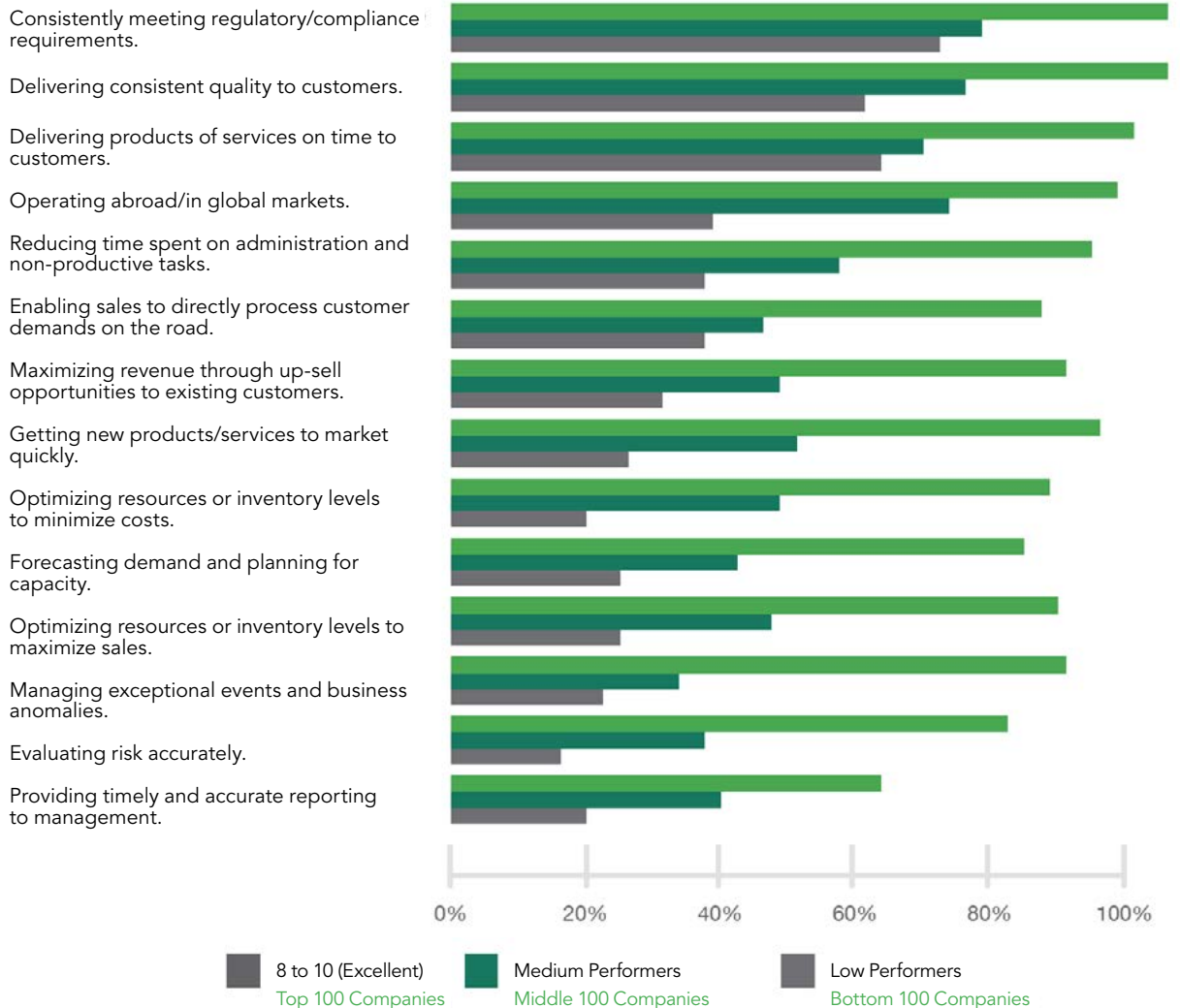Top 100 Companies | Middle 100 Companies | Bottom 100 Companies

Figure 3. Medium-sized business strengths include consistently meeting compliance, delivering consistent quality to customers, and delivering products/services on time.

business in key customer-focused or operational outcomes (such as time to market, upsell opportunities or innovation). The right ERP system can improve data accessibility, usability, quality and intelligence, enabling businesses to analyze performance and identify opportunities to enhance customer relations or operational efficiency.

According to the research, medium-sized business strengths include consistently meeting compliance, delivering consistent quality to customers, and delivering products/services on time (Figure 3).

Their challenges? Operating abroad or in the global market, reducing time spent on nonproductive tasks, mobilizing sales, and improving time to market. And, understanding which data attributes positively impact business outcomes can help address the challenges and pain points of medium-sized companies.

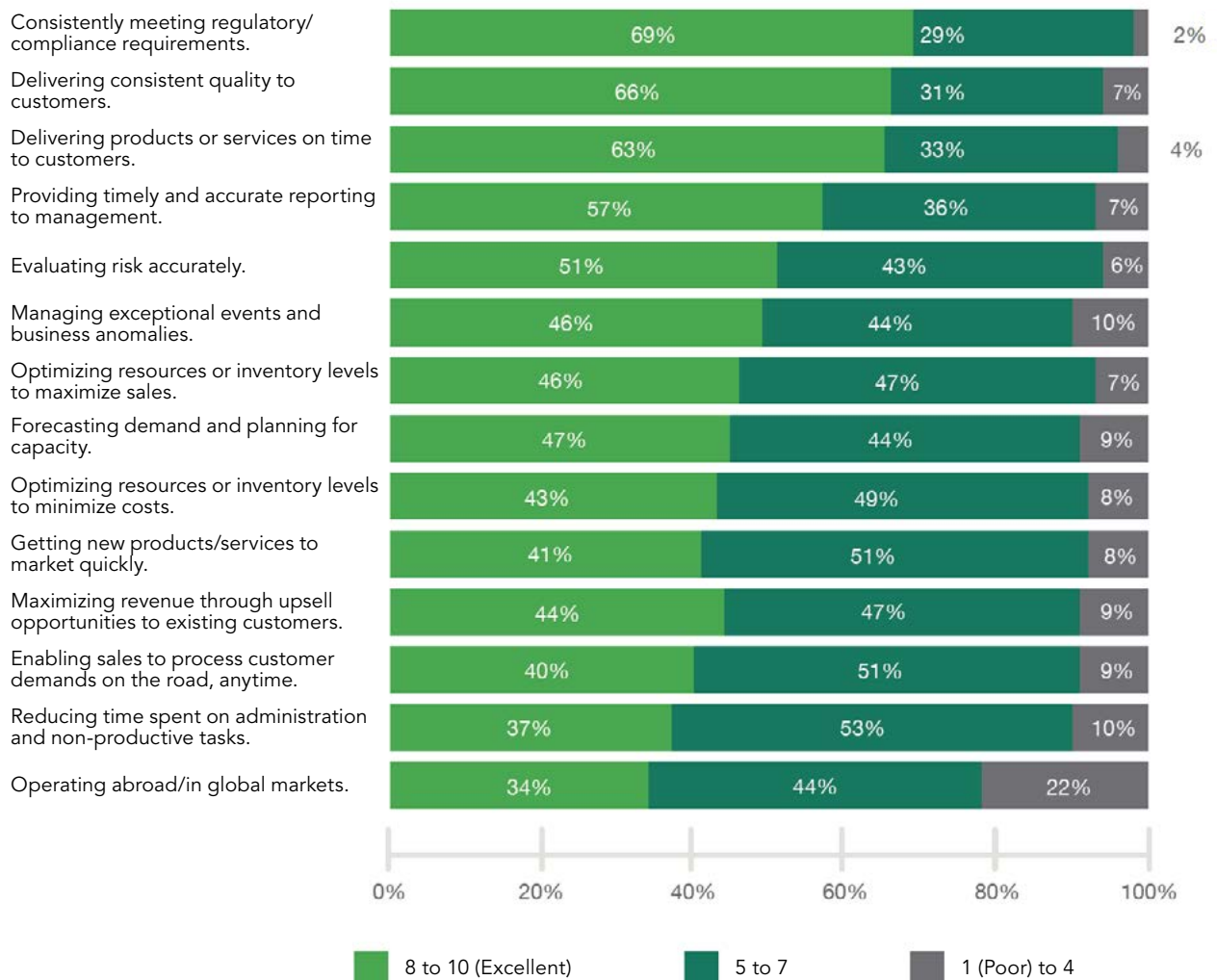**RATINGS OF SMB PERFORMANCE ON KEY BUSINESS OBJECTIVES**

Objective	8 to 10 (Excellent)	5 to 7	1 (Poor) to 4
Consistently meeting regulatory/compliance requirements.	69%	29%	2%
Delivering consistent quality to customers.	66%	31%	7%
Delivering products or services on time to customers.	63%	33%	4%
Providing timely and accurate reporting to management.	57%	36%	7%
Evaluating risk accurately.	51%	43%	6%
Managing exceptional events and business anomalies.	46%	44%	10%
Optimizing resources or inventory levels to maximize sales.	46%	47%	7%
Forecasting demand and planning for capacity.	47%	44%	9%
Optimizing resources or inventory levels to minimize costs.	43%	49%	8%
Getting new products/services to market quickly.	41%	51%	8%
Maximizing revenue through upsell opportunities to existing customers.	44%	47%	9%
Enabling sales to process customer demands on the road, anytime.	40%	51%	9%
Reducing time spent on administration and non-productive tasks.	37%	53%	10%
Operating abroad/in global markets.	34%	44%	22%

Figure 4. Only 40% of companies rate their ability to process customer demands on the road as excellent.

DATA INTELLIGENCE

How does improved data intelligence affect business outcomes at medium-sized businesses? Of the four data attributes, intelligence positively impacts the broadest set of business outcomes, including revenue and profitability growth, time to market, mobilizing sales, planning/forecasting accuracy, and upsell opportunities.

The research showed a 20% improvement in data intelligence will result in 2.6% increase in year-over-year revenue. This increase is solely due to improved data intelligence and is in addition to changes in year-to-year revenue that may have occurred due to other factors. Based on the average revenue per employee of $354,482 for medium-sized businesses in the sample, a 20% improvement in data intelligence results in an increase of $9,216 in revenue per employee year over year.

A 20% improvement in data intelligence also will result in 2.2% increase in year-over-year profitability. A medium-sized business with an annual profit of $2M would see a $440,000 improvement in profits year over year.

Companies with better intelligence are four times more likely to optimize inventory levels. A 20% improvement in data intelligence will lead to an 11.6% improvement in time to market. Based on this data, a company that currently takes 12 months to launch a new product or service could expect to reduce that time by 42 days.

In addition, improvements in data intelligence positively impact outcomes such as:
- Enabling sales to directly process customer demands anywhere, anytime.
- Improving planning/forecasting accuracy.

- Optimizing resources/inventory levels to minimize costs.
- Maximizing revenue through upsell opportunities to existing customers.

DATA QUALITY

How does improved data quality affect business outcomes at medium-sized businesses? Data quality directly and positively impacts several important business outcome — in particular, delivering consistent quality to customers, compliance and reporting.

A 20% improvement in data quality will result in a 9% improvement in delivering consistent quality to customers. A medium-sized business that delivers consistent quality to customers 70% of the time could expect that to increase to 76% with better data quality.

A 20% improvement also leads to a 6.4% improvement in consistently meeting regulatory/compliance requirements. A medium-sized business that consistently meets 85% of regulatory/compliance requirements now could raise that to 90%.

In addition, improvements in data quality positively impact outcomes such as:
- Increasing risk evaluation accuracy.
- Improving reporting timeliness and accuracy.

DATA USABILITY

How does improved data usability affect business outcomes at medium-sized businesses? Improving the ability to personalize and share data directly and positively impacts productivity, resource optimization and inventory management.

A 20% improvement in data usability will result in 10% improvement in time spent on nonproductive tasks. A medium-sized business employee who spends a third of his monthly work hours — about 53 of 160 hours — on administrative or nonproductive tasks would cut that time to 48 hours.

In addition, improvements in data usability positively impact outcomes such as optimizing resources or inventory levels to improve sales and operations in global markets.

DATA ACCESSIBILITY

How does improved data accessibility affect business outcomes?

Improving data accessibility — specifically out-of-office and mobile access — directly and positively impacts the ability to innovate by selling new products and services and to penetrate new markets.

Companies with mobile access to data will increase sales of new products or services by 5%. On average, among the businesses surveyed, 29% of annual revenue or $12.2M is derived from sales of new products/services. Based on this data, companies that improve data accessibility by 20% could expect a $610,000 increase in sales from new products/services.

This also results in a 3% increase in sales to new customers. On average, among the businesses surveyed, 29% of annual revenue or $12.2M is derived from sales to new customers. Improving data accessibility by 20% would increase market penetration, resulting in an incremental $366,000 in revenue from new customers.

In addition, companies with access to data sell 8% more to new customers. Successful companies are four times more likely to process orders remotely.

CONCLUSION

This study validated the theory that even marginal improvements in the accessibility, usability, quality and intelligence of data have a direct and positive impact on critical business outcomes.

Moreover, companies with ERP systems that provide more usable and accessible data are more likely to realize these outcomes; in other words, companies with highly effective ERP systems will be more profitable, enjoy a sharper upswing of revenue growth, and benefit from improvements in key customer-focused or operational outcomes such as time to market, upsell opportunities, or innovation with new products or services.

From revenue and profitability gains to new customers, better quality, and increased operational efficiency, businesses ranking in the top third for overall data attribute scores consistently achieve higher performance — a fact that should be noted by other companies looking to improve their performance. Considering that modest mean values for each of the data attribute scores — accessibility 6.6, usability 6.7, quality 7.3, and intelligence 6.931 — there is considerable opportunity for data improvement. The ROI in an ERP system that maximizes these data attributes would be significant given the potential impact on business outcomes. ●

JANET KING is SVP/GM; JEN MCKEAN, research director and PERRY LABERIS, research manager for IDG Research Services. For more information, visit www.idgresearch.com. For more information about Sage in North America, visit www.sage.com.