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The software edge

How effective software development and delivery drives competitive advantage

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IBM Global Business Services, through the IBM Institute for Business Value, develops fact-based strategic insights for senior executives around critical public and private sector issues. This executive report is based on an in-depth study by the Institute's research team. It is part of an ongoing commitment by IBM Global Business Services to provide analysis and viewpoints that help companies realize business value. You may contact the authors or send an e-mail to iibv@us.ibm.com for more information.

By Mark Albrecht, Eric Lesser and Linda Ban

Business leaders rank technology in the 2012 IBM Global CEO Study as the most important external force that will impact their organizations.[1] Our recent survey of over 400 business and IT executives reinforces this finding, identifying five technology trends as critical to competitiveness and underscoring the role of software in these trends. While more than half of companies recognize that effective software development – from ideation to delivery – is crucial to achieving competitive advantage, only a quarter are effective today. Establishing an enterprise capability for accelerated software delivery can close this gap and help differentiate companies in the market.

A wide range of emerging technologies – from mobile devices and collaborative tools to the explosion of unstructured data and use of cloud solutions – is changing the way organizations in virtually every industry compete. These technologies have transformed how companies interact with customers, business partners and suppliers, enabling significantly greater efficiencies and cost advantages. Some companies are struggling to find their footing in an ever-changing connected world, while others wholeheartedly embrace these changes and have embedded new technologies into their overall business strategies and processes. Regardless of where an organization lies on this spectrum, emerging technology will continue to impact performance and market success.

Modern methods for software development represent one significant opportunity to improve a company's bottom line. Once viewed as simply a way to automate back-office operations, today's software development features advanced approaches that create more agile, end-to-end, continuous delivery (better known as DevOps) capabilities that can quickly align a company's technology infrastructure with its rapidly changing business needs.

Organizations able to use these techniques most effectively can gain a competitive advantage by:

- Enabling a differentiated and engaging customer experience
- Obtaining fast-mover advantage with more rapid software-based innovation
- Increasing the capacity to innovate by reducing waste and shifting resources to high-value activities.

Businesses developing software for embedded devices or products can benefit by using many of these same techniques.

We sought to determine how organizations view today's top technology trends by surveying 435 executives around the world in both growth and mature markets (see sidebar, "Research methodology"). We examined the role technology trends play in an organization's market strategy and investigated whether effective software development and delivery can contribute to an organization's competitive edge.

The study revealed that most organizations are underprepared to leverage today's technology trends – ranging from the application of mobile technology to collaborative approaches to intelligent systems. We also found that more than half of survey participants recognize that effective software development is crucial to achieving competitive advantage. But with only a quarter who are successful at it today, there exists a real "execution gap."

The research identified three levels of maturity of software development organizations – Foundational, Intermediate, and Advanced – and found Advanced organizations to be most successful in closing the execution gap. However, we also discovered that organizations at all three levels have the potential to improve the effectiveness of their software development practices and, in turn, increase their competitiveness.

From our study, we see that organizations need to sharpen their software development capabilities, practices and results, as well as enhance collaboration throughout the software lifecycle. In addition, development organizations need to determine the right mix of sourcing for their software needs, obtaining skills and capabilities from outside the organization when necessary to meet market demands and stay ahead of competition.

Research methodology

Survey participants: For this study, we surveyed 435 executives representing 18 industries and 58 countries. Participating executives included 38 percent from line-of-business roles and 62 percent from IT/software development roles.

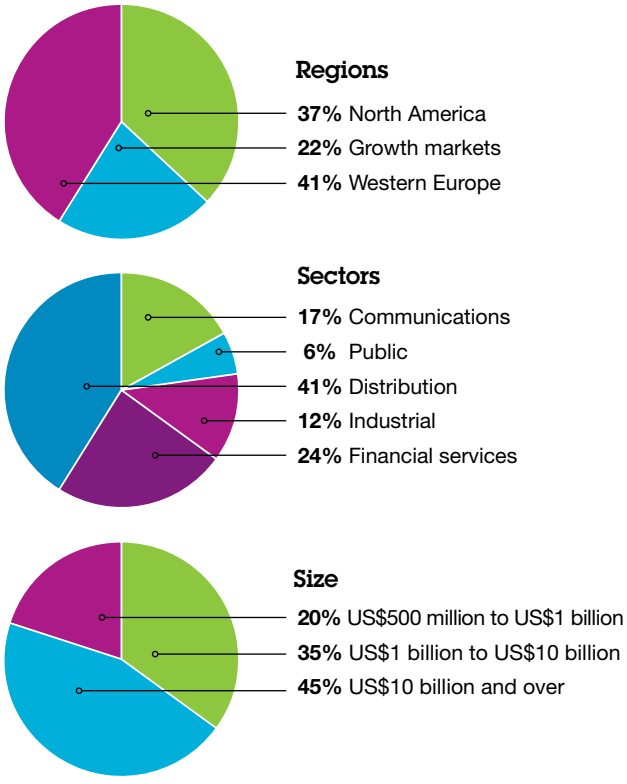
Definitions of terms used in this report:

IT roles include executives at director level and above in IT or other software organizations (such as product development/ engineering teams that focus on embedded software in products).

Software development refers to all areas of software development and delivery within IT or other development/ engineering organizations.

Organizations identified as *leveraging software for competitive advantage* are those that are currently able to provide software development outcomes that enable the business to be more competitive.

Outperformers are defined as companies that achieved significantly higher profitability than their industry peers, according to their own self-assessments.



Note: The response sample (n=435) based on location and primary industry of respondent using IBM's standard regions and industry sectors.
Source: IBM Institute for Business Value.

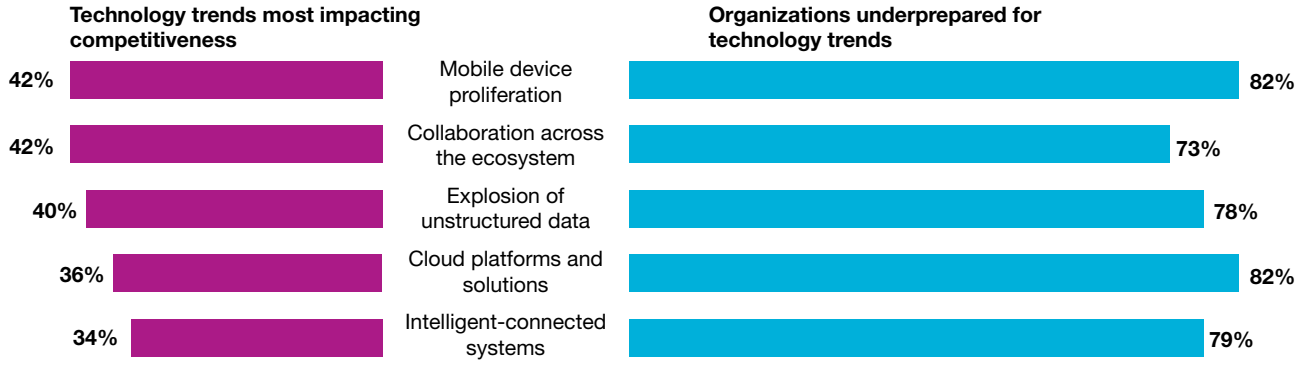
Technology – a competitive game changer

According to Chief Executive Officers (CEOs) we interviewed in our 2004 CEO study, technology was not even among the top-five forces impacting their organizations. By 2012, however, they cited it as the number-one factor – ahead of people skills, market forces and macroeconomic trends.[2] Now top-of-mind for today's business leaders, technology likely will remain so for the foreseeable future.

The speed at which technology continues to advance requires executives to place it front and center on the corporate agenda. Recent technology and social connectivity trends have enabled companies both to lower costs and engage with customers, business partners and vendors in ways that were unavailable only several years ago. Successful organizations are leveraging effective software development and delivery to disrupt business models and shift industry paradigms.

Just as effective software development can drive competitive advantage, ineffective development or delivery can lead to costly consequences. Unstable Web sites, processing errors, poorly managed software releases and security leaks can all have damaging effects on revenue, customer loyalty and even regulatory compliance. But more than software stability, today's customers demand a more compelling user experience and greater interaction regardless of the platform they choose. The digital world requires companies to stay abreast of the latest shifts in technology – and to execute accordingly.

With all of this in mind, we asked survey participants which technology trends they believe will have the most impact on competitiveness in the next five years. Based on their responses, we identified five top trends: Mobile device proliferation, collaboration across the ecosystem, explosion of unstructured data, cloud platforms and solutions, and intelligent/connected systems. We also asked how prepared they are for each trend. The answer was, essentially, "not very," with approximately three-quarters of organizations describing themselves as underprepared for all five (see Figure 1).

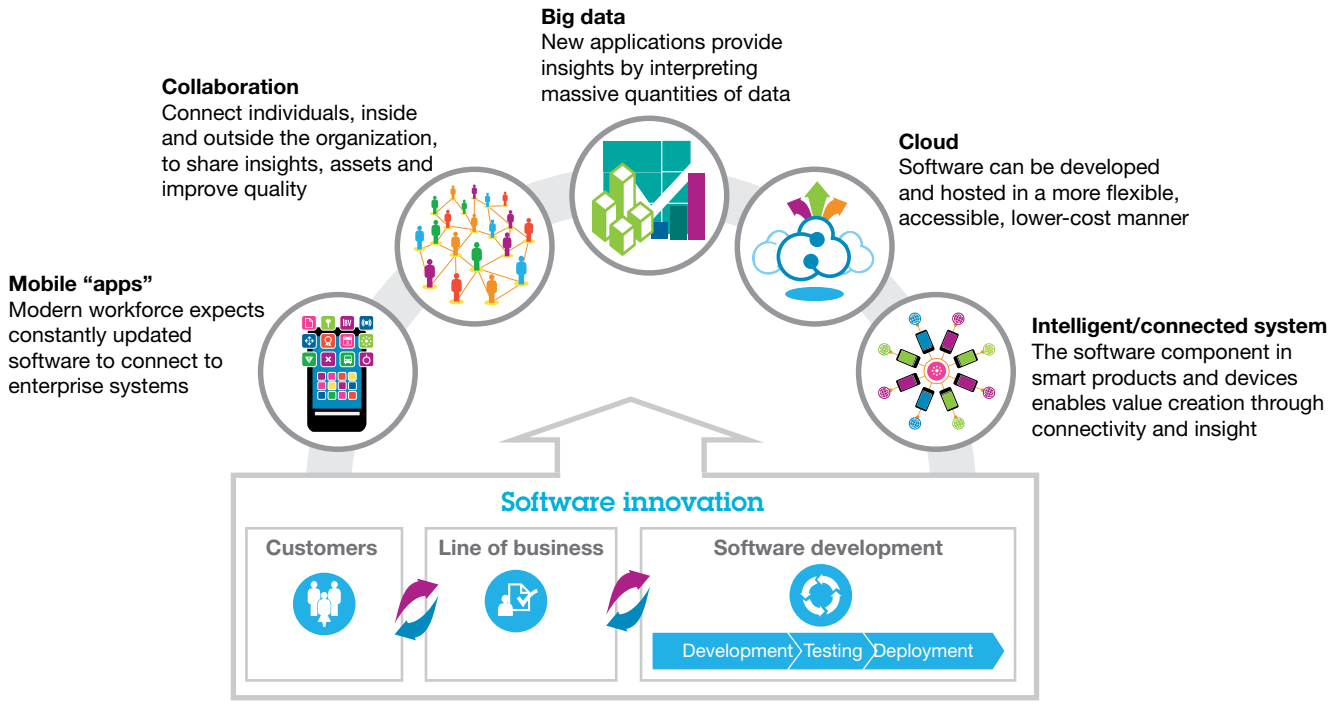


Note: Survey respondents were allowed up to three selections.
Source: IBM Institute for Business Value.

Figure 1: **Top technology trends are impacting how organizations compete; however, three-quarters are underprepared.**

Software development is the engine powering each of these technology innovations. This is significant, as current technology trends have the potential to change industry landscapes by offering new ways for businesses to differentiate themselves (see Figure 2):

- *Mobile device proliferation:* Software applications for mobile devices can enable new customer relationships, help improve loyalty, introduce new channels and enhance productivity.
- *Collaboration across the ecosystem:* Software can connect customers, partners and employees across boundaries, enabling innovative interactions.
- *Explosion of unstructured data – or "big data":* Through analytics software, organizations can better interpret the mass of structured and unstructured data to develop insights regarding customers, the supply chain and other parts of the operating environment.
- *Cloud platforms and solutions:* Cloud solutions allow for business flexibility and reduced fixed IT costs by offering "as needed" services. Organizations are applying cloud solutions to optimize their existing processes, develop new products and services, and create new business models.
- *Intelligent/connected systems:* Software can integrate a range of fixed and mobile devices to build real-time decision-making capability into devices and integrated systems, making it easier to automate tasks.



Source: IBM Institute for Business Value.

Figure 2: **Because software development is at the heart of capitalizing on technology trends, increasing its effectiveness can be a competitive differentiator.**

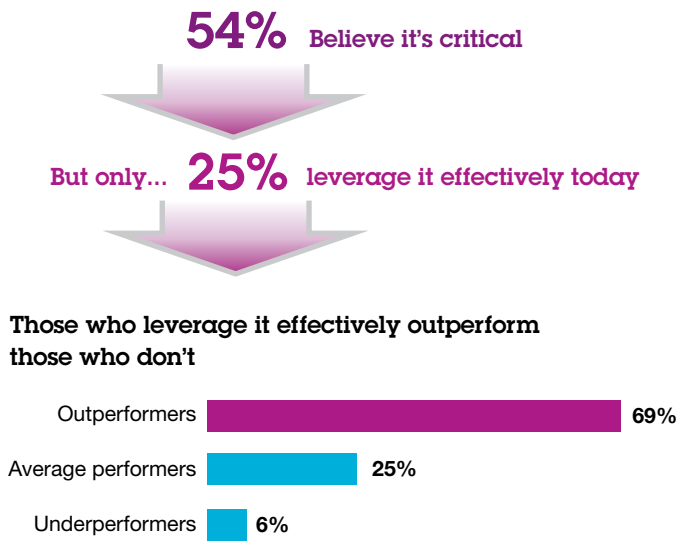
Further, our data showed that these technologies are often used in different combinations to enhance five sources of competitive advantage:[3]

1. *Expand customer relationships* – Using a combination of mobile and collaborative technologies, as well as the ability to understand and apply unstructured data
2. *Leverage data and insights* – Applying both unstructured and instrumented data to create unique perspectives regarding customers and ongoing operations
3. *Create product or service innovation* – Using mobile technology, intelligent systems and software embedded in products as the basis for new products or services
4. *Manage the ecosystem* – Using cloud technology to bring together customers, vendors and channel partners to improve access to data, increase coordination among companies and develop new business models
5. *Increase operational efficiency* – Combining cloud technologies and collaborative software to reduce coordination costs, improve access to data and bring insights to the point of customer need.

Software development: A key to success in the digital age

Companies can clearly benefit by closing the execution gap so they are prepared for and knowledgeable about top technology trends. In fact, almost 70 percent of the companies currently leveraging software development for competitive advantage outperform their peers from a profitability standpoint (see Figure 3). But notably, there are industry differences in the perceived value of software development (see sidebar, "Importance placed on software development varies by industry").

The importance of software development:



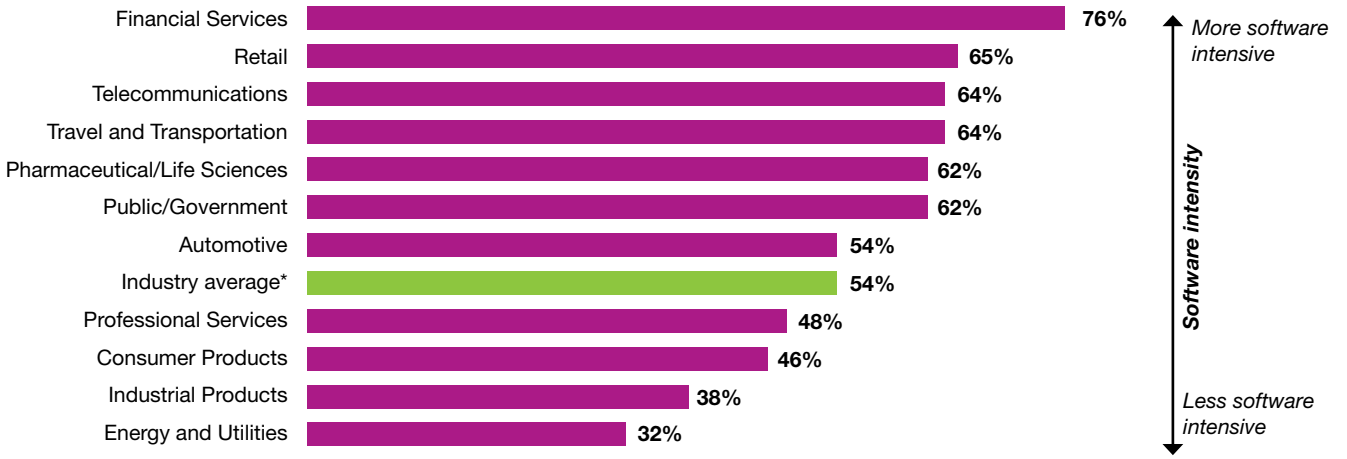
Source: IBM Institute for Business Value.

Figure 3: **Companies that effectively leverage software development for competitive advantage are more likely to outperform their peers.**

Importance placed on software development varies by industry

Organizations in highly software-intensive industries, such as Financial Services, are more likely to see software development as crucial, whereas those in less software-intensive industries, such as Energy and Utilities, grant it less importance.

Industries identifying software as crucial to competitiveness



*Industries were classified as "more software intensive" where more organizations identified software as crucial to competitiveness as compared with the average for all industries.
Source: IBM Institute for Business Value.

Our study identified three dimensions of software development performance needed to close the execution gap:

- *Capabilities* – The organization's effectiveness in areas of software design, development and delivery, where they will need to excel to be competitive
- *Practices* – The organization's maturity in processes, methods and systems for managing the software development and delivery lifecycle
- *Results* – The organization's ability to deliver positive software development outcomes that contribute to the business.

Using these dimensions, we identified three levels of maturity of software development organizations (see Figure 4):

	Foundational *19% of total sample*	Intermediate *49% of total sample*	Advanced *32% of total sample*
Capabilities	Not yet effective in all areas	Generally effective at most but not all	Consistently effective
Practices	Beginning to implement	Moderate maturity	Advanced maturity
Results	Inconsistent results	Mostly consistent, but not all goals are met	Consistently effective, all goals are met

Source: IBM Institute for Business Value

Figure 4: **The study identified and defined characteristics of three organizational states related to software delivery.**

- Foundational software organizations are not yet effective in all software capabilities. They are just beginning to implement standard software delivery practices, methods and processes, and thus deliver inconsistent results.
- Intermediate software organizations are generally skilled at most – but not all – software capabilities and have moderate maturity in software delivery practices. And although they are fairly consistent in delivering business results, there is room for improvement across multiple dimensions.
- Advanced software organizations are consistently effective at software capabilities, have advanced maturity in most software delivery areas, and consistently deliver effective results to support the business strategy.

Advanced organizations are closing the execution gap

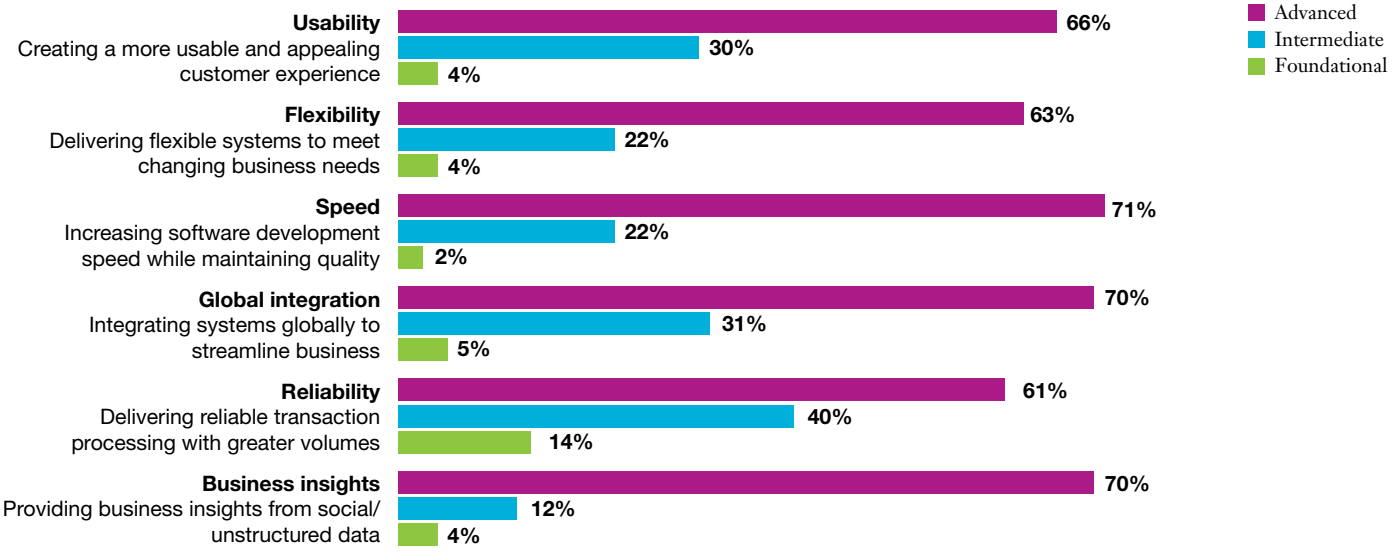
Our research revealed that Advanced software organizations are closing the execution gap by excelling in several key areas. For example, Advanced software organizations are more likely to recognize the importance of software development and to utilize it for competitive advantage in the marketplace. In fact, more than half of Advanced organizations are effectively leveraging software development, compared to 16 percent of Intermediate organizations and 4 percent of Foundational organizations.

Showcasing effective development capabilities

We also observed that Advanced software organizations, representing 32 percent of our survey, have much more effective software development capabilities than Intermediate organizations, the largest group in our survey (49 percent), and Foundational organizations (19 percent). Advanced organizations are significantly more effective at those development capabilities considered most important to competitiveness, such as creating a more usable and appealing customer experience and delivering flexible systems to meet changing business needs (see Figure 5).

Effectiveness of capabilities important to competitiveness

(Percentage who rated their organizations as "Effective" or "Very effective")



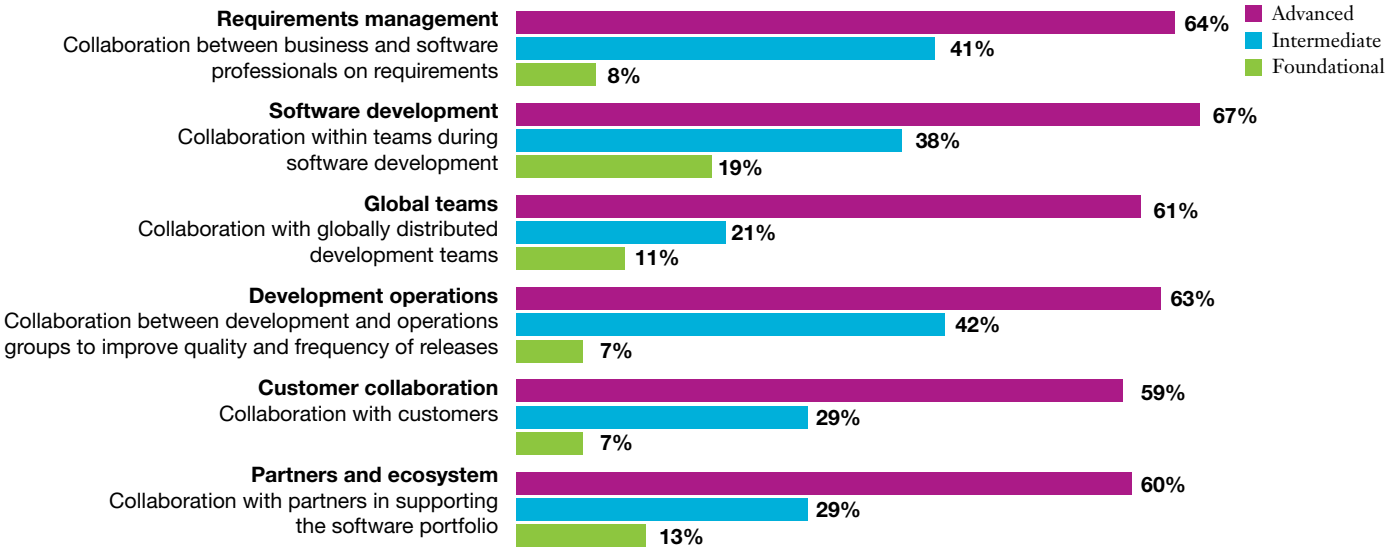
Note: Each capability is listed in descending order of importance as ranked by survey respondents.
Source: IBM Institute for Business Value.

Figure 5: **Advanced organizations have more effective software capabilities, particularly those considered most important to competitiveness.**

Advanced organizations also excel at using collaboration within the software development process both inside and outside the organization. Over half of Advanced organizations, well ahead of Intermediate and Foundational organizations, are effective at collaborating throughout the software development lifecycle. This includes collaborating with business users on requirements, sharing knowledge among global development teams, and working hand-in-hand across development and operations teams to improve quality and responsiveness (see Figure 6). In addition, Advanced software organizations also collaborate much more with customers and business partners to improve software development outcomes.

Collaboration within the software delivery process

(Percentage who rated their organizations as "Effective" or "Very effective")



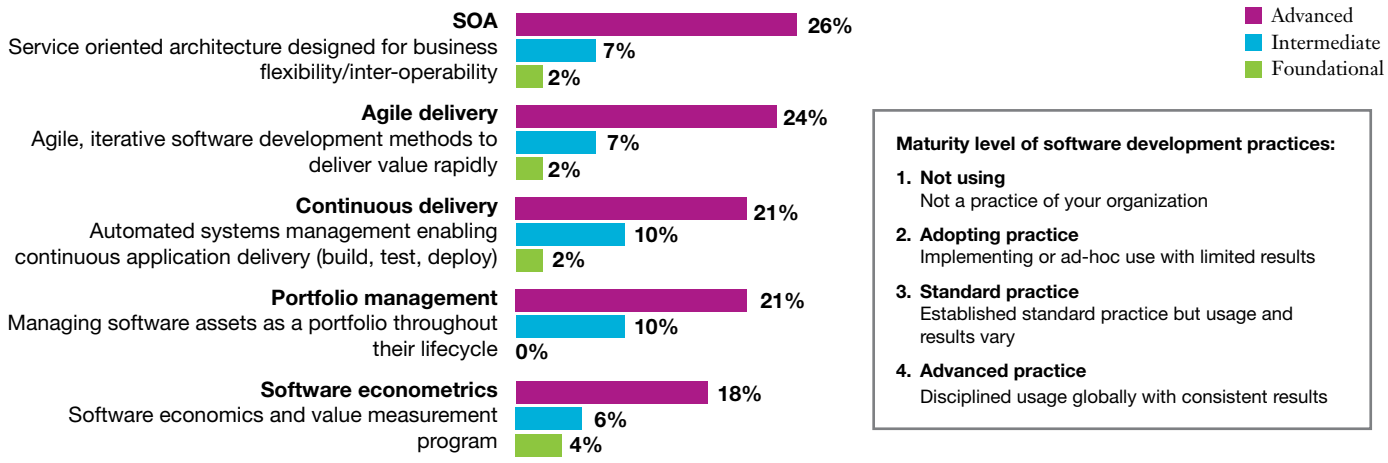
Source: IBM Institute for Business Value.

Figure 6: **Collaboration throughout the lifecycle is a hallmark of Advanced software organizations.**

Applying effective practices

In addition, Advanced organizations are more likely to apply more mature development practices, such as service-oriented architecture (SOA) and agile iterative development methods (see Figure 7). In fact, more than twice as many Advanced organizations apply these sophisticated practices consistently than Intermediate and Foundational organizations. However, despite their higher software development maturity over Intermediate and Foundational organizations, Advanced organizations also have room for improvement since only a small percentage is applying these advanced practices consistently on a global basis.

Maturity of software development practices
(Maturity level 4: Advanced practices)



Note: Practices are measured on a four-point maturity scale which sets a high standard for this dimension. Therefore, a smaller portion of the survey population describes its practices as advanced.
Source: IBM Institute for Business Value.

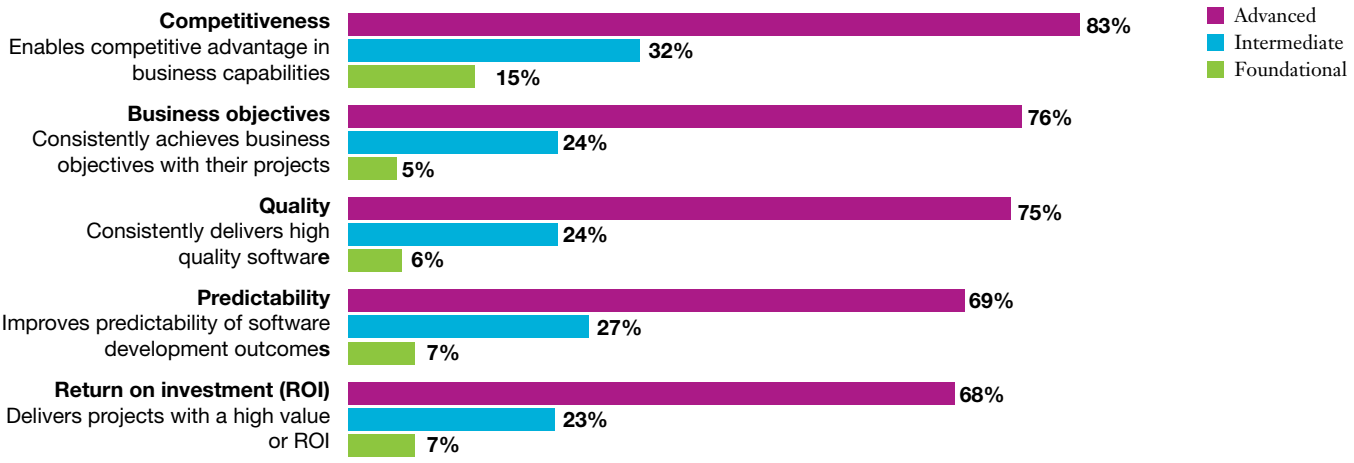
Figure 7: **Twice as many advanced organizations apply "advanced practices" consistently as compared to the other groups.**

Delivering business results

Perhaps most important, almost three-fourths of Advanced organizations deliver consistent results to the business, compared to 27 percent of Intermediate organizations and 7 percent of Foundational organizations. Advanced organizations are significantly more likely than Intermediate or Foundational organizations to create more competitive business capabilities, achieve business objectives, deliver high-quality software, improve predictability of software development outcomes, and deliver high value or return on investment (ROI, see Figure 8). The more mature software development capabilities and practices of Advanced organizations seem to support better business results.

Results from the software development organization

(Percentage who rated their organizations as "effective" or "very effective")



Source: IBM Institute for Business Value.

Figure 8: **Advanced software organizations deliver more consistent results to the business.**

Sourcing software

To obtain competitive business capabilities, organizations with each of the three profiles utilize a variety of sources for the development, management and delivery of custom software. And most plan to continue to use a mix of software vendors, outsourcing/partners, internal IT and customer collaboration in the future.

However, in an attempt to rapidly close their capabilities gap, Foundational software organizations are more likely to increase their use of outsourcing/partners and outside software vendors to obtain needed software delivery expertise. The margin is notable – 50 percent of Foundational companies are looking to increase their use of outsourcers and 45 percent from software vendors versus only 31 percent of Intermediate and 28 percent for Advanced companies.

At the same time, Advanced companies are more likely to involve customers in the act: 31 percent indicated that they are including customers in their software development process versus 15 percent of Foundational companies. Moving forward, almost 40 percent of Advanced companies stated they will be looking to increase customer involvement, while 31 percent of Foundational companies will be doing so.

Fostering software development talent

Evolving technology trends are sparking a change in the role of the software development professional. Today's software developers require new skills – from new programming languages and new business applications to industry-specific knowledge. To accommodate these new demands, software delivery professionals need to advance their knowledge of general business and the customer experience. At the same time, they must continue to hone their technical skills to meet the urgent need to integrate with back-end systems, contend with increased security and privacy requirements, and successfully manage the impacts on infrastructure and workloads.

Actions to increase competitiveness

All organizations – Foundational, Intermediate and Advanced – can make improvements in delivery capabilities, practices and results. The first step involves understanding how software development creates competitive advantage for the business. Next is examining the organization's current capabilities, practices and track record of delivering results to determine the current maturity level: Foundational, Intermediate or Advanced. Once this is determined, management can prioritize opportunities for improvement. Below are some recommendations to help each type of software organization improve its value to the business. In addition, we've identified some key actions for software development professionals.

For Foundational software organizations

These organizations typically focus on aiming for reliable, low-cost IT operations and obtaining business functionality through packaged software or outsourcing partners. This approach can limit these organizations to average performance at best because their software functionality provides little competitive advantage. Foundational organizations are most challenged by their inability to react quickly to changing business needs. These software organizations admit that they struggle with a lack of standards, poor quality software, inconsistent architecture, limited integration and legacy application maintenance that consumes most of the IT budget. As a result, Foundational software organizations may relegate their businesses to "follower" status since they cannot leverage software or new technologies to deliver innovative business capabilities.

Study findings indicate that Foundational software organizations should develop more mature capabilities, practices and results to improve their competitiveness. Recommended actions include:

Capabilities

- Benchmark current performance in delivering reliability, availability, scalability and flexibility.
- Standardize global infrastructure (platform processes and tooling) investments to improve opportunities for reuse and free resources.
- Align application architecture with needed business capabilities.
- Promote more collaboration between business and IT throughout the software lifecycle.
- Plan small, but business critical pilots in new technologies to stay competitive.

Practices

- Expand use of agile methods to increase speed and quality.
- Broaden use of SOA design to improve application flexibility and adaptability.
- Leverage collaborative application lifecycle methods and tools.
- Adopt software econometrics to communicate the business value of IT more effectively.
- Leverage partners to develop strategic solutions and streamline the software supply chain.

Results

- Transition from measuring "output" (effort expended) to measuring "outcomes" (business improvements achieved).
- Improve predictability of software development approaches to discern and address trouble signs earlier in the lifecycle.
- Prioritize projects and project plans to reduce the execution gap between what the business needs and what the software organization can deliver.

For Intermediate software organizations

Software organizations at the Intermediate level are somewhat more capable at application integration and developing flexible architectures, but remain challenged with achieving global integration and responding quickly to changing business needs. These organizations have yet to fully adopt agile/lean development methods or to implement formal measurement programs to demonstrate the economic value of their software investments. Therefore, Intermediate software organizations typically lag in delivering differentiating software solutions and achieve more modest business results than Advanced software organizations.

Results of this study suggest that Intermediate software organizations should intensify efforts to develop more advanced capabilities and practices to achieve greater competitiveness. Recommended actions include:

Capabilities

- Expand enterprise integration to leverage skills globally, reduce costs and enable more diverse business insights.
- Capitalize on flexible architectures and software development agility to improve competitiveness.
- Invest in a common platform of processes, methods and tools for continuous delivery (build, release, test, deploy) across development and operations teams.
- Collaborate to increase speed, quality and transparency of measured outcomes.
- Build internal skills in new technologies to deliver innovative business capabilities.

Practices
- Build the processes, methods and communities to extend agile software development.
- Improve software portfolio lifecycle management to optimize the value derived from software assets.
- Automate IT overhead activities such as documentation, change management, traceability, metrics collection, progress reporting and regression testing.
- Manage software vendor relationships across the complete software supply chain to increase competitive value, "insourcing" strategic initiatives where possible.
- Transition to common governance across the software supply chain.

Results
- Prioritize software development projects by their impact to the business.
- Achieve more predictable outcomes that quantify, manage and resolve uncertainties earlier in the lifecycle.
- Increase the ROI and return on average equity of strategic IT investments.

For Advanced software organizations

Advanced software organizations are the most effective at delivering high-value software solutions that help differentiate their businesses. In fact, both line-of-business and IT executives at these organizations agree they are leveraging software to create competitive advantage and rapidly applying new technologies to the business. Advanced organizations also typically outperform their peers in terms of profitability.

These leading software organizations focus on software investments that deliver marketplace results and track how well they are doing. They achieve this by building deep skills in agile and lean software development methods and fostering extensive collaboration among business users, IT (or engineering, in the case of embedded software) professionals and customers throughout the software development and delivery lifecycle.

Our study results support that Advanced software organizations are more effective, yet even this group admits some areas still need improvement. For example, only 23 percent of those in the Advanced group have fully mature software development practices. In addition, they are still seeking more ways to reduce the time to market. Recommended actions include:

Capabilities
- Invest more in innovation and less in overhead, scrap and rework.
- Exploit the predictability, quality and responsiveness advantages of robust architectural solutions.
- Exploit big data sources and advanced analytics to develop new business insights.
- Extend the culture of collaboration and transparency throughout the ecosystem.

Practices
- Leverage agility, econometrics and automation for efficiency and quality.
- Engage with customers to design for superior customer experience, flexibility and mobility.
- Create development/operations centers of competence to support strategic initiatives.
- Manage software vendor relationships with a common governance to make the most of competitive capabilities.

Results
- Improve software economics, market reputation and bottom line growth
- Develop predictable business cases for new and ongoing projects.
- Increase trust among stakeholders regarding delivery time and quality.
- Optimize the delivery cycle time to improve the client experience.

Software development professionals

Software development professionals can also take steps to increase their ability to drive competitive advantage. They should focus on improving their own business knowledge, skills and experience, including their knowledge of customers' businesses and user experiences. In addition, they should collaborate with their software colleagues – and extend that collaboration throughout the larger organization to further boost their overall understanding of the business.

Equally important, software professionals must continue to hone their technical skills and capabilities. Along with expanding their experience in agile software development methods, they should experiment with new technologies and ask for project assignments that challenge them in both technical and business areas. In addition, software professionals should embrace any available talent development programs, participate in professional communities to build a digital reputation and obtain certifications that broaden their credentials in business and technical areas.

Positioning for software development success

While rapid advances in technology have opened an almost infinite number of possibilities for today's businesses, organizations are typically challenged to exploit the latest trends to drive growth and market share. Our study found an important link between effective software development and the ability to successfully capitalize on today's emerging technologies for competitive advantage.

Unfortunately, most organizations are experiencing an execution gap. Although they recognize the importance of software in achieving competitive advantage, they are currently unable to execute.

Closing the gap will require IT/software professionals to acquire new skills and improve their development processes. Software organizations need to expand capabilities, evolve practices and focus more strongly on results, as well as improve collaboration throughout the software lifecycle. Business, development and operations teams also need to determine the right mix of sourcing for their software needs, and obtain skills and capabilities from outside the organization when necessary.

We believe those businesses that can identify which technology trends are most relevant to their industries – and subsequently manage their software development lifecycle to take advantage of these trends – will be well-positioned for success. In today's faced-paced digital world, speed and agility are critical. Companies need to act now to move beyond recognition to execution.

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The team would like to thank the following people for their assistance: Naveena Bereny, Pat Howard, Kurt Johnson, Kara Kent, Randy Newell, Michael Peach, Michael Perrow, Walker Royce, Thomas Sikorski and Kami Snyder.

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2 Ibid.

3 A series of questions asked, "In which ways can [each technology trend] most improve your competitiveness?" Our analysis of participants' answers derived five distinct areas of strategic advantage to which certain technologies are more aligned.

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March 2013

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