Technology Institute

Software disruption accelerates

Across industries, companies face the challenge of software-led transformation

100 Global Software Leaders

pwc

Executive summary

This paper looks at how advances in software are transforming three major industries—industrial manufacturing, health care and financial services. These insights can be applied to most industries. Software is at the front and centre of all major disruptive innovations today—whether as part of big data, the Internet of Things, artificial intelligence, connected homes, autonomous cars or drones—giving enterprises the opportunity through new digital capabilities to offer entirely new services, to enhance customer experience, to improve efficiency and to reduce costs, in ways never before imagined.[1]

1 In a series of white papers that began with the PwC Global 100 Software Leaders, we have used rankings—global leaders, cloud growth leaders, emerging markets leaders—compiled in conjunction with International Data Corp. to examine how the software industry is evolving. In this fourth and final article in the series, we turn to the future: using qualitative research without a ranking list, we look at how software itself is transforming multiple industries.

Introduction

The Web revolutionised the way enterprises did business at the turn of the century not just because Tim Berners-Lee developed HTML, which standardised how information was displayed on a computer screen, but also thanks to the widespread deployment of graphical user interfaces and high-speed networks. A similar evolution of how enterprises are leveraging the low cost of reliable multi-faceted connectivity is taking place today, aggregating new technologies in a wave of convergence between technology and operations so significant as to change the way enterprises conduct business in all industries.

In short, software-led advances in technology are digitally transforming industries and enterprises. Digital transformation tends to be a catch-all phrase these days, but one that nicely encapsulates everything from increased efficiency, lower costs, accelerated innovation, easier and newer forms of interaction with partners, higher employee productivity and enhanced customer experience and satisfaction.

The vast pervasiveness of the software-led digital transformation we are witnessing today was best described by General Electric (GE) CEO Jeff Immelt in late 2014 when he spoke to a conference on the state of the industrial Internet: "If you went to bed last night as an industrial company, you're going to wake up today as a software and analytics company." [2]

Software-led advances in technology are digitally transforming industries and enterprises.

2 http://fortune.com/2014/10/10/ge-data-robotics-sensors/

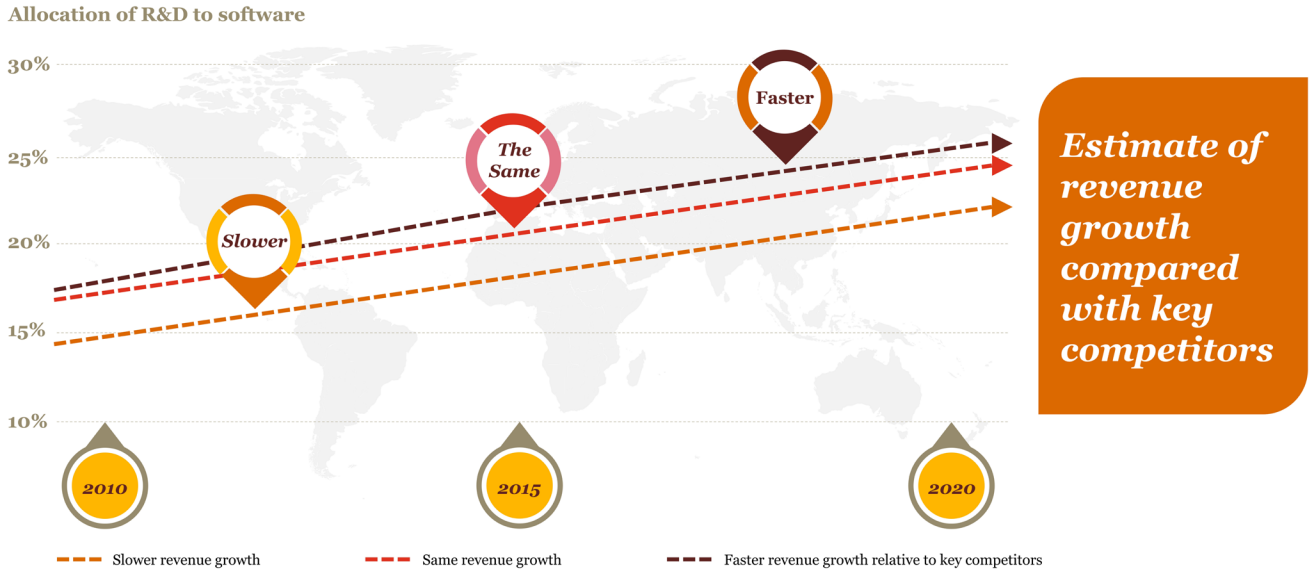
The new era of software

Two years after Immelt made that statement, he returned to the same conference with another prediction: he estimated that GE's annual software sales, including sales of its Predix platform for asset performance management, would triple from US$5 billion in 2015 to US$15 billion by 2020.[3] But there's more. According to a September 2016 Credit Suisse report on GE,[4] the profit margins on after-sale services for industrial companies are double or triple the margins on the sale of the original gear, especially in competitive markets.

And GE is no outlier. According to an October 2016 PwC *Strategy& Business* report entitled Software-as-a-Catalyst,[5] since 2010 companies that committed a higher proportion of their research-and-development budget to software earlier than their competitors are more likely to experience faster revenue growth.

Software spurs growth

Companies that reported faster revenue growth than their competitors allocated more R&D investment to software



Source: Strategy& analysis

3 http://fortune.com/2016/11/15/ges-ceo-digital-remake/

4 Credit Suisse report on General Electric

5 http://www.strategy-business.com/feature/Software-as-a-Catalyst?gko=7a1a

The potential to save money across all processes could be even greater than the potential for new revenues in this era of transformation. As Julien Courbe, Lead Partner for the Financial Services Advisory practice at PwC US, notes, "Every financial services firm is looking at every one of their business processes and understands how software can help revenue growth and cost reduction." Similarly, margin-strained hardware companies are leveraging the profitability potential of software.

In fact, that benefit applies to all industries. Consider these projections. The chief digital officer of Zurich-based ABB, a leader in industrial robotics and automation technology, stated in an October 2016 speech to investment bankers that the electricity transmission and distribution market could save as much as US$23 billion *per year* through service and software improvements to substations.[6] A 2013 West Health Institute study estimated that by connecting medical devices to electronic medical records (EMRs), the US health system could save US$30 billion per year by reducing clinician time spent manually entering information, adverse events, redundant testing and length of stay due to information delays.[7]

Forward-thinking companies in a variety of industries are already laying the groundwork:

- **Financial services:** Goldman Sachs CEO Lloyd Blankfein[8] and JPMorgan CFO Marianne Lake[9] have referred to their financial services firms as "technology companies," with one-fourth of Goldman's and nearly one-fifth of JPMorgan's employees focusing on technology.[10]

- **Health care:** Joseph Touey, Senior Vice-President for Global ERP at pharma leader GlaxoSmithKline, has said, "By 2020, we will have a healthcare delivery system that is fully digitised."[11]

- **Manufacturing:** According to David Cote, CEO of Honeywell, half of manufacturing leader Honeywell's engineers are software engineers, up from less than one-fourth four years ago.[12]

Clearly, there is a strong upside to the transformation in how industries conduct business and reap rewards. But pitfalls also loom: if not done right, the transformation can be counter-productive, with stumbling blocks relating to everything from cost of engineering resources to development styles to measuring efficiency. Success will depend not only on how enterprises navigate the technology, but also the attendant business process improvements and culture.

6 http://new.abb.com/docs/default-source/investor-center-docs/cmd/cmd-2016/abb-cmd-2016-digital.pdf
7 http://www.westhealth.org/wp-content/uploads/2015/02/The-Value-of-Medical-Device-Interoperability.pdf
8 http://www.bloomberg.com/news/videos/b/8df546df-20d1-46e5-824b-0702e9225046
9 http://www.businessinsider.com/marianne-lake-says-jpmorgan-is-a-tech-company-2016-2
10 From https://www.statista.com/statistics/270610/employees-of-jp-morgan-since-2008/ and http://www.businessinsider.com/marianne-lake-says-jpmorgan-is-a-tech-company-2016-2, JPM has 234,598 employees, and 40,000 technologists
11 http://www.pwc.com/us/technologyandinnovation
12 http://finance.yahoo.com/video/honeywells-transformation-digital-age-ceo-120600030.html

The advantages of software-led transformation

The transformation brings numerous advantages to various industries, and, as with cloud computing, customer companies now have the opportunity to obtain services using their operational budgets, not their capital budgets. Just as technology companies offer hosting services to customers who pay a monthly fee for infrastructure as a service, an industrial company, like GE or Caterpillar, may increasingly offer its equipment to customers on an 'as service' basis without them having to own it.

In manufacturing, predictive maintenance is the easiest goal to achieve through digital transformation. While GE has been investing in it for a long time, the idea of creating digital revenues by augmenting service offerings for the installed base looms as a future competitive market.

Krishna Mikkilineni, Honeywell Senior Vice President, Engineering, Operations and IT (see interview), cites his company's efforts in offering consultative services to its customers with chemical processing plants. "We have created ways, through our understanding of process controls and how chemicals are used, to drive more yields for customers." Occasionally in process control scenarios, an improper proportion of chemicals, over or under the specification, can affect the yield and cause waste. "Process control can tell you when something is out of spec, but you also have operators who may not have the deep knowledge of chemical engineering to correct the issue. With connected plants and ongoing monitoring, we can provide experts who have that additional knowledge. It helps us augment our conventional offerings."

Other opportunities, according to Steve Eddy, Partner and Advisory Leader of PwC's Global Industrial Products Industry, include digitisation of internal supply chains, product optimisation, asset performance management, inventory optimisation and field service efficiencies.

In anticipation, manufacturers are devoting significant investment to digital technologies, according to PwC's June 2016 report entitled, "Manufacturing's next big act: Building an industrial digital ecosystem."[13] In the last two years, US manufacturers invested an average 2.6% of their annual

13 https://www.pwc.com/us/en/industrial-products/assets/pwc-industrial-digital-ecosystem.pdf

revenue in digital technologies, but they expect to increase that investment over the next five years to 4.7% of revenue—for an estimated US$350 billion in investments in digital operation technologies across automotive, industrial production and manufacturing industries alone.

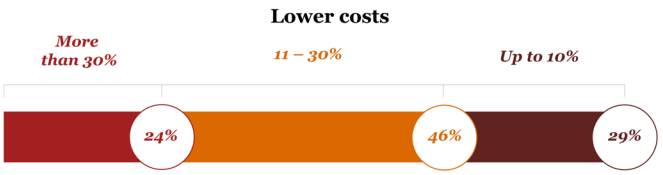
The goal: manufacturers expect digital investments to lower costs, with about four of ten expecting cost savings of 11% to 30% over the next five years. Not surprisingly, they also expect digital investment to generate new revenues.

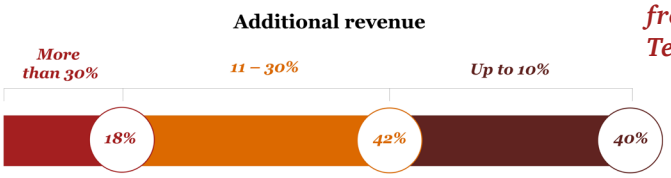
In healthcare, similar efforts are underway. "Technology is a force for good," says Michael Weissel, Group Executive Vice-President and Head of Strategy for health services company Optum (see interview). "It has the power to lower costs and enable better care."

Weissel and others note that analytics software is increasingly used to manage large volumes of data from varied sources to predict health patterns. According to Daniel Garrett, Principal and Leader of PwC's US Healthcare IT Practice, pharma companies are trying to incorporate tech that serves consumer needs and develops better relationships. For instance, Eli Lilly has a new diabetes protocol that incorporates a consumer-focused smartphone app, available via App Store download, that monitors insulin and sugar levels of diabetics.

Some savings through digital transformation are relatively easy to achieve. David Reilly, Chief Technology Officer of Bank of America (see interview), calculates that it has saved US$1.1 billion per year by creating a cloud-based internal infrastructure that allows for standardization and nimbleness creating new opportunities through highly flexible workloads. The result: faster time-to-market and lower expenses. Reilly's colleague, Aditya Bhasin, CIO of the bank's Consumer and Wealth Management group, says that the cost incurred when a customer deposits a check via smartphone app is 1% of the cost of depositing it at a branch. Thanks to adding this one small piece of technology to the bank's mobile application, a traditional business process is now not only faster and much cheaper, but also enhances customer engagement.

Executives from industrial products companies say digital technologies lower costs and add revenue





Cumulative Benefits from Connected Technologies

**Due to rounding, percentages do not add up to 100*

Source: PwC Global Industry 4.0 Survey, 2016

> ***Manufacturers expect digital investments to lower costs … they also expect digital investment to generate new revenues.***

Jump-starting software-led digital transformation

There are basically three ways non-software enterprises can jump-start digital transformation efforts: through internal, organic growth; through acquisition of other companies, mostly technology-focused; or through partnerships. Each method has advantages and challenges.

Some companies are growing organically. For example, pharma manufacturer Eli Lilly expanded its research-and-development centre for innovation in Cambridge, Mass. GE established its GE Digital division in San Ramon, Calif., in part to take advantage of its proximity to Silicon Valley. Manufacturer Honeywell has built a software centre in Atlanta for more than 700 employees who will focus on application development, cloud computing, data analytics and user experience.

Strategies for digital transformation

Strategy	*Advantages*	*Challenges*
Organic growth	• Control the growth process • Capitalise on internal knowledge and processes • Leverage IP portfolio • Spend less than other options • Maintain market leadership exclusivity	• Compete for costly programming talent • Assume all development risk • Take longer to market • Run risk of being late to market or entirely eclipsed • Limit areas of expertise to core competencies
Acquisition	• Acquire critical mass of talent quickly • Adopt new ways of thinking • Minimise or limit development risk • Shorten time to market • Acquire IP beyond core competencies	• Spend large amounts of money and time • Discover you acquired the wrong company • Retain acquired talent that might be disaffected • Integrate effectively
Partnerships	• Gain industry-wide insight based on multiple, non-exclusive relationships • Share risk • Leverage capabilities you lack: skills, markets, IP	• Commit significant resources to nurture relationships • Reconcile divergent agendas • Survive cultural challenges among entities • Disagreements over competing purposes and agendas

Some are acquiring software-focused companies:

- Honeywell bought Intelligrated, a developer of supply chain and warehouse automation solutions.[14]
- In September 2016, GE bought asset performance management developer Meridium[15] and 3D printer manufacturer Arcam.[16]
- Caterpillar's marine division acquired ESRG Technologies Group in 2015 for its vessel monitoring and analytics capabilities,[17] its oil and gas division acquired M2M Data Corp. in 2016 for monitoring assets and performing remote diagnostics.[18]

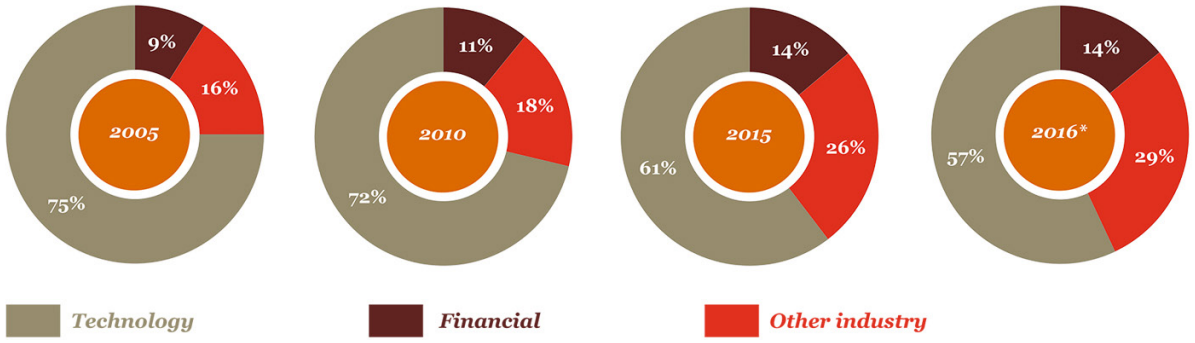
Interestingly, the number of non-technology companies acquiring technology start-ups is growing considerably. According to data compiled by Bloomberg, in 2005, 75% of technology M&A was done by technology companies themselves. Even before 2016 had ended, that percentage was down to 57%.

Lastly, the digital transformation can also be started or accelerated by cultivating relationships with start-ups that focus their efforts on a specific business-process issue. Many companies, especially in manufacturing and technology, have their own venture capital groups, which invest in start-ups specifically to develop those closer relationships. At Bank of America, CTO Reilly has overseen the organisation of innovation summits to learn more about and develop relationship with start-ups. It has purchased the Splunk log management software application and the Tanium security application that it first learned about at one of its summits.

14 https://www.honeywell.com/newsroom/news/2016/08/honeywell-completes-acquisition-of-intelligrated
15 http://www.genewsroom.com/press-releases/ge-digital-acquires-meridium-inc-accelerate-delivery-comprehensive-asset-performance
16 http://www.geaviation.com/press/other/other_20160906.html
17 http://gcaptain.com/caterpillar-marine-acquires-key-big-data-esrg
18 http://www.compressortech2.com/July-2016/Caterpillar-Acquires-M2M-Data-Corp/#.WFg8RPkrL-w

Non-technology acquirers show increased appetite for tech M&As

Global announced technology M&A by acquirer industry



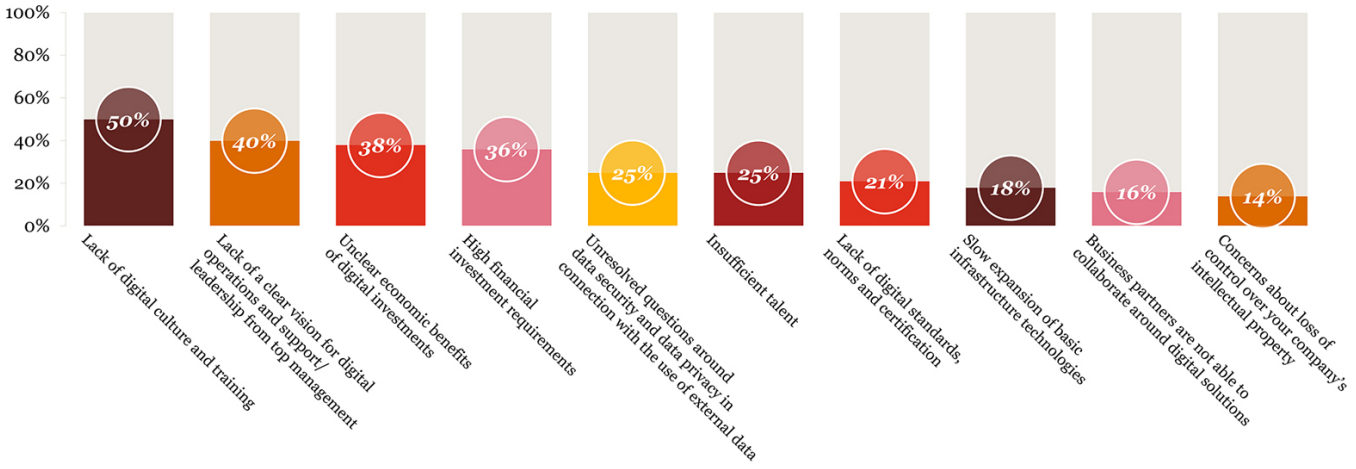
Note: Data calculated by number of deals
** As of 13 Dec 2016*

The challenges of digital transformation

In their journey toward digital transformation, enterprises encounter major challenges in at least four areas: talent, funding, culture and technology.

Talent: Companies in vertical sectors now compete against traditional technology companies for the kind of software development capabilities programmers have; according to research reported recently in the *Wall Street Journal*, the top job openings in the manufacturing sector, based on the number of postings, are sales reps and software engineers.[19]

Lack of digital culture and training is the biggest challenge facing companies



Source: PwC Global Industry 4.0 Survey, 2016

Note: Survey takers could choose up to three responses

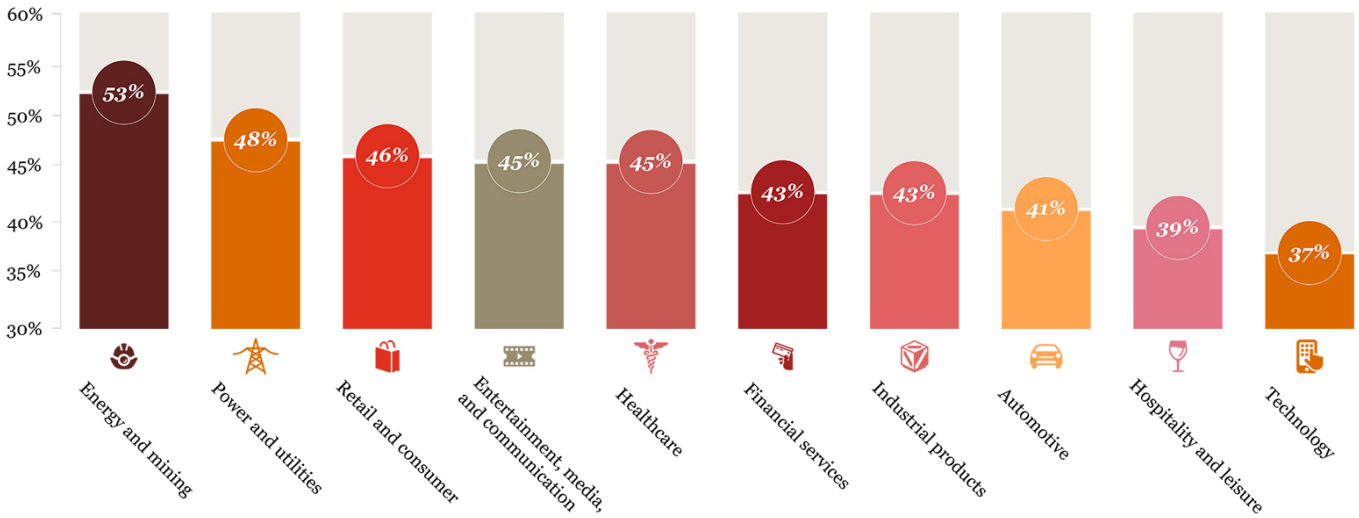
19 https://www.wsj.com/articles/manufacturers-struggle-to-woo-software-developers-1476741531

Technology companies may have an advantage when it comes to total compensation, including salary, stock options and other perks. According to the same *Wall Street Journal* article, technology companies pay US$105,227, "pay US$105,227 per year for experienced programmers," 12% more than manufacturing employers, for software developers, and for entry-level software jobs, tech companies pay US$88,820, 5% more than manufacturers. The same article[20] notes that the manufacturing sector is trying to regain its footing after decades of offshoring production to countries with cheaper labour or more advanced factory technology. That will make its journey to digital transformation harder.

But not everyone sees a bleak view, suggesting that sector companies have other ways to compete. Joe Kennedy, a Principal in PwC's US Architecture, Integration and Mobile Development Group for the financial services sector, notes that "individuals who are excited by technology aren't limited in financial services, because companies offer a range and variety of services." Adds PwC's Courbe: "When you are a superstar engineer at Google, everybody looks like you. In other industries, if you have this skill set, you can differentiate yourself a little more, and the opportunities for advancement are better."

The talent issue is not just in software, adds Honeywell's Mikkilineni. "We are selling a different set of services, which requires different capabilities in sales and marketing—in fact throughout the company. We are now figuring out the right benchmarks for success in these areas and driving improvements aggressively."

Tech skills one of biggest barriers to reaching digital goals



Source: PwC, 2015 Global Digital IQ® Survey; Base: 1,988
Q: To what extent do you agree with the following statement? We have all the technology skills we need to execute our digital enterprise vision. (Above graph corresponds to respondents who disagree)

20 http://www.wsj.com/articles/manufacturers-struggle-to-woo-software-developers-1476741531

Funding: Digital transformation—indeed, any transformation—is both expensive and far-reaching. That makes it difficult to justify to stockholders who may be focused on short-term gains rather than long-term investment. Vertical enterprises, especially in manufacturing, also face a challenge in how they report revenues from software, since it may not fall into any existing line items (see the *initial paper* in this series for more on the financial reporting challenge.)

Health care, because of its numerous participants and previous investment, also faces a funding challenge. "Leapfrogging over legacy platforms is expensive, and you see many hospital systems and health plans spending hundreds of millions on upgrades," says Optum's Weissel. "You have to ask what the ROI is and how you get there, and can you afford not to get there."

Culture: Cultural issues frequently flummox enterprises. Manufacturing is a traditionally conservative industry, notes Honeywell's Mikkilineni. "Our customers are not used to consuming these kinds of services. They look at risk differently. We see their situation changing and maturing rapidly though, so I believe customers will embrace it soon."

PwC's Eddy notes, "Manufacturing companies are trying to pivot into a huge cultural change. They may spend years developing an engine, but software iterates routinely. It's a different value proposition selling a product versus selling a solution. The shift to software and solutions means a change in business model, a change in talent and, as a result, a need to change culture. Different talent means different cultures."

In health care, "digital transformation is a question of thinking differently about how you use data to change the way you treat and engage patients," says Weissel. "It means changing the way consumers empower themselves. The issue is much broader than the digital platforms themselves."

Bank of America's Bhasin insists that enterprises must guard against hewing to old processes when trying to make the transformation: "Old-line IT organisations would wait for the requirements document that would be thrown to a development team. That kind of 18-24 month lead time can't exist in 2017. You have to move to a more agile development model, and take steps to embed security and risk and compliance into the application development process (see interview)."

Cultural issues frequently flummox enterprises.

Technology: Within the technology challenge, there are several subcategories. Perhaps the biggest relates to data—where it comes from, how it's used and how it's shared. One of the key tenets of successful digital transformation is the ability to share data smoothly, but that means understanding how data will be aggregated and who owns it before, during and after that process.

As PwC's Garrett notes, "The more complex issue is that all the data being collected in health care is in unstandardised formats. There are massive amounts of data being spun out of everything from diagnostic devices and wearables to telemedicine and electronic medical records. Aggregating it will be a significant big data and analytics challenge."

The technology has come a long way with APIs (application programming interfaces), especially cloud-based APIs, but there's no guarantee that a lot of medical record and other database information can be aggregated accurately. That creates a challenge for analytics—enterprises only get smarter data with more sources; they can't be efficient without analysing the data.

As for data ownership, it's not just a question of who controls it—especially if it's gathered from many sources—but who's responsible for the privacy and security of the data. Deeply related to the issue of security is the issue of trust; i.e., how can an enterprise be sure that the source of the data is trustworthy? If executives can't be sure, they're less likely to buy into the changes that software-led digital transformation requires.

Another potential obstacle for transformation is the infrastructure that allows for smooth exchange of information. To move to that capability, enterprises may have to spend money to upgrade equipment and software (cloud computing lessens the financial impact somewhat, but not entirely).

PwC's Kennedy says, "It's difficult to convince CFOs and CEOs of the importance of enterprise architecture." At its most fundamental, digital transformation requires tech-centric initiatives that solve large business problems, but it's hard to get them on the radar screen of those who approve funding. Because they're infrastructure-based and not client-facing, it's frequently difficult to see how they can save millions in time and processing across an enterprise. "Sometimes the way firms manage IT spend is the problem," adds Kennedy.

This technology challenge for digital transformation is not limited to IT. In manufacturing, industrial equipment has been running proprietary software for years. Now the sector must upgrade networks and applications to link to ERP systems and deploy APIs to link to partners.

Stumbling blocks aside, it's still early for vertical markets. It's not as though enterprises are already being left behind. There's time to overcome these issues. PwC's Eddy says, "Even most progressive companies are in early days of digital transformation. In fact, many companies are still exploring potential use cases versus delivering real business outcomes at scale."

Where traditional technology companies will play

As software invades other industries, traditional software companies are not idle observers. The major technology vendors—including Microsoft, Oracle, SAP, Apple and others—are aggressively partnering with non-tech companies, matching technology to business expertise. Other technology vendors with venture capital divisions—including Google Ventures and Intel Capital—are nurturing non-technology start-ups.

Others are working to adapt their core offerings to vertical applications. IBM is fashioning its Watson supercomputer as a foundational system in health care analytics. Salesforce is collaborating with health care companies (among other verticals),[21] using its CRM application as the patient database. "Health care companies have no way of doing this on low margins," says Dr. Joshua Newman, chief medical officer at Salesforce (see interview). "Technology companies have a special ability because innovation is what we do every day."

The recent proliferation of start-ups has inspired a response by larger technology companies. Two years ago, says PwC's Courbe, new financial services technology was "purely the domain of start-ups, but the landscape has changed. As much as the start-up community is still present in the financial services landscape, we see more of the bigger technology companies taking that space."

The question remains, will they be successful? On the one hand, according to the PwC CEO Pulse 2016,[22] 60% of respondents "expect a tech-based, non-traditional competitor to enter their industry. On the other hand, Min-Sun Moon, Senior Manager in the Data & Analytics Delivery Services group at PwC US says, "GE understands that customers have their own issues that need to be customised, and it thinks it has an advantage in figuring out solutions."

Major technology vendors are aggressively partnering with non-tech companies, matching technology to business expertise.

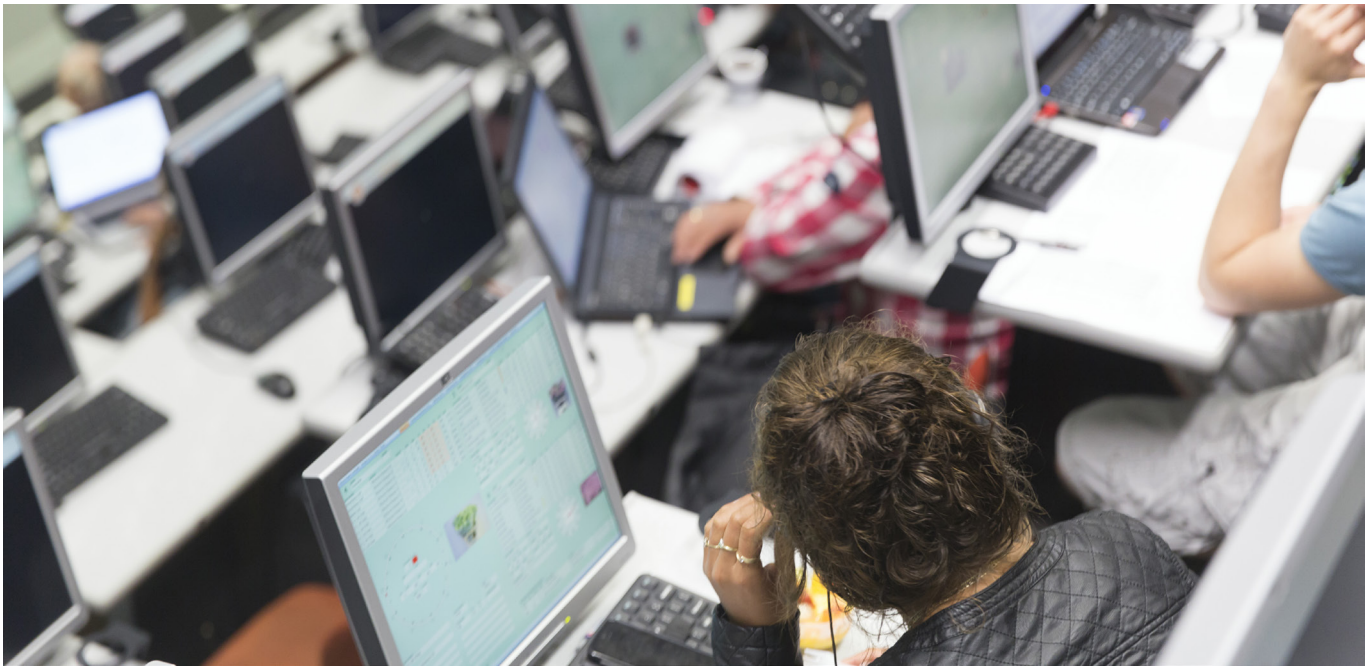
21 https://www.salesforce.com/solutions/industries/
22 http://www.pwc.com/gx/en/ceo-agenda/pulse.html

One way to succeed is to nurture new ways of collaborating, to enable the rapid accumulation, transmission and sharing of data, which is an essential element of the digital transformation. Technology companies can contribute to that effort through industry APIs. Such APIs standardise and simplify connections between systems, helping companies increase their ability to interact while reducing internal costs. PwC's Kennedy says, "We see a number of companies exposing their APIs to larger development communities, which allows for individuals to create new apps for payment processing."

Similarly, technology vendors can contribute to the process by vetting start-ups. Kennedy notes that vendors realise they can't be the single point of innovation; start-ups do bring value. APIs linking established systems to those created by start-ups expands the use of vendors' core processing capabilities without cannibalising other services.

Amazon CEO Jeff Bezos issued a mandate in 2002[23] about the importance of APIs: "All service interfaces, without exception, must be designed from the ground up… to expose the interface to developers in the outside world. No exceptions." One could argue that this helped Amazon's transformation from online bookseller to e-commerce and cloud leader.

Technology vendors can also be the guide for new, untested technologies. "When it comes to emerging technologies like robotics, artificial intelligence or blockchain, we're seeing much more cooperation between technology companies and financial services firms," Kennedy says. He particularly cites blockchain, a way to create a secure record of transactions, as "a very open capability that doesn't require aligning with a vendor." The same logic applies to open-source software, says Moon. "Technology companies are investing heavily in open-source software because [applications based on it] can get adopted more quickly."



23 https://apievangelist.com/2012/01/12/the-secret-to-amazons-success-internal-apis/

Conclusion: How software will change all industries

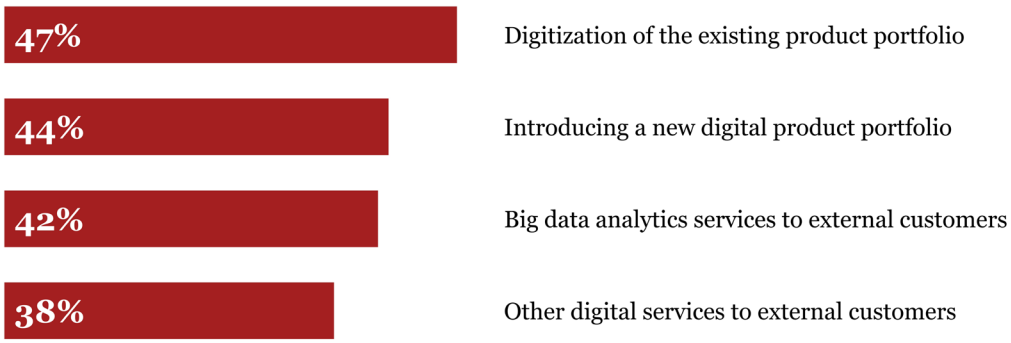
Consider these possible milestones on the way to the software-led digital transformation:

- Advanced automation becomes rampant in factories around the world, eliminating the need for low-cost workers. Without the need for lower-level workers, manufacturing returns to the developed world in droves, because those regions can provide the high-level engineering talent necessary to manage a completely automated factory.
- The health care industry works with technology partners to create a standardised communications protocol for medical devices, simplifying the ability to collect, anonymise and share information. The cost of health care drops accordingly.
- The financial services industry uses industry-standard APIs to exchange information in real-time on cybersecurity, thus protecting data and web sites from hackers.

Whether these possibilities manifest or not, it's certainly true that in five years "the landscape and business models will be fundamentally transformed," says PwC's Courbe.

Digital connections between manufacturer and customer open new revenue possibilities

Percent of companies that expect to achieve 10% or more additional revenue in the following areas over the next 5 years



Source: PwC Global Industry 4.0 Survey, 2016

Software will enable financial services robo-advisers in wealth management. Manufacturing entities will use automation to improve response time and agility. The health care industry will, at the least, improve communication across care-givers.

Overall, industries will be able to create an environment that's both customer-centred and context-centred. Enterprises will be able to tie massive amounts of situational data from smartphones, sensors and wearables to operational data, such as transaction history and risk profiling. All these industries will be able to take advantage of real-time, next-action recommendations.

Likening the effect to the impact of lean manufacturing, Mikkilineni says, "It's skinny in the sense of process streamlining, which we believe will lead to a lot more efficiency and effectiveness. We'll see it especially in the streamlining of process, leading to more plants where highly skilled, technology-savvy operators can make predictive decisions in real time."

Optum's Weissel concurs: "Whether we like it or not, we're being forced to go digital, because the efficiency opportunities that exist are incredible. Moving to digital will save money and lives."

None of this change will happen without commensurate advances in various issues that are difficult to tackle today, whether on the technology side (integration, security and agile development) or on the financial and cultural side (well-funded investment, communication to stockholders). The fundamental building blocks for the software-led digital transformation are available now, but much work remains to be done. As Salesforce's Dr. Newman says, "The next level of capabilities we're talking about is unprecedented. You can't describe it as 'the Wild West' because it's wilder than that."

The good news: that means no one's behind yet, and anyone can get ahead.

Enterprises will be able to tie massive amounts of situational data from smartphones, sensors and wearables to operational data, such as transaction history and risk profiling.

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Let's talk

If you have any questions about the Global 100 Software Leaders or would like to discuss any of these topics further, please reach out to us:

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