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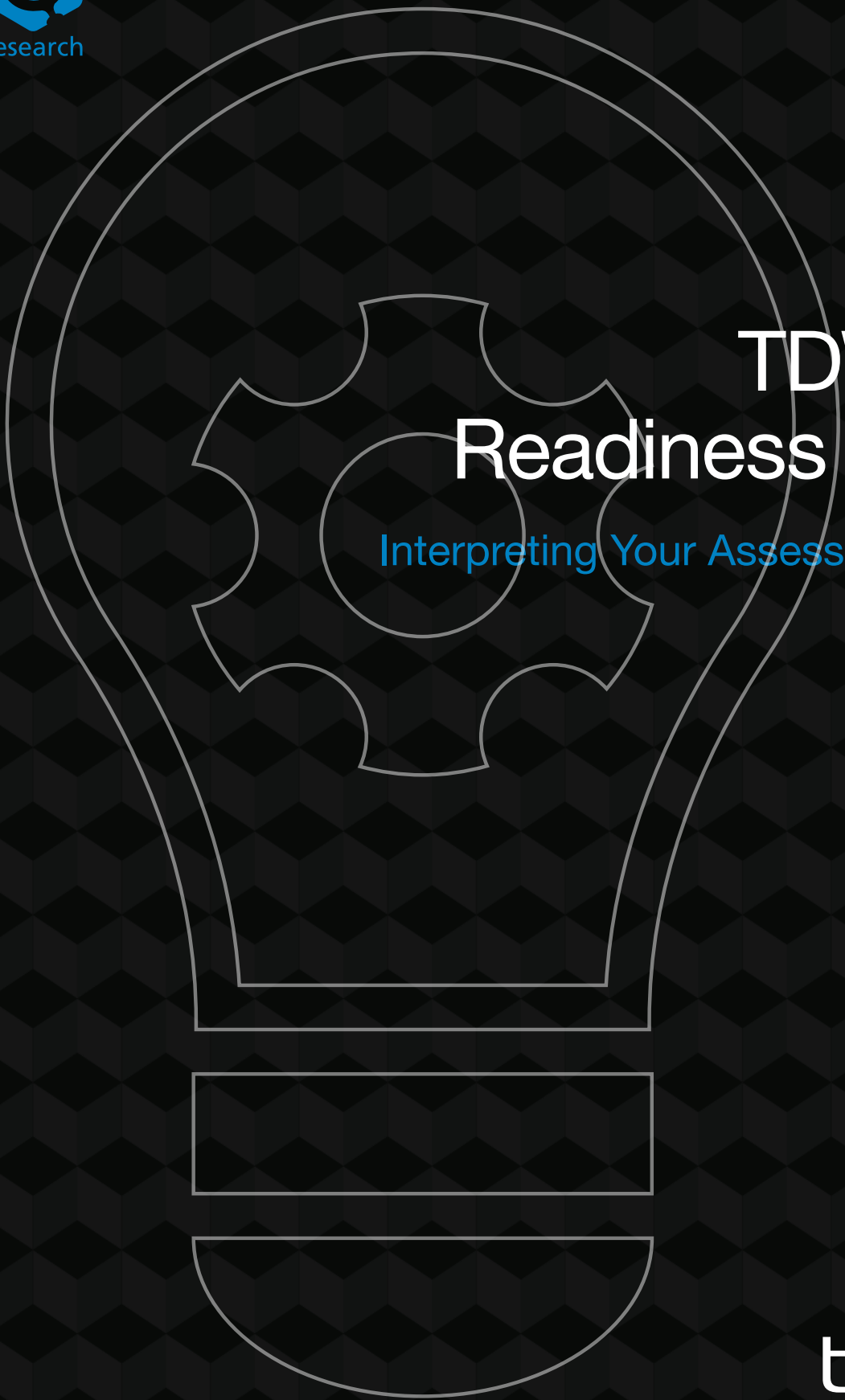
TDWI IoT Readiness Guide

Interpreting Your Assessment Score

By Fern Halper



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About the Author

FERN HALPER is VP and senior director of TDWI Research for advanced analytics, focusing on predictive analytics, social media analysis, text analytics, cloud computing, and other "big data" analytics approaches. She has more than 20 years of experience in data and business analysis, and has published numerous articles on data mining and information technology. Halper is co-author of "Dummies" books on cloud computing, hybrid cloud, service-oriented architecture, and service management, and *Big Data for Dummies*. She has been a partner at industry analyst firm Hurwitz & Associates and a lead analyst for Bell Labs. Her Ph.D. is from Texas A&M University. You can reach her at fhalper@tdwi.org, @fhalper on Twitter, and on LinkedIn at linkedin.com/pub/fern-halper/2/491/63.

About TDWI Research

TDWI Research provides research and advice data and analytics professionals worldwide. TDWI Research focuses exclusively on data management and analytics issues and teams up with industry thought leaders and practitioners to deliver both broad and deep understanding of the business and technical challenges surrounding the deployment and use of data management and analytics solutions. TDWI Research offers in-depth research reports, commentary, inquiry services, and topical conferences as well as strategic planning services to user and vendor organizations.

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IBM, Teradata, and TIBCO sponsored the research for this TDWI IoT Readiness Guide and its accompanying Interactive Assessment Tool.

Foreword from the Author

The Internet of Things (IoT)—a network of connected devices that collect and interpret data over the Internet—is a hot and growing trend. Analysts predict that there will be tens of billions of these devices by 2020[1]. By some estimates, IoT will create $11 trillion of value by 2025[2]. The goal of this Readiness Guide is to help readers understand IoT and the critical factors that affect the success of IoT implementations, especially how the data is analyzed and used. In fact, a primary focus of the assessment is on data and analytics—what some industry experts call the "Analytics of Things."

This guide accompanies TDWI's IoT Readiness Assessment Tool, a survey that helps respondents understand how prepared their organizations are to leverage an IoT implementation to change their business model, improve operations, and improve the customer experience. When you complete the online questionnaire, the assessment tool immediately provides you with scores that quantify your organization's IoT readiness.

This Readiness Guide provides a primer on IoT and IoT analytics readiness, an explanation of the Readiness Model, and tips for interpreting your assessment scores. Although we recommend that you read this guide before taking the assessment so you are prepared to interpret the scores displayed at the end of the questionnaire, the guide and the tool can both be used independently, so you can work with them in either order.

The Reason for an IoT Readiness Assessment

Interest in IoT and IoT analytics is growing. In a recent TDWI study, although slightly less than 20 percent of respondents are using IoT data today for analytics, an additional 34 percent are planning to do so in the next three years[3]. This indicates that a majority of organizations believe that IoT can provide value for them—either by improving operational efficiencies or by increasing the enterprise's top line. Some view it as a competitive necessity.

Whatever the motivation, organizations are exploring IoT to see if it is right for them and if they are ready to take the first step to implementing an IoT application. They have questions about what their strengths and weaknesses are around IoT because some implementations can involve analytics, tools, skills, and processes that their organization has not utilized before. The IoT Readiness Assessment Tool and Guide provide answers for these questions.

When it displays your scores, the online assessment tool will also display an average of all people who took the assessment, including those in your industry and at companies of similar size. That way, you can look at the state of your readiness in isolation or you can add a dimension to that knowledge by comparing your strengths and weaknesses to those of other organizations.

Thank you for reading this Readiness Guide and using the IoT Readiness Assessment Tool. I hope you will find both useful.

Fern Halper, VP and senior director for advanced analytics, TDWI Research

[1] See Gartner [2015]. "Gartner Says 6.4 Billion Connected 'Things' Will Be in Use in 2016, Up 30 Percent From 2015," press release, November 10. http://www.gartner.com/newsroom/id/3165317

[2] James Manyika et al [2015]. "Unlocking the potential of the Internet of Things," McKinsey Global Institute, June. http://www.mckinsey.com/business-functions/business-technology/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world

[3] For more information, see the 2015 *TDWI Best Practices Report: Next Generation Analytics and Platforms for Business Success*, online at www.tdwi.org/bpreports.

IoT Primer

Before discussing IoT readiness, let's review IoT for readers newer to the topic and define the terms that will be used throughout the guide.

Defining IoT

The Internet of Things is a network of connected devices that can send and receive data over the internet. These "things" are devices that have embedded hardware and software that receive and collect data, and can communicate internally and externally. Many of them are inexpensive. They provide command-and-control functionality and include a CPU, often with limited power and memory. These devices—which include sensors, RFID tags, and more—are in your home in smart appliances; you're wearing them for health and wellness. They are on factory floors, in office buildings, on farms, and much more.

The idea behind IoT is not new. Machine-to-machine (M2M) applications have been around for decades performing monitoring tasks and collecting operational data. M2M communications enable networked devices to exchange information and perform actions without human assistance. M2M is often used for remote monitoring. For instance, an oil rig might send information about flow rates or parts movements to a remote computer. If the flow rate, as measured by sensors, exceeds a certain value, the computer might adjust it. This remote communication between a device and a central system that monitors and controls the device is similar to modern IoT, although traditionally M2M operated over a closed network and on a limited set of problems.

IoT is becoming hot now for a number of reasons. First, there are technological improvements that enable the deployment of IoT. These include the fact that the costs for compute, storage, and high-speed networks are declining, as are the prices for sensors and other devices. Software now exists to manage large amounts of data and data streams. The technology to analyze and take action on this data is also available. Second, organizations are eager to compete on analytics. B2B organizations may look to provide IoT-related services to their clients to help them manage operations or assets. Consumer-facing companies might provide new "as-a-service" models for consumer products such as those related to smart homes. These new sources of revenue help to differentiate companies from their competitors. Other organizations will implement IoT internally to help them improve efficiencies—for instance, to predict when a part will fail or to track the temperature of a train car transporting fruit to ensure freshness upon arrival at the grocery store. The possibilities are wide and varied.

How Organizations Use IoT

IoT is not a future scenario. There are numerous use cases for IoT and IoT analytics in production today, including:

- Predictive/preventive maintenance: Data from sensors and other devices is used to determine when a part failure might occur. This can be accomplished using predictive analytics or rules-based logic. For instance, a manufacturer might use sensor data on a truck to determine when and what maintenance is needed. They would use analytics—for example, a moving average of temperature from specific parts or a predictive model built using historical data of failed parts—to determine if there is a problem. If similar conditions exist, an alert is generated and maintenance is scheduled. This kind of application is being used in many industries such as oil and gas, utilities, manufacturing, healthcare devices, and transportation.

- Product design and innovation: In this case, a company can use sensor data that comes from a product to help understand how consumers interact with the product in context. That insight can be used to modify or create new features.
- Optimization: Enterprises combine analytics with IoT data to optimize the performance of an asset. For instance, a telecommunications company might want to optimize its network utilization to meet demand but may not have excess capacity. Analytics (such as visualizations) can help them see where network traffic is congested and where excess capacity exists, and plan accordingly. More sophisticated models can be used, as is often the case in IoT deployments for logistics.
- Customer behavior analysis: Enterprises again join analytics with IoT data to understand behavior and act accordingly. For instance, a retail store might use in-house beacon technology to collect data about how customers move in the store. It can then create a model of in-store foot traffic. Another example is an insurance company that collects telematics information from drivers in cars. This contains information about the client's driving patterns that can be used to price insurance premiums. Fleet operators might also use such data.
- Asset monitoring and analysis: Assets (such as tools on a construction site or computers) might be tagged with sensors that provide location information. This can help in tracking lost or stolen property. Sensors can also be used to ensure the safety of human assets. For instance, construction companies can use sensors on hard hats to determine if a worker has fallen. All of this data could be analyzed to find patterns that can help allocate resources and improve worker safety.
- Smart cities: Some cities are implementing projects to manage public transportation. One city continuously monitors the density of cellular activity to determine hotspots in the city. Based on this information, they can dynamically allocate taxis or public transportation to these spots.

Other uses include smart homes, smart meters, smart grids, root-cause analysis, situational intelligence, and supply chain visibility. The point is that different kinds of analytics are used together with IoT and other kinds of data to drive efficiencies and provide services that can generate value.

Components of IoT Applications

There are many components in an IoT application—sensors, devices, gateways, routers, network infrastructure, cloud or local servers, analytics platforms and analytics algorithms, as well as other big data technology.

For example, Figure 1 illustrates a preventive maintenance IoT application in the transportation industry, although the same principles hold for other industries. The diagram provides some insight into the various components of an IoT deployment and what kinds of questions an organization should ask itself before embarking on IoT. In the figure, sensors are used to collect data from various trucks that are part of a fleet. Sensors might measure temperature or number of vibrations per second of a part, for example. All of this data is collected by a gateway device that might be in the truck. This data is batched on a periodic basis and sent to a data center or to the cloud where data from all the trucks in the fleet is analyzed to determine what factors precipitate a part failure, or when excessive wear and tear is occurring. That information might then be encoded into a set of rules or a model and then pushed down to the gateway or other edge device. When an alert condition is met, that alert will be sent to the driver's mobile device or to headquarters.

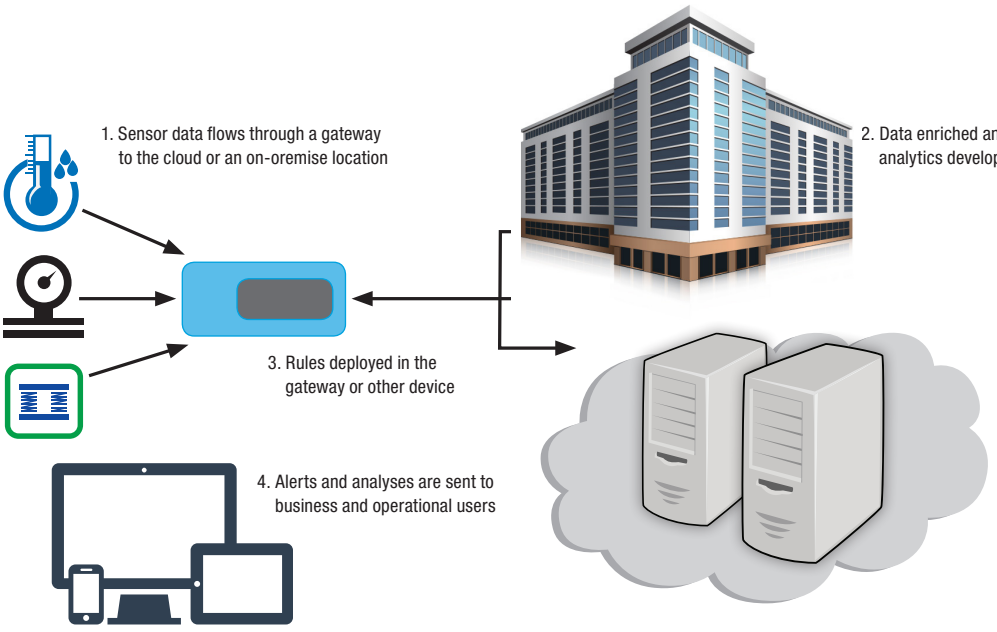

Figure 1: *An illustration of a preventive maintenance IoT application.*

This example illustrates the kinds of issues that must be addressed when embarking on an IoT application. Some technical issues include (but are certainly not limited to):

- What kind of sensors should be used? What kind of data needs to be collected?
- What kind of gateway device should collect that data from the sensors?
- Where should the collected data go? How often should the data be collected?
- What is the frequency of all of the data sources? How can these be synchronized?
- Where is it necessary to integrate the data with other data sources, such as an enterprise data warehouse?
- How should data quality issues be handled?
- How much data should be prioritized for storage? Does it need to be secured?
- What kinds of analytics will be used on the data?
- Are legacy systems impacted?
- Where should the analytics be deployed—on an edge device, on the gateway, in the cloud, or in an on-premises data center?

Of course, there are people and process issues, too. For instance:

- How will an IoT implementation and the analytics function support the strategic direction of the company? Are desired outcomes clear?
- What processes are impacted with these new alerts?
- Has everyone bought into this?

- Do you have the funding?
- Should you build a proof of concept first?
- Are there security or regulatory concerns that must be considered?
- Are there members of the organization who can deal with security concerns?

The TDWI Readiness Model for IoT

As you can see, an IoT analytics deployment can involve a number of departments and teams. Organizations deploying IoT often mention that domain experts, data scientists, data management experts, as well as those who understand networks and devices, can be needed to build an IoT application. Executives help get the project funded and set the tone and vision. Operations personnel must also be involved. Partners are often engaged to help in areas where the company has not yet built expertise. IT, business, and analytics groups embarking on IoT need to be aware that these other groups will be involved, especially in areas such as device management and network topologies.

Each function, of course, can be at a different state of readiness for IoT and each can affect the success or failure of IoT programs. Because of these factors, which touch on different aspects of an IoT implementation, TDWI's Readiness Model for IoT assesses IoT readiness across five dimensions, most of which map to specific business or technical analytic functions. (See the five dimensions across the top of the Readiness Model illustrated in Figure 2.) Of course, within each function, there are multiple processes, team structures, and levels of experience that can affect IoT success. These are represented in the model as metrics. (See the metrics listed below each dimension in Figure 2.) At the highest maturity of IoT, these functions are closely aligned to each other and, ultimately, to the strategic direction of the company. This ensures investments in IoT and analytics deliver the outcomes the enterprise needs.

Essentially, the Readiness Model described here is a catalog of success factors for completing an effective implementation that leverages IoT. Note that the catalog is compact for a reason. Based on conversations with many users, consultants, and vendors, we have identified the most fundamental success factors relative to readiness. One goal is to shorten the assessment tool's questionnaire (which is based on the Readiness Model) so as many users as possible will complete it. The primary goal, though, is to focus users and their organization on the highest priorities—namely, the most common and the most fundamental success factors for IoT implementation and analysis. Note, too, that the model is focused on IoT data and analysis. As such, although the assessment does ask some questions about networks, sensors, and security, these questions are in the context of getting ready for IoT deployments that make use of data analysis. The questions are included because it is important for teams to be aware of these aspects of IoT projects.

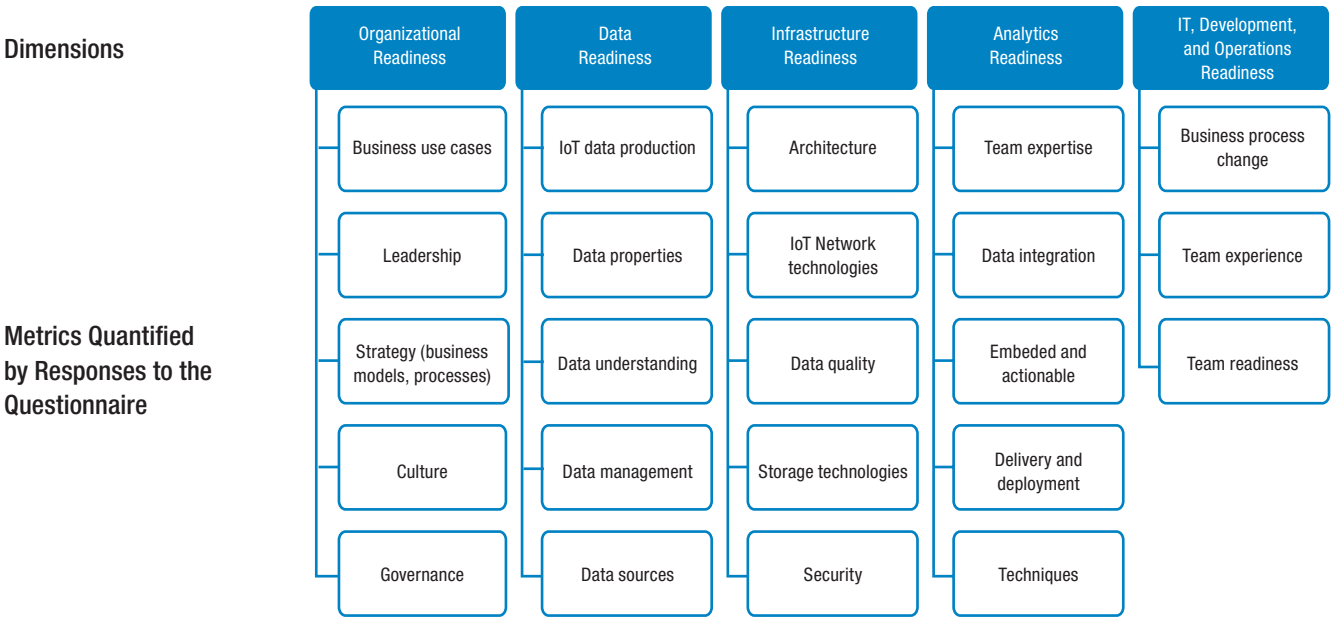

Figure 2: *The IoT Readiness Model consisting of dimensions and metrics.*

Dimensions and Metrics for IoT Readiness

In TDWI's online IoT Readiness Assessment Tool, there are one or more questions per metric from the Readiness Model. With multiple metrics per dimension, there are several questions per dimension. In other words, the online tool itself and the scores provided after completing the assessment are based on the hierarchical structure of dimensions and metrics, as defined in the IoT Readiness Model found in Figure 2.

Here's a general description of each dimension, with a few examples of the questions that the assessment tool asks for each dimension and its metrics.

Organizational readiness: This dimension consists of five key success areas. The first is that an enterprise must define a use case for IoT that makes business sense. This is critical because often organizations start an IoT project without including all relevant stakeholders in early discussions. For instance, some organizations are worried about what competitors are doing. They want to get started on a project but have not necessarily thought about the data needed, its frequency, the processes impacted, or how they will take action on IoT analytics.

Second, ideally upper management is committed to analyzing IoT data, has a vision for it, and is willing to fund it. This can be important, especially if outside expertise is needed to help with the deployment.

Other success factors include a culture that supports IoT, the beginnings of a strategy, and governance for IoT.

Data readiness: Questions in the online assessment tool test the presence of IoT data and whether the organization has the experience and skills to source, manage, and process IoT data, or big data in general (although not all IoT data is necessarily big data). In this section, respondents answer questions about IoT data sources and data management. They are also asked about data frequency.

Infrastructure readiness: The assessment tool tests whether your organization has thought through architectural issues related to IoT and IoT analytics. It looks at where analytics will occur in the IoT deployment, what data storage will be put in place, and how security will be handled. Data quality is also examined here. In this section, questions about where data is processed (e.g., at the edge or in the cloud) are also addressed.

Analytics readiness: Collecting IoT data is important, but analyzing and acting on it is where the largest value lies. That analysis might include techniques such as predictive analytics, stream analytics, or query and reporting. This section examines the composition of the analytics team and its experience with different analytics techniques. It also looks at whether your organization is set up to take action on analytics, and the deployment and delivery models for doing so. For example, it asks questions about data scientists and how your organization currently acts on analytics.

IT/Dev/Ops readiness: IoT projects often include other parts of the enterprise. For example, development teams might be involved as well as engineering and operations. IT may be involved in the data management and processing portion of an IoT deployment, but operations may need to be included in the rollout as well. The assessment tool tests how ready the technical team is to deploy and manage IoT. To further quantify readiness, the tool collects information about how the organization will address changes to systems or processes brought about by IoT. This might involve developing workarounds to legacy systems.

How the Readiness Assessment Tool Quantifies Metrics and Dimensions

When you select answers to questions in the Readiness Assessment Tool, the score for particular dimensions is calculated. For many questions, the multiple-choice answer you select determines the score for that question.

When you take the online assessment, resist the urge to inflate your score by answering the questions based on aspirations for the future. For your assessment to be accurate and useful for IoT planning, you should answer all questions as accurately and honestly as you can.

The greatest score for each single dimension is 20. Multiplying 20 by the five dimensions yields 100 as the greatest possible score overall.

At the end of the assessment, the Readiness Assessment Tool displays your scores per dimension (out of 20) and overall score (out of 100), plus the average dimensional and overall scores of all respondents. That way, you have a context for determining whether your organization is ahead of or behind the curve. You will also see the average for your industry and company size.

If your organization is completely prepared to leverage IoT today, your score across all dimensions might tally to 100, but that's rare; most overall assessment scores will fall between 40 and 70. An overall score of 50 is a reliable watershed benchmark. Above that, users should proceed with IoT analytics and further preparation can be successfully executed concurrently during the implementation. Below that, there are likely improvements that should be made to use-case commitments, goals for business value, technical skills, and technical infrastructure before you undertake an IoT implementation. The questions in the assessment should provide guidance for what it takes to get ready for IoT.

Interpreting IoT Readiness Scores

At the time this guide was written and published, the online IoT Readiness Assessment Tool had not yet gone live and TDWI had not yet begun collecting response data from people taking the assessment. Therefore, the following examples of scores are based on what we at TDWI anticipate, based on prior experience with other assessment tools.

As mentioned earlier, the online tool will show you your scores after you complete your session, as well as an average of scores across all assessment respondents. That way, you can benchmark your scores against those of your peers at organizations that are also contemplating an investment in IoT. The output of the assessment provides a table of benchmarks so you can compare your scores. It will also provide information in a radar chart (see Figure 3 for an example).

The average scores could go in a variety of directions and average scores will evolve as more people complete the IoT Readiness Assessment. Note that all data sets have one or more biases based on the diversity of the data's sources and other factors. With the IoT Readiness Assessment questionnaire, TDWI believes certain organizational profiles may be more common than others. For instance, there are going to be those organizations that have previous experience in monitoring their systems using M2M closed networks. These organizations may score high in many dimensions. There may also be some other profiles described below present in the responses.

Scenario One: Getting Started on Sophisticated Analytics

Organizations are at an inflection point when it comes to analytics. Many organizations are deploying analytics to help make decisions. They are using tools such as dashboards and visual analytics to help gain insight. In TDWI surveys, 30 percent (or more) of respondents are starting to make use of predictive analytics. More say they are planning this in the next few years. Typically, these organizations have experience managing structured data in some sort of data store, such as a data warehouse. They are interested in disparate data sources but are not making use of them yet.

These organizations have probably heard about IoT analytics and want to understand whether it makes sense for them. They are curious about it because they believe it will be important and it is something they should be (potentially) considering in the near future. Organizations with this profile still have some work ahead of them before they begin an IoT project.

Figure 3 illustrates what a simple radar chart from this kind of respondent might look like. Here, respondent scores are slightly higher in data readiness and analytics, although they are not that high, as illustrated by the pentagon's edge being somewhere in the middle of the chart. Scores are weaker in the other dimensions.

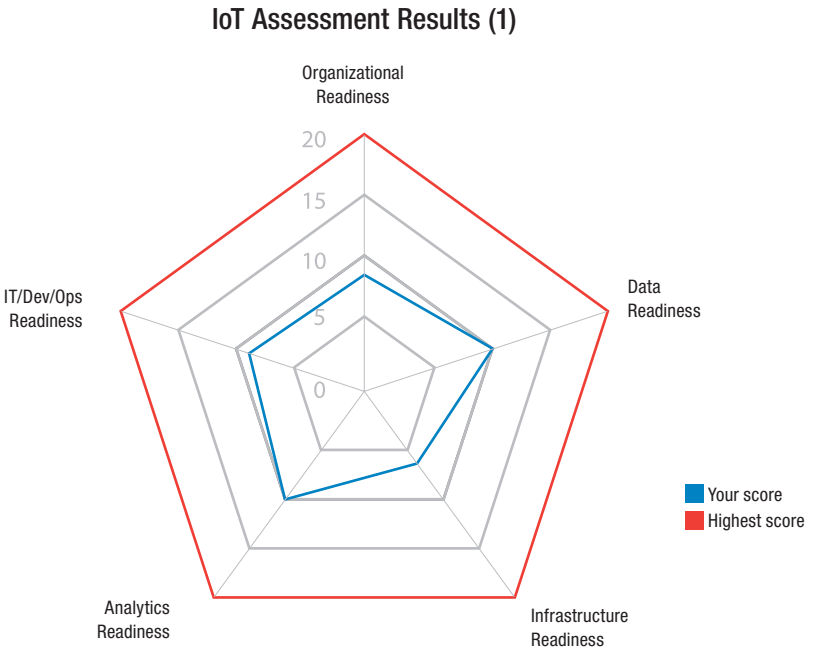

Figure 3: *Possible individual scores for organizations that are not that analytically mature. Note: in online assessment, average scores are also provided.*

Strengths: There is clear interest in building analytics capabilities and typically these organizations possess strong data management skills. Executive support may exist for analytics efforts.

Opportunities: These organizations will need to improve their skills around IoT data capture, management, and analysis. This may involve new analytics and technology skills. Typically, these organizations are only starting to put processes in place to act on their analytics, which will mean building support across the organization for it and learning to act on the results of analysis. As one subject matter expert in an interview for this guide said, "Knowing your use cases, what use case makes sense, and being able to put it into action is critical for success." If you're not going to be able to act on the output of the IoT analysis, it will not be successful.

Recommendations: Start thinking through IoT applications that make sense for your organization. Put plans together about who should be involved (for example, data scientists or domain experts). Think through the kinds of data you'll need to collect, its frequency, and how you're going to deal with it. Getting full value from IoT will require building competency that complements existing competencies, which may involve external partners.

Scenario Two: Strong Analytics Capabilities

Some organizations might be strong in data management and analytics but lack experience with big data or other IoT-related technologies. If that is the case, their organizations might score high in some of the data- and analytics-related categories, but IT or another department may not be prepared for some of the complexities of IoT, such as sensor selection and network configuration. The IT department might be working with the business for analytics but may have not worked with engineers or operational staff. Typically, organizations select partners to help them with these kinds of IoT issues. Organizations with this profile may be well positioned for IoT and may simply need to think through some of the specifics.

Figure 4 illustrates the output from this kind of respondent. Because the organization is strong in analytics with a culture that supports it, the pentagon's edges are near the outer edge of the radar chart, which denotes strength in these categories. Some of the other categories are located more toward the inner edge of the chart, which denotes weakness.

Strengths: The organization represented in Figure 4 is lucky to have strong technology (namely, for data management) and analytics. This is a good starting point for IoT. If they are sophisticated in analytics, then they are probably also well positioned to frame the right questions for IoT analytics. They may also have executive support for analytics, which will be important to get an IoT project off the ground.

Opportunities: Although getting started with IoT doesn't demand big data—smart cities that are monitoring bridge integrity might only get a few hundred sensor measurements a day per bridge—the reality is that at some point, some sort of big data infrastructure may be needed, perhaps Hadoop or some sort of stream-processing engine. The company will have to build skills in these technologies and learn new platforms. Even then, this doesn't ensure that the business is convinced that they need to deploy IoT.

Recommendations: If analyzing IoT data makes sense for the organization, then someone (perhaps the executive in charge of analytics) will need to make the business case for IoT so that the project can get off the ground and the other needed people can get involved. It will also be important to beef up communication between groups and partners early in the project.

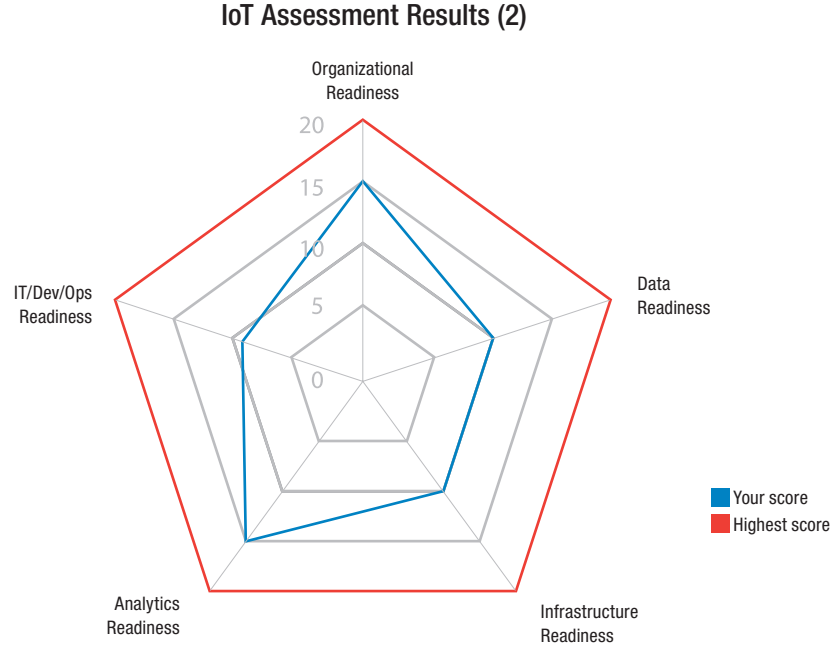

Figure 4: *Possible individual scores for organizations that are analytically strong.*

Scenario Three: Previous Big Data Experience

Big data and IoT data are not the same thing. For instance, an organization may have experience collecting large amounts of website browsing data, credit card transactions, or social media streams, which may require housing the data and analyzing it—perhaps even in real time.

However, this data is not connected "thing" data. There is no physical object involved. IoT data often involves instrumentation that the IT department is not familiar with. Figure 5 illustrates the potential output from a respondent with this profile. The figure reflects that the organization is strong in many dimensions.

Strengths: On the upside, the organization represented in Figure 5 is already committed to capturing, governing, and analyzing big data, so they should already have competencies in big data management and analytics. They may also have some competency in technologies such as stream processing and in embedding analytics for action. They may be using the cloud to perform some of their data analysis or as part of their data management infrastructure.

Opportunities: On the downside, the weakness in IT/Dev/Ops and infrastructure readiness is probably due to a lack of experience with specific IoT technologies and the development of IoT applications. Big data apps might impact how team members do their jobs already, so these organizations may already have experience acting on their analytics output—which is key for IoT.

Recommendations: Priority should go to beefing up teams that support IoT analytics infrastructure to learn the skills, acquire the tools, and deploy the infrastructure needed. This may involve training or partner support. Additionally, the organization thinking about deploying an IoT project should start communicating with development and operations, and any other groups involved. Otherwise, these organizations are in good shape to start their IoT analytics deployments.

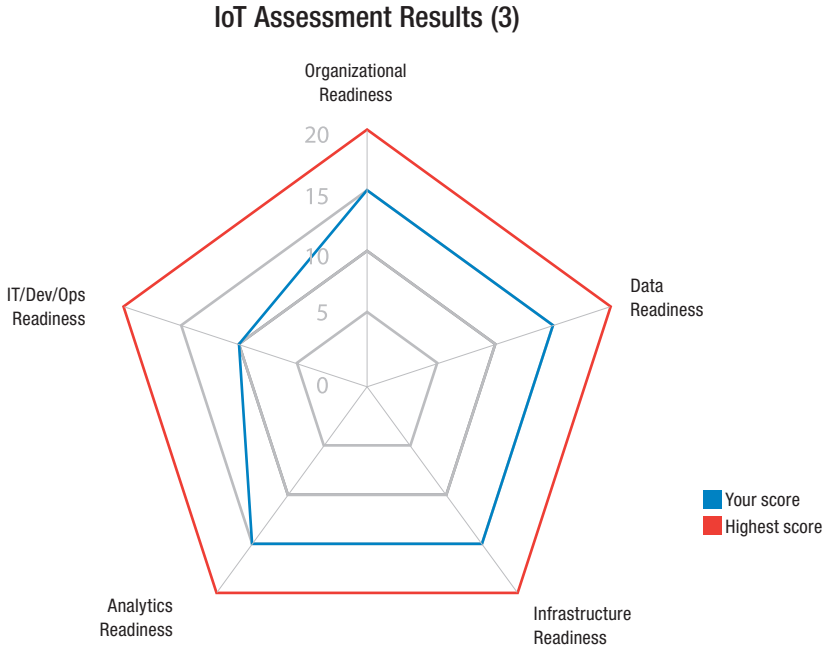

Figure 5: *Possible individual scores for an organization that has experience with big data and analytics.*

Summary

The TDWI IoT Readiness Assessment provides a quick way for organizations to gauge their readiness for IoT and to compare themselves in an objective way against others with IoT initiatives. The assessment is based on the TDWI IoT Readiness Framework, which consists of 38 questions across five dimensions. Although this assessment serves as a relatively coarse measure of your readiness, we think you will find it useful.

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