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Ace Company: Breadth or Depth Growth Strategy?

Shameen Prashantham, Liyang Ruan, Meng Li, and Tianwei Jing wrote this case solely to provide material for class discussion. The authors do not intend to illustrate either effective or ineffective handling of a managerial situation. The authors may have disguised certain names and other identifying information to protect confidentiality.

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Wen Jin, the chief marketing officer (CMO) of Ace Company (Ace), based in Shenzhen, China, was troubled. In August 2017, just a month after the start-up had obtained an A-round investment of ¥21 million,[[1]](#footnote-1)the founding team was divided about the direction of the company’s growth strategy.

Since the company officially released its first product, Ace OS 1.0, an operating system for the Internet of Things (IoT), in May 2016, more than 10,000 developers had joined Ace’s platform, and dozens of companies had applied Ace’s IoT technologies and solutions to upgrade their equipment and operations. Having proven the technical viability of its offering, Ace now had to scale up. However, at this crucial point in the start-up’s life cycle, the venture’s two founders, Yang Ren, chief executive officer (CEO), and Kui Zhang, chief technical officer (CTO), disagreed about the company’s next step.

In the beginning, Ren and Zhang had shared the same goal of turning a fanciful idea into viable products in the market. They had done better than expected. The core products were successful, and Ace was now equipped with both skills and funds. It had acquired a pool of developers and a sufficiently large customer base to ensure the survival of the enterprise. The co-founders knew that the next step must be to generate sufficient revenue to scale up, but they disagreed on whether to extend the company’s breadth or increase its depth. Which path should they choose?

Rise of the IoT Industry

IoT referred to the network of connected vehicles, home appliances, wearable devices, and other physical devices embedded with software, sensors, and actuators, which enabled these devices to connect and exchange data with computing systems. The systems could monitor or manage the status and actions of connected devices.[[2]](#footnote-2) For example, wearable devices could collect and analyze data about users’ health and wellness and inform users of the information through applications on their smartphones.

There were about 8.4 billion IoT devices produced in 2017; Gartner predicted the number would be 20.4 billion in 2020.[[3]](#footnote-3)The McKinsey Global Institute predicted that, by 2025, the number of connected devices around the world would dramatically increase to 25–50 billion, with the economic impact of IoT (including consumer surplus) ranging from US$3.9 trillion[[4]](#footnote-4) to $11.1 trillion per year in nine application settings (see Exhibit 1).[[5]](#footnote-5) Given the potential of IoT, investment in this market had exploded. The total funding in the IoT market had reached $6.25 billion in 2016 (see Exhibit 2).[[6]](#footnote-6)

The IoT fever continued to rise. To maximize the potential of IoT, technical and non-technical developments, including hardware and software technologies, interoperability, data security, organizational capabilities, and government policies were all needed (see Exhibit 3).[[7]](#footnote-7)

Technically, IoT consisted of four layers of activity (see Exhibit 4).[[8]](#footnote-8) The sensing layer consisted of small, memory-limited electronics devices with sensors and actuators. These were capable of sensing and recording data, and they connected to a network to share data. The network layer, which could be the cloud or a closed wireless network, was able to transmit the data collected in the sensing layer through various communication protocols. The platform layer consisted of management and analysis platforms that could aggregate, process, and analyze the recorded data through cloud computing. And the application layer included those user-oriented applications that could apply the results of analysis in the platform layer, such as smart homes and intelligent manufacturing.[[9]](#footnote-9) The increase in the number and type of IoT sensors and the reduction in their cost; the spread of lower-cost, ubiquitous wireless coverage; and advancements in big data and cloud or fog computing technologies made the uptake of IoT applications—including those for smart homes, travel, factories, and other uses—possible. An emerging IoT ecosystem comprising IoT hardware and software vendors, system integrators, and a growing community of organizational and individual IoT users was generating a complex, integrated system for the development of the IoT industry.

Governments had policies firmly on their agendas. For example, in 2011, the German government proposed Industry 4.0 as one of the top 10 future projects in its High-Tech Strategy 2020 for Germany. In the same year, the US government launched the Advanced Manufacturing Partnership (AMP 2.0). Since 2015, the Chinese government had also released several polices to promote the IoT industry, including Made in China 2025.[[10]](#footnote-10) With a favourable policy environment for the IoT industry, a growing number of IoT enterprises emerged.

Problems for the IoT industry

There were two main problems that hindered the wide adoption of IoT: (1) the IoT industry was fragmented; and (2) while embedded systems were required for 90 per cent of the IoT market, the development of embedded systems for IoT devices[[11]](#footnote-11) was inefficient.

Fragmentation of the IoT Industry

The IoT industry was much more fragmented than the smartphone industry, which had common standards, universal operating systems like Android, and shared network protocols. There was no universal IoT operating system in the market, and there were no common standards for hardware. IoT hardware devices from different manufacturers lacked a common software interface and could not, therefore, interoperate with each other. Yet McKinsey predicted that interoperability among IoT devices would make up 40–60 per cent of the total potential value of IoT.[[12]](#footnote-12)Further, there were multiple communication protocols in the IoT network layer,[[13]](#footnote-13) making the data incompatible and isolated. A complex network environment further resulted in data security concerns and limited connectivity.[[14]](#footnote-14)

Inefficient Development of Embedded Systems

The second problem could be seen as comparable to the difference between feature phones and smartphones. A feature phone was usually developed by a single manufacturer and had fixed functions. However, for a smartphone, an operating system like Android enabled the independence of hardware, operating system, and applications. The whole development process could therefore be divided and fulfilled by professionals working in different areas. For example, a Huawei phone could run on the Android system and download independently developed applications such as WeChat and Facebook.

IoT devices made with embedded systems were similar to feature phones. Lacking a universal operating system, the manufacturers needed to develop hardware and software as a whole. Thus, developers were required to have both hardware and software expertise, which was challenging, since electronic engineering and computer science were two separate disciplines.

In addition to these needs for manufacturers, embedded systems had other inherent deficiencies, such as low efficiency and poor flexibility. During the development process, developers had to deal with a lot of repetitive work. Meanwhile, IoT application demands were diversifying in different industries, but it was difficult to port existing embedded system modules from one use to a different use. Therefore, the process of developing embedded systems was inefficient. Worse still, the functions in IoT devices that were provided by embedded systems were fixed and could not be updated. Yet the functional demands through the life cycle of IoT devices were subject to change, and embedded systems were not sufficiently flexible to adapt to these changes.

As a result of these two significant problems, IoT projects were often costly in terms of both time and money. Few companies were capable of developing or updating IoT devices themselves, and a total IoT solution was unaffordable for many small and medium enterprises (SMEs). Therefore, adoption of IoT was not widespread.

Ace Company

Origin of the Idea

These problems inspired Ren to establish a new company. Ren was a serial entrepreneur and an expert in computer science. He had previously been the technical director for Nokia North America and had led the programming of Nokia’s Internet platform, Ovi, and its operating system, Symbian.

In 2013, while travelling frequently in China, Canada, and the United States, Ren noted that the concept of IoT was becoming popular around the world. Particularly in China, numerous so-called smart devices, such as smart sound boxes, watches, and eyeglasses, were being developed. However, the “smartness” at that time was actually no more than an ability to access the Internet or the addition of some specific and fixed functions such as voice recognition and remote control. In Ren’s opinion, a genuine smart IoT device should be able to gather, integrate, and analyze data about people, objects, and the environment and should perform different functions contingent on its current settings.

In early 2014, when Ren investigated the market, he realized that the key to smartness was the existence of a universal operating system and sufficient applications running on that system. Applications with different functions could be added to a smart device through the internal operating system, regardless of the brand or model of the device. Developers of the two ends could simply program applications or produce hardware compatible with the operating system and let the operating system match the hardware with the application, just as Android did for smartphones.

However, a universal IoT operating system had not yet appeared, and the fragmentation of the IoT industry and the difficulty of developing embedded systems made the proliferation of IoT applications impossible. Ren wrote in his blog, “Assuming there are 1.85 million programmers in China, only 0.1 million of them could carry on ESD [embedded system development]. Even in BAT [Baidu Inc., Alibaba Group Holding Ltd., and Tencent Holdings Ltd.], ESD engineers are scarce.” Though many experienced software engineers like Ren attempted to develop IoT devices, most of them failed due to the difficulty of developing embedded systems. Ren speculated, “There is no tool in the market to help me develop smart devices efficiently. . . . Tens of thousands of software engineers like me need a tool to deal with the drivers and hardware abstraction layer in advance. So, why not create such a tool on my own?”

Founding Ace

Ren approached his college classmate Zhang, who was also a serial entrepreneur, with his idea. Zhang was running a highly profitable games company at that time, but he was discouraged because the games company had no opportunity for an initial public offering (IPO), and growth was limited due to regulations in China. Acknowledging the great potential of the IoT industry, Zhang soon sold his games company and became Ren’s co-founder.

Zhang worked as the CTO and focused on research and development (R&D). Ren acted as CEO and focused on execution, financing, and recruitment. Jin was invited as a third co-founder and acted as CMO. Jin was an engineer with a dual master’s degree in computer science and entrepreneurship, and he had previously been investment director of a well-known venture capitalist company. With his technical and investment background, Jin knew this new venture was a great opportunity.

The founders obtained initial funding in September 2014. When the investor heard their business plan and saw a working demonstration programmed by Ren, he immediately decided to invest. An angel investment of ¥3 million was transferred into Ren’s account for the enterprise, which was valued at ¥30 million. Ace Company was registered in February 2015, and in May, it received a pre-A investment round of ¥12 million, at a valuation of ¥120 million. After two years of development, mainly focusing on R&D and commercialization trials, Ace had about 50 employees, 70 per cent of them technicians. The company’s main business included providing IoT technologies for system integrators (SI) and independent software vendors (ISV) and IoT solutions for industrial enterprises.

Ace’s Core Technology

Ace’s vision was, “Software defines hardware.” To realize this idea, once they had received the angel investment, Ace’s team started developing the Ace operating system (OS).

Ren programmed a demonstration to prove the possibility of using a non-embedded programming language to develop an operating system for IoT devices. But the language Ren used was too outdated to be popular. The company needed a more widely used language to gather a greater number of developers into a large-scale ecosystem. The first choice was JavaScript, which was the only programming language for full stack development—the development of a complete system from back end to middleware to front end—and which had a huge number of users. JavaScript was not tied to any particular operating system or any chipsets, so it was intrinsically suitable for an open source operating system.[[15]](#footnote-15) JavaScript was widely used in web application development because it had a lower threshold for developers and few bugs during programming. The JavaScript community was also active, breeding numerous new ideas, which were shared among developers.

The team developed a demonstration of the original prototype of Ace OS in June 2015. The demonstration displayed their complete concept, but it was still far from maturity. However, the feedback when they exhibited the OS was beyond expectation. Both software and hardware developers were keen to try it. In January 2016, Ace released 300 sets of a public beta version of the developer kit, carried on Ace OS 1.0. The buyers were mostly from smart device R&D departments of companies such as Xiaomi Corporation and JD.com, Inc., and from chip manufacturers who were willing to produce chips compatible with Ace OS in the future.

Based on the feedback from the first users, Ace improved certain aspects of the product. In May 2016, the first official version of the Ace developer kit began to be sold on WeChat at the price of ¥298. The sales volume for the first month was more than 1,000 sets.Ace OS continued to be updated based on the developers’ feedback. By August 2017, the 1.11 version had been released.

Ace OS was an open, agile, and efficient JavaScript operating system specializing in IoT applications. Its function was similar to that of Android for smartphones. It provided a JavaScript runtime for IoT application development; had a hardware abstraction layer (HAL); and was compatible with many different platforms, sensors, and peripheral modules. With Ace OS running between IoT applications and hardware, software developers did not need to concern themselves with the underlying driver design or porting, nor did they need to understand circuit diagrams or data manuals. An application programming interface (API) enabled software developers to conduct full stack development of IoT applications on personal computers (PCs) with JavaScript. Hardware developers simply needed to make their hardware compatible with Ace OS. Hardware and software could therefore be developed separately by specialist professionals.

Ace OS was not the only IoT operating system. There were numerous competitors, such as VxWorks, Zephyr, FreeRTOS, RIOT, Windows IoT, Android Things, Huawei LiteOS, eLinux, Tizen, Ubuntu, Raspbian, Mbed, Contiki, JerryScript, Tessel, Espruino, and Johnny-Five. Many of the operating systems were developed or supported by information technology (IT) giants and had some market share. However, they were not compatible with each other and could hardly become a universally applicable operating system for IoT devices as Android had for so many brands of smartphones. Jin explained, “Most of these operating systems were still for ESD and failed to avoid the inherent weaknesses. Some of them were open and provided a certain degree of hardware abstraction, but not as complete as Ace OS does.”

Compared with its competitors, Ace OS had three advantages: First, it applied JavaScript as the programming language, which enabled more developers to participate in the IoT industry. Codes could be simplified to a large extent. Second, Ace OS provided a complete hardware abstraction layer, which could completely separate development of the operating system, applications, and hardware. Software engineers could therefore develop IoT applications without knowing the hardware, which would greatly enrich the IoT applications repository. Third, compared with other JavaScript-based operating systems, Ace OS was more suitable for large-scale industrial use because of its high development efficiency and usability in constrained hardware.

In light of the competition, Ace needed to contend for market share. Jin observed, “The more developers using Ace OS to develop IoT devices, the more promising Ace’s market will be.” Therefore, Ace provided the developers with a system for IoT application development. The developers could access a system of development tools and test the software programming logic on development machines without printing circuit boards. Ace also provided the developers with a platform to exchange ideas and share existing codes to avoid iterative development. Ace hoped that the platform could evolve into an ecosystem, assembling more and more IoT developers and end-users, and forming a strong network effect. The abundant resources in the ecosystem would become a significant barrier for competitors and would accelerate overall IoT application.

Commercialization of Ace’s Technologies

The direct customers of Ace’s technologies would be IoT SIs and ISVs. They could develop abundant applications based on Ace OS for end-customers. Ace could access these end-customers with their sales network, but the relationship also created challenges. Jin explained, “Ace intended to be a professional operating system supplier at the beginning, since we don’t own a factory to produce hardware. And the development of professional applications for the end-customer needs industrial expertise, which is also not Ace’s specialty.” However, by supplying the operating system only to SIs and ISVs, Ace would be dependent on those customers. And because these customers controlled the channel to the end market, Ace had less bargaining power and could be replaced by other operating systems.

To change this situation, Ace needed not only to provide its OS to SIs and ISVs, but also to build direct connections with end-customers and increase the popularity of the OS among them. Skipping the middle SIs and ISVs, Ace could get a higher premium from end-customers, and the end-customers’ wide acceptance of Ace OS would motivate more SIs and ISVs to voluntarily choose Ace OS. However, unlike SIs and ISVs, with their ability to develop applications, most Chinese enterprises, especially SMEs, were incapable of using only an operating system to develop applications on their own. However much they might have wanted to apply IoT technologies and upgrade, they did not know how to start. Their equipment was even too outdated to connect to the network. Therefore, Ace would need to help them apply IoT technologies.

After Ace OS was first released in 2016, a company providing financing products based on new energy came to Ace for help. This company needed a complete IoT solution to realize real-time data collection and transmission, monitor the operating status of power stations, and visualize data on mobile terminals to allow users to keep track of the power stations’ operations and earnings. Ace successfully met the company’s demands and continued to provide the maintenance service for the product.

After this first successful trial, Ace began to broadly commercialize its technologies for industrial use. In about a year, the company had provided IoT solutions for more than 20 companies in industries like construction materials, transportation, energy, and agriculture. However, providing IoT total solutions to industrial customers on a case-by-case basis meant that expansion was slow.

Zhang conceived the idea of providing industrial customers with a standardized device that had some basic functions to kick off the customers’ IoT transitions. Other software developers would provide advanced applications based on this device when the number of customers was large enough. Like WeChat, which provided basic functions like message and moments and had a vast user base, Ace’s product could have many mini-applications (applets) developed by third-party developers. Therefore, Ace’s two other products—Ace Connector and Ace Plant Inside (PI)—were invented.

Ace Connector was a universal industrial IoT gateway that could help connect outdated equipment to the system. It had an open API for developing customized applications and could meet various needs ranging from fog computing to big data collection. Possessing an abundant library of industrial drivers, Ace Connector was suitable for deployment in different settings, including industrial automation, energy acquisition, smart agriculture, and smart communities. It also had abundant hardware interfaces for multiple industrial devices, and it provided easy deployment and remote maintenance and diagnosis. Equipped with Ace Connector, traditional factories could have the basis for digitalization.

Ace PI was a standardized IoT application running on Ace OS and embedded in Connector. Ace PI provided traditional factories with four basic functions: (1) it could use Ace Connector to enable device access, two-way data communication, and reverse control; (2) it could gather various data from the connected devices; (3) it could provide reliable operation alarms based on users’ settings; and (4) it could create statistical reports for future analysis. The suitable industries for Ace PI included manufacturing, smart offices, health, retail, home appliances, agriculture, and energy maintenance. Ace estimated that, on average, the use of PI reduced unexpected interruptions in operations by over 55 per cent, lowered maintenance costs by more than 55 per cent, improved productivity by 5–10 per cent, and increased production efficiency for customers by more than 30 per cent. Compared with the exclusive use and high cost of traditional IoT solutions (more than ¥10 million), Ace PI was universally applicable, and its cost was much lower.

Jin summarized Ace’s progress: “Every technological innovation should eventually serve the commerce to prove its value. Ace has progressed from prototype design to commercial application, which will extend to a larger scope in the future.”

Ace’s Future: Two Possible Paths

Ace was considered a promising IoT enterprise by the industry. After winning the TechCrunch Beijing 2016 Startup Competition with Ace OS, the company was selected to be part of the Microsoft Corporation (Microsoft) Ventures Accelerator program in January 2017. The company won honours as Most Creative Enterprise in GE’s Predix Hackathon for Ace PI. Ace established strategic co-operation relationships with Microsoft, Schneider Electric SE (Schneider), Baidu Inc., Intel Corporation, World Peace Industrial (WPI) Group,[[16]](#footnote-16) Honeywell Group, and others. Microsoft, for example, sold Ace’s products to its Microsoft Azure clients to allow them to access the cloud. Schneider and Ace were jointly updating Schneider’s programmable logic controller to adapt to the IoT trend. WPI helped to produce the hardware for Ace Connector.

By mid-2017, Ace’s revenue had exceeded ¥10 million, proving that its technologies and services could be profitably applied to commercial practices (see Exhibit 5). Next, the company needed to find a way to scale up, but at this critical point, the co-founders were in dispute. They especially disagreed over whether they should extend Ace’s business to as broad an industrial base as possible or forge a deep involvement with a limited number of industries.

Path 1: Extending Breadth

Zhang insisted on extending Ace’s business to as many industrial scenarios and companies as possible through large-scale promotions. He felt that Ace should simply provide the customers with the OS, Connector, and basic PI and let other software developers provide specialized applications.

The success of this strategy would depend on Ace PI. It needed to be universally applicable, with narrow but useful functions that could attract many loyal end-customers. When the number of customers reached a certain scale, other software developers would voluntarily develop specialized applications based on Ace OS. Therefore, Ace needed to iteratively improve PI to meet the end-customers’ fundamental needs, as well as attempt to sell PI to as many customers as possible, even at a bargain price, charging developers for Ace OS in the future. In order to implement this path, Ace needed to build a strong marketing team and other support departments in addition to the established technical team. Heavy investment in large-scale promotion would also be necessary.

Zhang pointed out that Ace did not have sufficient knowledge in specific industries to provide an effective complete solution, so it would make sense to follow the principle of specialization and focus on Ace’s strengths. Ace OS had the potential to replicate Android’s success with smartphones and become a widely used standard in the IoT industry. To get there, the next key step would be to increase market acceptance of Ace OS by promoting Ace PI among industrial customers, who were not able to rely on a single OS. As Ace PI attracted more loyal end-customers, more software developers would develop applications based on Ace OS. This approach might help to grow Ace’s ecosystem and make Ace OS the mainstream IoT operating system. This would lead to numerous end-users, developers, and applications on Ace’s platform, creating a virtuous circle: a large number of users guaranteeing the sales of applications, these sales inspiring more developers to create diversified applications, and the richness of the applications attracting more end-users. Should this happen, other IoT operating systems would have less room to compete with Ace.

However, Ren disagreed with Zhang’s preferred plan on the basis that even the ¥21 million investment Ace had received was insufficient for large-scale promotion. The funds would last for no more than three months if Zhang’s path were implemented. Moreover, Ace’s employees were mostly technicians rather than sales personnel. How could they implement such a large-scale promotion? In addition, Ace PI was still not a mature product. Meeting most industrial customers’ fundamental needs with one product was more difficult and costly than had been anticipated. R&D for PI had cost 60 per cent of Ace’s total budget but had yielded little income.

Another serious problem was that few industrial companies understood Ace’s method of using a universal operating system and a combination of standardized applications to satisfy different needs. The companies were still looking for total IoT solutions and did not want to stop their production and risk trying Ace’s products.

Ren also worried that if Ace provided only an OS and basic PI, it would not be able to compete with big companies like BAT, Amazon.com Inc., Microsoft, and Google LLC, which were able to create more advanced IoT operating systems that could be accepted by the market more easily. As a former manager of Nokia, Ren had seen Symbian be overtaken by Android and Apple’s iOS operating system, even when Nokia had a 70 per cent market share. Although Ace OS had avoided the fatal shortcomings of Symbian, Ace still needed to be aware of its powerful competitors and strengthen its differentiation.

Path 2: Digging Depth

Ren insisted that Ace should penetrate deeply into a few industries and become a leading IoT solution provider for them. If this strategy were implemented, Ace would have direct exchanges with end-customers rather than through SIs or ISVs. As a result, it could focus more on developing specialized applications rather than Ace PI alone. The company would need to co-operate closely with end-customers to understand their specific needs, learn and accumulate industrial knowledge, and provide customized applications with specialized functions and total IoT solutions for each customer. A flexible organizational structure would be preferable for dealing with diversified projects, and the technicians would be better employed in acquiring more industrial knowledge to develop customized products, rather than just focusing on IoT technologies. Investment into Ace PI could possibly be stopped.

Ren argued that, because Ace was a small enterprise of only 50 employees, focusing on a few industries and being fully involved would immediately generate revenue. The quality of Ace’s products and services could be guaranteed, which would support Ace’s growth. Although the company currently had limited knowledge in the targeted industries, the knowledge could be accumulated gradually as projects increased, and the growth of knowledge would enhance Ace’s differentiation and irreplaceability. It had already served more than 20 companies and gathered some knowledge. These successful experiences lay the foundation for deeper involvement in those industries. Moreover, Ace could form an ecosystem and take advantage of the networking effect within each industry, becoming more exclusive and developing more professional, industry-specific applications that would attract target users. In addition, the knowledge of one industry might be applied to similar industries, upstream and downstream, and successful experience and modes could be duplicated, enabling Ace to expand its breadth in the future. Ren felt that, given the capabilities and resources Ace possessed, this path had a greater chance of success.

However, Zhang opposed this path and pointed out the risk of limiting development to specific industries. He felt that Ace was not an industrial expert and was unable to predict the potential of various industries. Improper selection of industries would hinder Ace’s growth, especially if the company became exclusively specialized in those industries. Moreover, by focusing only on a few industries, Ace would lose the opportunity to become the mainstream operating system of the whole IoT industry. If another IoT operating system did become the standard and formed the ecosystem, Ace would have little hope of replacing it, and the company’s growth potential would therefore be limited. For instance, Android and iOS had conquered the smartphone market and were unlikely to be replaced by other operating systems.

Which path to choose?

Jin felt torn between the two growth options. He preferred Zhang’s idea of extending breadth, because for any operating system, as the scale of users the OS could accommodate broadened, the chances for the OS to sweep out competitors and conquer the market increased. However, as the CMO, Zhang also clearly understood the company’s limitations. They had only one sales manager and three salespeople and could therefore not implement a large-scale promotion. Recruiting and developing a marketing team needed more resources than the company could afford, and the limited funds could never meet the cost of large-scale promotion.

Further, because Ace was just a start-up and had not yet developed a reputation, it would be difficult to gain the end-customers’ trust. Most Chinese SMEs did not find it worth the risk of applying a new system from an unknown start-up if their factories were working well. Ace planned to acquire 20 industrial customers every month during the current year, but they had just 20 customers in total due to difficulties with promotion.

Zhang’s path posed another, even larger, problem, and that was the immaturity of Ace PI. The company had invested 60 per cent of its budget in developing Ace PI, but success was unpredictable. The responses from current customers were not positive. The large-scale promotion would be in vain if the product was not ready.

Jin had to admit that Ren’s path of focusing on a few industrial scenarios was more rational for their current situation. Providing IoT solutions to industrial customers had generated stable cash flow for Ace, which could at least support its day-to-day operations. Ren’s path was also supported by the investors. However, when Jin joined Ace, he had dreamed of making Ace OS the universal operating system of the IoT industry. He still believed that the possibility existed to change the whole IoT industry and that Ace had the potential to do so. But Ren’s path was far from this dream, and Ace might lose the opportunity to be a revolutionary force if another operating system could seize the initiative. Compared with the expectations for Ace, the reality was disappointing.

Jin understood both Zhang and Ren. Zhang was the CTO; he thought from the perspective of a technology expert, and he was enthusiastic about games, in which he could gain infinite resources to do whatever he wanted. He applied the same logic to the path of extending broadly, regardless of cost. Zhang had great ambition, but he was somewhat idealistic.

Ren, on the other hand, preferred to accumulate resources and then decide what those resources could do. As the CEO, who had generated the original idea and took 60 per cent of the co-founders’ shares, Ren naturally wanted the enterprise to survive, so he preferred a safer path of pursuing depth based on the company’s resources, even though he might agree that Zhang’s path could have greater potential. Ren had not set clear long-term goals for Ace.

The dispute between the CEO and the CTO worried Jin and the employees. The two paths needed different product mixes, human resources, and marketing strategies. They needed a clear plan to guide organizational growth and resource allocation. At this crucial stage of scaling up, which path should they choose?

Exhibit 1: The potential economic impact per year of IOT applications in nine settings in 2025 (US$ billion)

|  |  |  |
| --- | --- | --- |
| **Setting** | **Function** | **Potential Economic Impact** |
| Home | Chore automation and security | $200–$350 |
| Office | Security and energy | $70–$150 |
| Factory | Operations and equipment optimization | $1,200–$3,700 |
| Retail | Automated checkout | $410–$1,200 |
| Worksites | Operations optimization, health and safety | $160–$930 |
| Human | Health and fitness | $170–$1,600 |
| Outside | Logistics and navigation | $560–$850 |
| Cities | Public health and transportation | $930–$1,700 |
| Vehicles | Autonomous vehicles and condition-based maintenance | $210–$740 |
|  | **Total** | $3,900–$11,100 |

Source: James Manyika, Michael Chui, Peter Bisson, Jonathan Woetzel, Richard Dobbs, Jacques Bughin, and Dan Aharon, *The Internet of Things: Mapping the Value beyond the Hype* (McKinsey & Company, 2015), accessed February 1, 2018, www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world.

Exhibit 2: Trend in IoT funding

Notes: F = forecasted, based on first quarter results.

Source: Tang Junze, “The Future Comes to You: A Research Report on the IoT Industry [in Chinese],” 36Kr, July 2017, accessed February 20, 2018, www.199it.com/archives/624850.html.

Exhibit 3: Five enablers for maximum IoT impact

|  |  |
| --- | --- |
| Software and hardware technology | * Low-power, inexpensive sensors and computers * Ubiquitous connectivity; low-cost mesh connectivity * Additional capacity and bandwidth in the cloud * Confidence in security across entire IoT ecosystem |
| Interoperability | * Standardization in technology stack and ability to integrate across technology vendors * Standard protocols for sharing between IoT systems * Standard access to external data sources |
| Intellectual property, security, privacy, and confidentiality | * Establishment of trust with consumers for sharing data * Collaboration across companies and industry verticals * Horizontal data aggregators * Data commerce platforms |
| Business organization and culture | * Industry structure: e.g., organized labour co-operation, third-party servicing * Hardware-focused companies developing core competency in software * Companies committing to up-front investment based on clear business cases |
| Public policy | * Regulation for autonomous control of vehicles and other machinery * Government and payer subsidy of health-care IoT * Agreements on fair practices for data sharing and use |

Source: James Manyika, Michael Chui, Peter Bisson, Jonathan Woetzel, Richard Dobbs, Jacques Bughin, and Dan Aharon, *The Internet of Things: Mapping the Value beyond the Hype* (McKinsey & Company, 2015), accessed February 1, 2018, www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world.

Exhibit 4: Four Layers of the IoT industry

|  |  |
| --- | --- |
| Application layer | * Business-level application: Smart factory, smart agriculture and forestry, equipment detection, road detection, public service, logistics monitoring * Consumer-level application: Wearable device, smart travel, smart home, smart parking, consumer electronics |
| Platform layer | * Cloud service and aggregate date processing based on cloud computing * Device management platform, access management platform, application development platform, business analysis platform |
| Network layer | * Near field communication such as Bluetooth. * Long distance cellular communication such as 2G, 3G, and 4G networks. * Long distance non-cellular communication such as WiFi. |
| Sensing layer | * MEMS (micro-electro-mechanical systems) sensor * Actuators * Communication module * MCU (micro control unit) |

Source: Tang Junze, “The Future Comes to You: A Research Report on the IoT Industry [in Chinese],” 36Kr, July 2017, accessed February 20, 2018, www.199it.com/archives/624850.html.

Exhibit 5: Ace Company, Financial Overview (¥ million)

Note: ¥ = CNY = Chinese yuan renminbi; Q = quarter.

Source: Provided by Ace Company.

1. ¥ = CNY = Chinese yuan renminbi; US$1 = average of ¥6.65968 in August 2017. [↑](#footnote-ref-1)
2. James Manyika, Michael Chui, Peter Bisson, Jonathan Woetzel, Richard Dobbs, Jacques Bughin, and Dan Aharon, *The Internet of Things: Mapping the Value beyond the Hype* (McKinsey & Company, 2015), 1, accessed February 1, 2018, www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world. [↑](#footnote-ref-2)
3. Gartner Inc., “Gartner Says 8.4 Billion Connected ‘Things’ Will Be in Use in 2017, Up 31 Percent from 2016,” press release, Gartner, February 7, 2017, accessed March 1, 2018, www.gartner.com/en/newsroom/press-releases/2017-02-07-gartner-says-8-billion-connected-things-will-be-in-use-in-2017-up-31-percent-from-2016. [↑](#footnote-ref-3)
4. All dollar amounts are in USD unless otherwise stated. [↑](#footnote-ref-4)
5. Manyika, Chui, Bisson, Woetzel, Dobbs, Bughin, and Aharon, op. cit. [↑](#footnote-ref-5)
6. Tang Junze, “The Future Comes to You: A Research Report on the IoT Industry [in Chinese],” 36Kr, July 2017, accessed February 20, 2018, www.199it.com/archives/624850.html. [↑](#footnote-ref-6)
7. Manyika, Chui, Bisson, Woetzel, Dobbs, Bughin, and Aharon, op. cit. [↑](#footnote-ref-7)
8. Junze, op. cit. [↑](#footnote-ref-8)
9. Ibid. [↑](#footnote-ref-9)
10. Jian Zhang, “Policies Related to IoT from 2009 to 2019” [in Chinese], Sohu, June 17, 2017, accessed February 12, 2018, www.sohu.com/a/149762449\_654086. [↑](#footnote-ref-10)
11. An embedded system was an application-specific, electronic sub-system with a specific function within a larger electronic system that served a more general purpose. Embedded systems were used in many electronic devices such as phones and vehicles but not in personal computers. The embedded system consisted of software and hardware such as an embedded microprocessor unit, hardware peripheral, an embedded operating system, and a user application. (Patel Nareshkumar Babulal and Anand Pravinbhai, “Embedded System Development Trends,” *9th ISTE State Level Annual Convention & AICTE Sponsored Nation Seminar on Restructuring of Technical Education to Meet the Global Industrial Needs*, November 17–18, 2006.) [↑](#footnote-ref-11)
12. Manyika, Chui, Bisson, Woetzel, Dobbs, Bughin, and Aharon, op. cit. [↑](#footnote-ref-12)
13. “Detailed Explanation of the Communication Protocols of IoT and Suggestions for Options [in Chinese],” Electronic Enthusiasts, May 23, 2015, accessed February 25, 2018, www.elecfans.com/iot/419545\_a.html. [↑](#footnote-ref-13)
14. Manyika, Chui, Bisson, Woetzel, Dobbs, Bughin, and Aharon, op. cit. [↑](#footnote-ref-14)
15. Peter Hoddie (founder, Kinoma–Marvell Semiconductor), “Programming Constrained IoT Devices,” interview by Bruce Sinclair, episode 39, IoT-Inc., video, 16:45, n.d., accessed March 26, 2019, www.iot-inc.com/programming-constrained-iot-devices-video. [↑](#footnote-ref-15)
16. World Peace Industrial Group was the largest electronic chip and component distributors in China. [↑](#footnote-ref-16)