Dell: Roadmap of a Digital Supply Chain Transformation

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Dell Technologies Inc. was founded in 1984 in Austin, Texas, and became a global company that designed, developed, and manufactured personal computers and a variety of computer-related products. In 2016, it merged with EMC Corporation to create the largest privately-controlled technology company with the most comprehensive end-to-end solutions portfolio in the industry. In March 2018, the company formed an internal strategic group named Dell Global Operations and tasked its senior vice-president of strategy with planning the digital transformation of the company's supply chain. in 2018, the Dell Global Operations group had to consider the intrinsic challenges of a giant and diverse enterprise. How would the company ensure that key actors were aligned with its digital vision? Which levers were needed to establish a digital vision that matched business strategy and priorities with supply chain operations? How could an actionable roadmap be developed to achieve the digital transformation of such a complex supply chain? What actions or goals should be prioritized?

Learning Objectives:

This case is suitable for graduate- and executive-level courses on strategy, operations, supply chain management, or digital transformation. The case illustrates the process that allows a company to successfully implement a digital transformation strategy in its supply chain. It provides a powerful illustration of Dell Technologies Inc.'s strategic decisions and how the company influenced different steps in its digital transformation. Ideally, students should have had some exposure to formal supply chain management and processes before discussing this case.

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DELL: ROADMAP OF A DIGITAL SUPPLY CHAIN TRANSFORMATION

Dr. Inma Borrella, Dr. María Jesús Sáenz, and Dr. Elena Revilla 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.

> We have been transforming Dell's business and the computer industry for decades. The challenges we are facing today should drive a transition towards a value- and data-driven supply chain. We have to define what supply chain capabilities can help Dell better respond to our ever-changing customer requirements.
>
> Kevin Brown, chief supply chain officer of Dell Global Operations

In March 2018, during a leadership meeting in the Austin, Texas, headquarters of Dell Technologies Inc. (Dell), Andrea Smith was tasked with a new challenge of significant proportions. As the senior vice-president of strategy for Dell's Global Operations (Dell GO), Smith was asked to propose a new plan and path forward to realize the digital transformation of Dell's supply chain. Dell had not yet managed to digitally consolidate its supply chain systems. In the past, a variety of digital projects had been explored and used across Dell's supply chain, and several digital systems were already in place. But these systems were disparate and not well integrated. Employees relied heavily on Microsoft Excel for data analytics and data sharing, and there was a lack of coordination in the digital realm. A lengthy process would be required to achieve the new vision of a fully integrated digital supply chain. An organization-wide framework for digitalization was needed.

Before the leadership meeting, Smith's team had been working tirelessly to create a strategy for Dell's digital supply chain transformation. After the strategy was defined, it was time to start implementing it. However, the team had to determine where to start. The landscape for opportunities was vast, but there were considerable challenges and investments associated with each potential strategy. Smith wondered how to begin and what parameters to use for the next steps. He also wondered what initiatives should be implemented first and how to choose them.

DELL: THE DIFFERENTIATED SUPPLY CHAIN STORY

Dell was founded by Michael Dell in 1984 as PC's Limited (soon renamed Dell Computer Corporation and later Dell Inc.), with a groundbreaking vision of how personal computers should be designed, manufactured, and sold. At the time, most of Dell's competitors supplied pre-built personal computers based on orders from distributors, resellers, or retailers. Dell, however, sold fully customized computers directly to its

customers. Dell could create a fully customized computer in only thirty-six hours and have it delivered within two or three days of the date the order was placed. By means of this innovative business model, the company quickly grew and expanded into international markets to become a multinational technology company with a comprehensive portfolio of technology hardware, software, and services. Over the following three decades, market changes and new competitive forces pushed Dell to restructure its supply chain to remain competitive.

Outsourcing Manufacturing

In 2008, Dell decided to outsource much of its manufacturing and partner with original design manufacturers in Asia. The move allowed Dell to grow from a small Texas company that customized, built, and shipped its customer orders from a couple of factories into a network of approximately 40 owned and contracted factories.

New Transportation Modes

With a more complex manufacturing network, shipping choices also expanded. Dell implemented a fast logistics approach, chartering planes to deliver its products. However, high per-unit costs forced the company to introduce cheaper alternatives, using boats across the ocean and trains from Asia to Europe.

Introducing Built-to-Stock

Eventually, the benefits of personal computer customization were outweighed by its drawbacks. By 2012, computing power had evolved so much that the average consumer no longer cared about a high level of customization. Dell decided to simplify its personal computer line by introducing a built-to-stock model, and to offer a catalogue of built-to-order products for larger customers. Moving to a stocking model required managing an inventory of finished products, something the company had never done before, with implications for Dell's information technology systems.

Mergers and Acquisitions

In 2016, Dell merged with EMC Corporation to become Dell Technologies Inc. The merger with EMC Corporation contributed a large new market segment to Dell's portfolio: corporate storage and virtualization. Two completely different corporate cultures and supply chains had to be integrated, creating an opportunity to redefine systems and approaches and to accelerate the path to forming a digital supply chain.

New Competitive Challenges

In 2017, the business outlook was changing rapidly. E-commerce was growing and customers were demanding quicker, more reliable, and cheaper (or free) delivery. Data had become a key asset for any business, and competitive advantage increasingly relied on the use of advanced analytics to generate insights from this data. Automation technologies and artificial intelligence became investment priorities for large companies. Simultaneously, new technologies such as Internet of Things, radio-frequency identification, and edge-computing promised to increase both world connectivity and connectivity in supply chains.

The company created an internal group called Dell GO to manage all manufacturing, procurement, and supply chain activities worldwide. By 2017, Dell GO was managing 392,000 stock-keeping units manufactured in twenty-five global locations that handled 220,000 orders per day (see Exhibits 1, 2, and 3).

STARTING THE DIGITAL TRANSFORMATION JOURNEY

The new competitive challenges became evident to Smith when he proposed making digital transformation one of the strategic pillars of the organization. Smith raised the new concept during a board meeting in Austin, Texas, in January 2017. Dell GO needed a paradigm shift. The group had to find a new way to create value by leveraging digital technologies and data. After Dell's top leadership team endorsed Smith's proposal, it became the official starting point for Dell's digital supply chain transformation journey.

Exploring Digital Technologies

Dell GO's strategy team started by examining the digital landscape. Over a period of six months, the team reviewed more than sixty academic publications, attended external forums and conferences, and held approximately 100 interviews with experts from industry and academia. Dell GO concluded that data was becoming ubiquitous. The ability to interpret and compute data was continuously improving. The team also found that innovative and rapidly evolving technologies such as Internet of Things and robotic process automation held momentous potential for supply chains. The main outcome of the six-month exploratory work was the identification of eighty technologies with a potential impact on supply chain operations (see Exhibit 4).

During the summer of 2017, Dell GO's strategy team organized multiple workshops with subject matter experts in their various functional areas. In these workshops, participants brainstormed how digital technologies could be applied to their specific activities and operations and assessed which implementations might have the greatest positive impact. For example, in the manufacturing area, two technologies were identified as relevant and readily applicable in a factory setting: autonomous guided vehicles and machine learning. Implementing autonomous guided vehicles could save workers the time required to go from one place to another. Machine learning algorithms could be applied to create a smarter system that reduced dwell time. Machine learning was deemed to have greater potential to improve the efficiency of factory operations than autonomous vehicles.

By fall 2017, Dell GO's strategy team was pondering an exceedingly long list of 121 use cases that had been identified during the workshops. The team determined that the spectrum of potential technological avenues was too broad and disparate. A framework within which to analyze the technologies and their potential impacts was needed.

A Framework Based on Digital Capabilities

The strategy team concluded that three digital capabilities were ubiquitous across digital transformation projects: transparency, predictive analytics, and automation (see Exhibit 5). These digital capabilities enabled companies to achieve real transformation and become more competitive.

Transparency referred to the capacity to bring timely data from distant parts of the supply chain to provide end-to-end visibility into events, shipments, inventory, and other areas, allowing a "single source of truth." Leveraging data to make informed decisions around order fulfillment, forecasting, logistics, and supplier management created visibility into the progress of a customer's order. If something went wrong,

transparency would enable the company to fix it before the customer was even aware that a problem existed. Transparency would also provide the company a view into facts that, in turn, would create visibility and openness with customers and supply chain partners. Openness would enable collaboration to proactively mitigate problems, avoid disappointing customers, and facilitate root-cause analysis.

Predictive analytics referred to the capacity to use advanced analytical techniques to take advantage of big data, providing deeper insights into the overall performance of supply chains. Advanced analytics could be descriptive, showing the historical fill-rate, on-time-delivery rate, and stock-outs, among other details. Advanced analytics also had a predictive character that could estimate future spare part volumes and lead times, for example, or forecast an impending product failure in the field. In some cases, analytics required sophisticated algorithms such as machine learning and artificial intelligence to diagnose product failure root causes, based on the non-technical descriptions of the symptoms that a customer identified.

Automation referred to the use of hardware and software robots to automate processes, consequently improving cost, quality, and time to market. Software robots could mimic any repetitive action that humans performed on computers, such as reading the screen, interpreting data, making simple decisions, or communicating with customers. Hardware robots offered new possibilities for factories and warehouses to increase efficiency, improve safety, lower labour costs, and reduce a company's cost of operation.

Together, these three digital capabilities provided a framework for organizing digital technologies and use cases into areas and for structuring Dell's strategic approach (see Exhibit 6). Smith saw transparency, predictive analytics, and automation as the three pillars of a digital supply chain:

> If you just looked at the digital landscape as a forest, it was hard to really make sense out of it. Giving it some structure by these three pillars, as kind of the foundation of what we were going to do, was very helpful. . . . When we started all this in 2017, initiatives around technology and digitalization were disparate and disconnected. What we provided was an opportunity to integrate all these ideas into a broader structure that looked holistically throughout the supply chain.

An Early Demonstrator

After the strategy team had been working on digital transformation for almost a year, pressure emerged to show some tangible progress in the digitalization of Dell's supply chain. Smith noted that "we felt very strongly that we needed to show progress, we needed to start to create and deliver value and build momentum, so that the digital transformation could start to fund itself."

Dell GO began the transformation by implementing robotic process automation. This new technology was easy to apply and quickly created value. It had huge potential for adoption across a variety of use cases and the potential for driving efficiency and cost savings through automation. For example, it could help automate processes related to data entry and reconciliation (e.g., automating parts receipt), data extraction and analysis (e.g., consolidating shipper data to resolve undeliverable packages), and customer inquiry management (e.g., automating the handling of customer delivery inquiries). The technology easily bolted onto any enterprise application. A dedicated team that combined internal talent and outside consultants was created to develop use cases for robotic process automation. The new technology helped to save 200,000 hours of manual work per year, reaping benefits very quickly and demonstrating the potential of digitalization.

FROM DIGITAL TECHNOLOGIES TO STAKEHOLDER EXPERIENCES

A year into the program, at the end of 2017, most of the work done in the digital transformation space had been focused on technology. However, the strategy team had come to the realization that there was a lot more to consider than just the implementation of discrete initiatives. As Smith explained, digitalization was an overarching transformation that required new data, new capabilities, and new ways of operating: "How do we think about this as a broader program using digitalization as the impetus for standardizing and modernizing our processes, driving collaboration and better decision-making, building new capabilities and human capital, and ultimately transforming ourselves?"

Digitalization needed to be linked to a value proposition. Smith concluded that this value proposition was to create impactful experiences for Dell customers and suppliers, and ultimately the company's workforce, saying, "Before, we had a solution [digital technologies] in search of a problem. Now, we have defined what really mattered to us, and the key question became, 'How are we going to transform the experience of our stakeholders through digitalization?' It sounds very intuitive, but it was absolutely an Aha! moment."

The digital transformation program transitioned from finding smart use cases for digital technologies to encompassing a much broader business transformation. Creating positive stakeholder experiences meant working on end-to-end system solutions that connected a series of technologies and supply chain processes to achieve the envisioned goal. Dell defined five stakeholder experiences: the first three focused on the customer, the fourth on suppliers, and the fifth on the workforce (see Exhibit 7).

These five stakeholder experiences became the core of Dell GO's digital supply chain strategy. Depicting a supply chain vision made digital transformation become more real for the Dell GO team by embodying tangible goals and a clear contribution for each function. However, along with excitement came fear and discomfort. The digital transformation could improve the business, but it could also radically change the workforce's responsibilities and allocation. There was also a certain skepticism. In the past, major technology projects had been started and then put on hold. This initiative was even greater in scope and complexity than those that had preceded it and been subsequently discontinued.

DATA AS A PREREQUISITE

Smith was satisfied with the definition of the five stakeholder experiences. He firmly believed that this vision could guide Dell GO's transformation and inspire its employees. But he was also aware that a key element was missing in the framework: the data layer. He used a water analogy to explain: "Digital transformation is the plumbing in your house, but without data you have got no water. It must be clean and flow all over the house."

A solid data foundation was a prerequisite for the digital transformation and for the realization of every stakeholder experience. But achieving strong data governance and reliable master data represented a significant challenge. In Dell's complex global supply chain, data was sourced from various platforms and from offline Excel tables. Often, data was updated manually using different formats. For example, Dell GO had six different systems in which supplier data was kept, which meant that the company had six different conceptualizations of any individual supplier.

A new work stream, comprising two data foundations—harmonize and visualize—was added to span the five stakeholder experiences (see Exhibit 8). The Dell GO team then created a dedicated internal group called "data analytics and automation" to lead this new work stream. This group consolidated all

investments on data made in previous years and brought together everyone who worked on data science across the supply chain. The idea was to break down silos and start driving real progress.

The data analytics and automation group focused on two key areas: data and applications. Data, which encompassed data management, data governance, and the canonical data model, ensured that the right frequency, latency, and granularity were present. Applications, which encompassed augmented data analytics, automation, and visualization, involved different supply chain functions and supported key metrics.

Changing the entrenched mindset about data was a real challenge. Data had to be understood as an immutable truth; competing versions of the truth across functions could not coexist. This change would take time, even with full support from the company's top management team. The data analytics and automation group was not a replacement for the company's information technology department. It was a group that encompassed multidisciplinary teams (e.g., software development, data management, supply chain expertise) and that rapidly devised solutions to supply chain challenges. After the group discovered a working solution, it would be transferred to the information technology department to be scaled and integrated.

With the five stakeholder experiences guiding the transformation, and with a data foundation enabling its progress, the Dell GO digital transformation was complete (see Exhibit 8).

HOW TO MAKE DIGITAL TRANSFORMATION A REALITY

By 2018, approximately 80 per cent of Dell GO's strategy team was dedicated to the digital transformation program. The team worked on developing a specific roadmap for each of the five stakeholder experiences, including mapping all processes related to each experience, diagnosing status and performance, identifying technology applications that might improve that experience, and redesigning the processes as needed. The team then connected all elements and drafted a roadmap to materialize the vision of each experience.

A major commitment was also required to work on the data layer, which comprised the two data foundations: harmonize and visualize. The main objective of the data foundations was to centralize the master data management operation and to build a data system that could be efficiently and effectively sustained over time. The manager of each stakeholder experience would communicate the data requirements to the data analytics and automation team. Instead of directly providing this data, the team would pull the requested information into a common data lake and translate it into a standardized format, before feeding it back. The data system started with a landing zone, where data from different sources was collected. This data was then transformed using the canonical data model, and finally shared with the appropriate application via the consumption zone (see Exhibit 9).

Dell's chief supply chain officer emphasized that the company initially had to prioritize and focus on just one or two of the five stakeholder experiences. It was virtually impossible to tackle all five at once due to the complexity involved and use of available resources. The chief supply chain officer pushed everyone in the leadership group to think about what mattered the most to Dell GO and where the biggest disruption and impact to the business could be found. After many discussions, it was determined priority should be given to the first two stakeholder experiences—Make the right commitments and Ensure parts supply—both of which were focused on the customer.

Stakeholder Experience 1: Make the Right Commitments

The first stakeholder experience aimed to provide more reliable commitments to the customer by improving supply chain planning ability and supply chain efficiency.

Dell GO had been experiencing some challenges in the planning area of the supply chain. Dissimilar planning was a common problem. Dell GO's highly segmented supply chain had evolved organically over time. Different segments, which were largely operating independently, generated different planning solutions. These planning silos encapsulated information by separate entities. Combined with a lack of visibility across the different segments, both internally and upstream in the supply chain, the silos led to inefficiency and disruption in forecasting, inventory management, and manufacturing processes. The intrinsically low level of visibility led to hedging within planning efforts. Delayed feedback loops introduced latency in forecast corrections. All of these factors resulted in sub-optimal forecast accuracy and disruption across the entire supply chain.

The complex planning process involved many different functions. Therefore, planning protocols had to be well established. A supportive platform combining end-to-end data availability, quality, and compatibility with the most appropriate digital tools was a key factor to improve planning. It was also determined that processes and digital tools should be standardized for everyone involved in the planning realm—in every line of business, in every region, in every country. Smith explained the efficiency of a truly digital process:

> The planning team was just digitizing how we operate today. They were taking current processes and moving them into digital platforms, but kept operating in exactly the same way as when using analogical tools. We took a step back and said, "Okay, if we're going to truly take advantage of automation, analytics and machine learning, how should the process be?" We have decided to start with a clean slate, and completely redesign the process to take complete advantage of digitalization, together with a comprehensive and simple set of KPIs [key performance indicators].

Stakeholder Experience 2: Ensure Parts Supply

The second stakeholder experience aimed to enhance demand–supply balance visibility. The idea was to make sure that Dell had enough parts, at the right place, at the right time, to avoid any shortage in the supply chain.

Managing parts supply was a highly manual and cumbersome effort for Dell GO. It involved correcting data inaccuracy, fragmented processes, and communication delays. As noted earlier, data was sourced from various applications and offline Excel tables. This resulted in delays in data availability and in time lost by reconciling various sources to create a single source of truth. Analyses were performed in a silos format and tended to vary depending on the particular team's analytical appetite. Decisions on appropriate inventory levels were based on intuition and past experiences, rather than on science or concrete historical data.

This second stakeholder experience was expected to incorporate an improved customer experience by ensuring continuity of supply and by developing a more responsive supply chain. Achieving this vision required more advanced inventory management processes, supported by analytics for optimizing the right number of available parts, and working closely with suppliers to obtain information about data availability. This was critical to ensure data quality and compatibility, to facilitate the digital thread for all supply chain processes involved. Manufacturing processes also had to be aligned by improving efficiency, reducing holding costs, and decreasing response lead times.

Seamless communications about changing priorities and schedules were also deemed essential. The labour-intensive, ad-hoc methods used by Dell in the past (e.g., phone calls, email, Excel files, PowerPoint presentations) were to be avoided. New dashboards based on real-time data would more promptly resolve issues and drive decisions, such as in the case of inventory backlogs. Improvements in communications would facilitate fluid replies from key stakeholders in different time zones. Smith explained what had to occur: "The culture at Dell GO empowers everyone to go solve whatever problems they need to solve, using whatever tools they need to use. The integration or implications of it would be figured out later. This cultural dynamic must change for supply chain to be truly transparent and connected across functions and regions."

THE ROAD AHEAD

Dell GO's journey discovered that a generic "one-size-fits-all" approach would not work in digital transformation. Opportunities in any digitalization journey were vast, but it was difficult to decide what to prioritize and where to start. Implementing digital technologies could also vary—even within the same company—due to the variation of context, digital maturity, personnel, and processes from one implementation to another.

Dell GO's digital transformation journey was guided by clear value propositions, as depicted by the five stakeholder experiences. But these experiences eventually had to translate into a reality, by working with three transformational levers: actors, processes, and technologies. The right actors had to be selected as supply chain partners and stakeholders for their digital ecosystem. Employee skill sets had to be updated and new ways to create value for the company had to be found. Some worker responsibilities would become obsolete with digitalization. Supply chain processes had to be redesigned to get the most benefit from digitalization opportunities. Finally, technology tools had to be wisely chosen to respond to the needs of both processes and people to support digital capabilities and create business value.

Smith wondered what should be prioritized. What major challenges would his team face in the goal of making digital transformation a reality?

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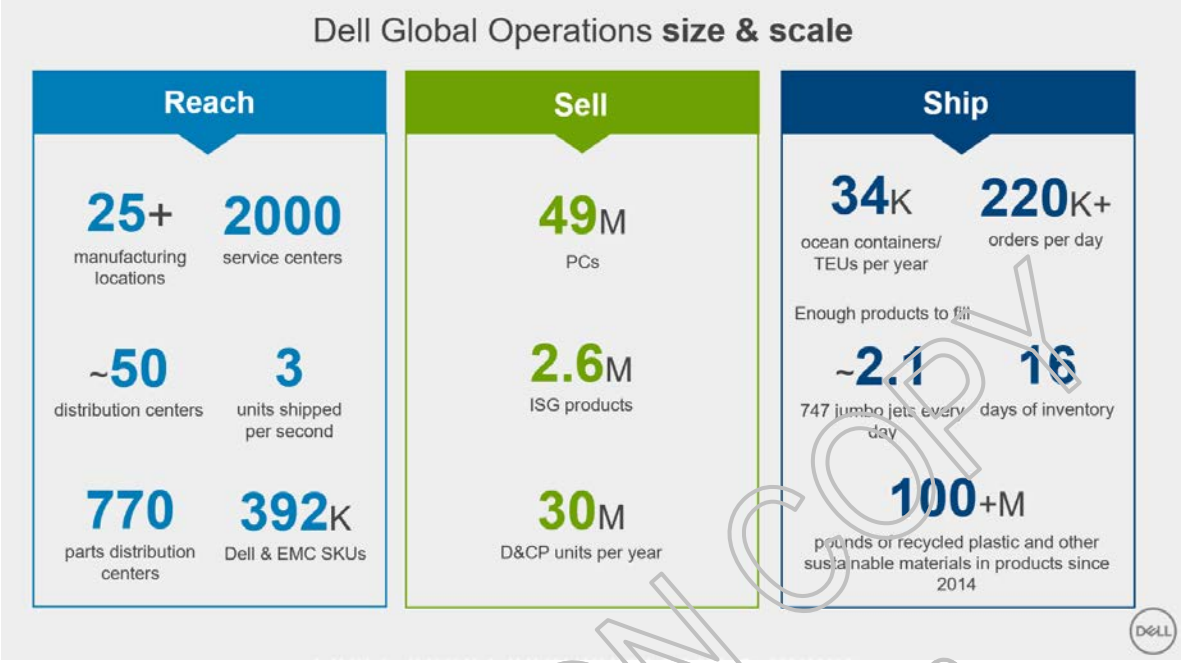
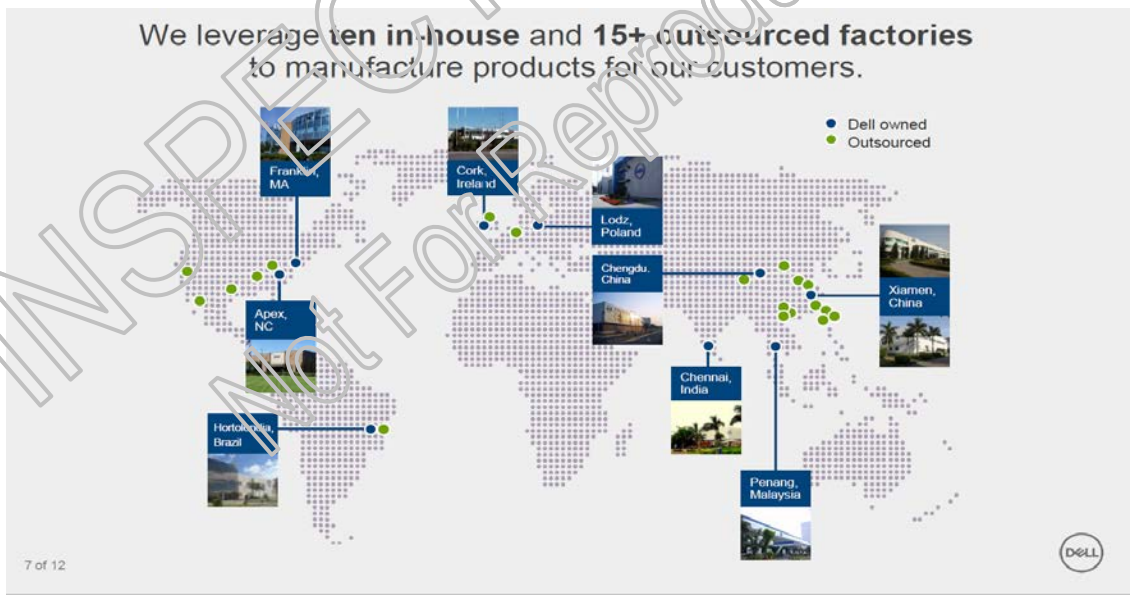
Dr. Elena Revilla, IE Business School.

EXHIBIT 1: DELL GLOBAL OPERATIONS SIZE AND SCALE



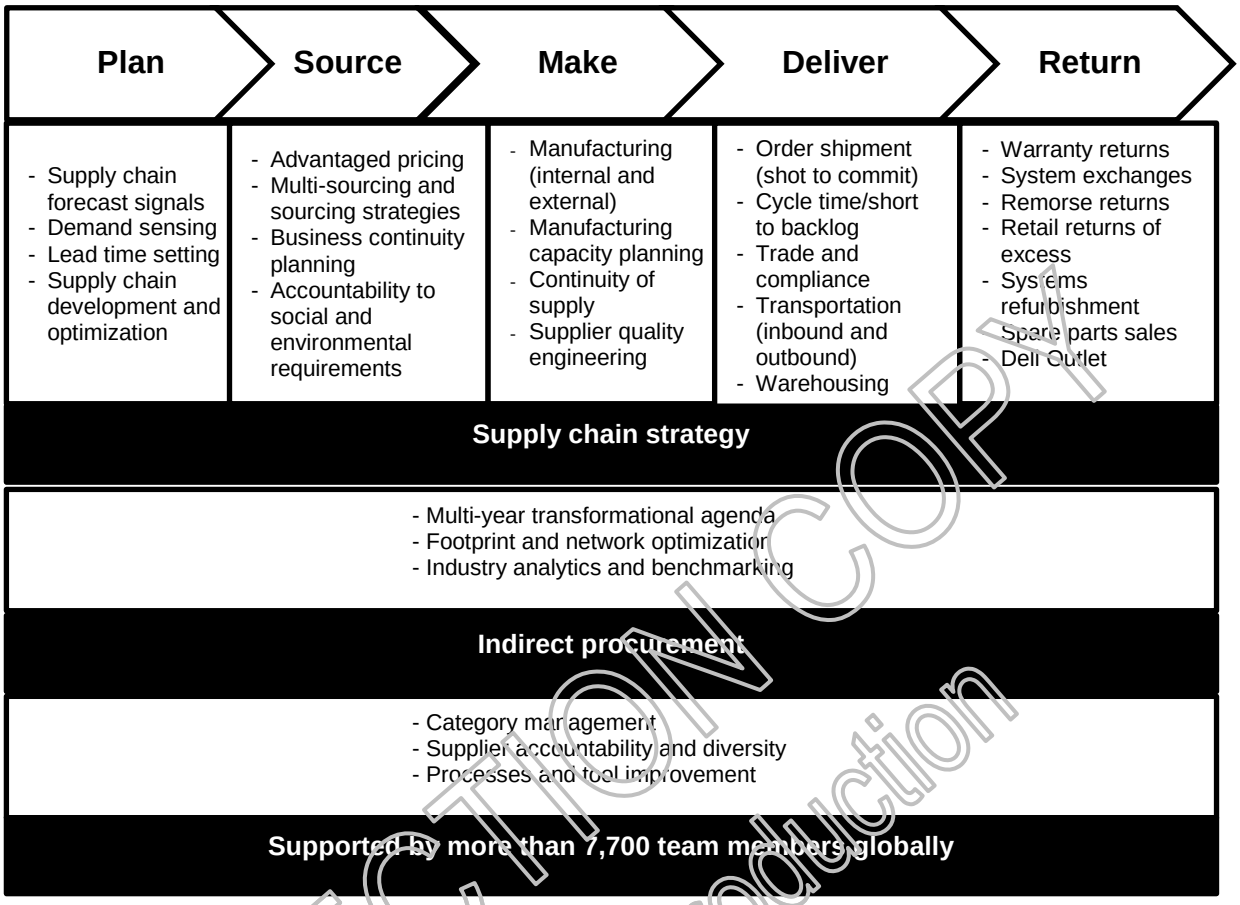
Note: SKU = stock-keeping unit; + = over; ~ = approximately; K = thousand; M = million
Source: Company files.

EXHIBIT 2: DELL GLOBAL OPERATIONS FOOTPRINT



Source: Company files.

EXHIBIT 3: SUPPLY CHAIN FUNCTIONS



Source: Company files.

EXHIBIT 4: SCAN OF DIGITAL LANDSCAPE

Exploration *Dell Global Operations team conducted in-depth external research and internal discussions*	> 60 academic publications reviewed > 20 external forums attended > 100 functional SMEs interviewed from 11 functions ~ 90 focus groups conducted
Outcome	80 technologies identified

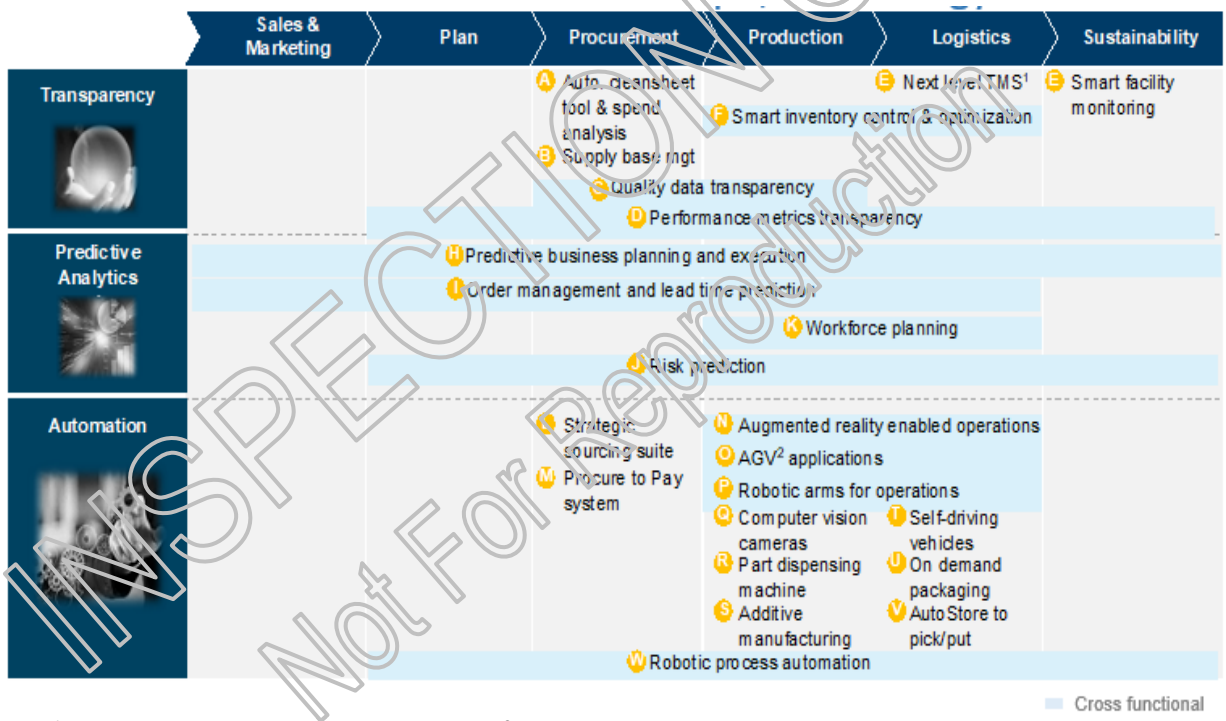
Note: SME = subject matter expert; > = more than; ~ = approximately
Source: Company files.

EXHIBIT 5: DIGITAL CAPABILITIES

Transparency	Predictive Analytics	Automation
End-to-end, real-time visibility for better and faster decision making - *Logistics mode compliance* - *Automated executive dashboards and root-causing* - *Real-time transportation analytics and reporting*	**Advanced analytical techniques taking advantage of big data** - *Demand planning and forecast accuracy* - *Disruptive order identification* - *Manufacturing process optimization*	**Physical and software automation to drive performance** - *Robotic process automation* - *Factory robotics and augmented reality with wearables* - *Virtual reality operator training*

Source: Company files.

EXHIBIT 6: FRAMEWORK BASED ON DIGITAL CAPABILITIES



Note: [1]TMS = transportation management system; [2]AGV = automated guided vehicle
Source: Company files.

EXHIBIT 7: DESCRIPTION OF THE FIVE STAKEHOLDER EXPERIENCES

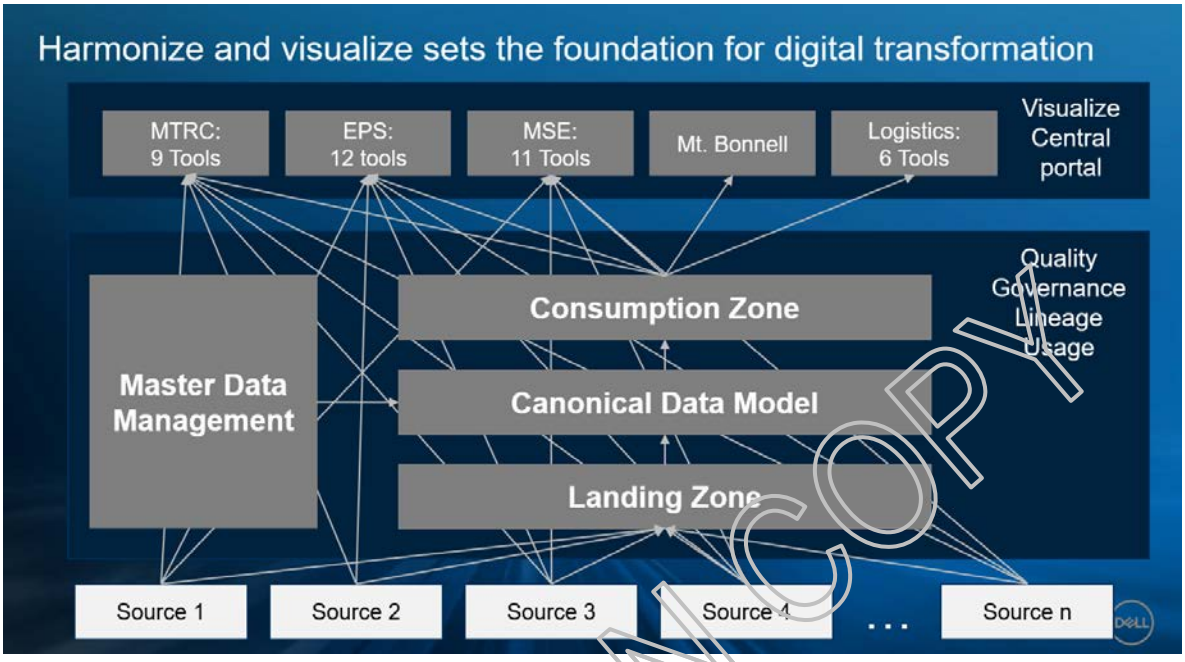
Stakeholder Experience	Key Elements of the Experience
1. Make the right commitments	Sell what is available or offer supportable alternatives; promise it when it can be delivered with certainty.
2. Ensure parts supply	Have accurate CFG level forecasts, supplier insights, site level inventory/demand to predict shortages and take timely, optimized corrective actions.
3. Keep customer informed	Provide real-time order visibility; identify issues early, provide options, and resolve collaboratively.
4. Manage supplier ecosystem	Provide a more automated, frictionless management experience for suppliers, procurement stakeholders, and executives.
5. Drive operational efficiency	Improve financial and operational performance by leveraging digital tools, processes, and capabilities (e.g., advanced analytics, near-real time data, and automation).

Note: CFG = components of finished goods
Source: Company files.

EXHIBIT 8: FIVE STAKEHOLDER EXPERIENCES AND TWO DATA FOUNDATIONS

Source: Company files.

EXHIBIT 9: HARMONIZE AND VISUALIZE



Note: MTRC = Make the right commitments; EPS = Ensure parts supply; MSE = Manage supplier ecosystem
Source: Company files.