May 10, 2017

REPORT: TRENDS

Nine Starting Points for Digital Transformation in Manufacturing

Digital Trends Signal Manufacturing Renaissance Ahead

R "Ray" Wang

Founder and Principal Analyst

Copy Editor: Maria Shao

Layout Editor: Aubrey Coggins

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Western economies have faced an onslaught of negative developments in their domestic manufacturing bases over the past 40 years. With the rise of Industry 4.0, the current trend of automation and data exchange in manufacturing technologies, manufacturers now have new opportunities to undergo digital transformation. Constellation finds that digital transformation in manufacturing will not only jump start growth, but will also create the environment for a manufacturing renaissance. Through in-depth study of successful digital transformation projects, Constellation identified nine entry points for manufacturers to begin their digital transformation journeys. Research also revealed six organizational features present in all successful digital transformations.

Form (i.e. technologies) must follow function (i.e. business models) in order to create success. Leaders should focus on creating new business models first and then enabling success with supportive disruptive technologies. Success requires organizations to take a multi-modal approach that enables a group's culture and governance to drive concept to commercialization of new products and services.

This report explains the nine entry points for digital transformation in manufacturing and highlights the six features of organizations that succeed in digital transformation. It concludes with five recommendations to ensure digital transformation success in manufacturing.

Business Themes


Data to Decisions


Next-Generation Customer Experience


Matrix Commerce


Technology Optimization

constellation RESEARCH

WESTERN MANUFACTURERS HAVE FACED A NEGATIVE ONSLAUGHT FOR FOUR DECADES

Every industry faces a significant transformation of business models through disruptive technologies. However, Western manufacturers have endured the brunt of the fallout from not only globalization and the short-term mentality of public equity markets, but also from over-regulation, labor unrest, and under-investment. Add an aging workforce to the list and the overall manufacturing base in Western economies has shrunk (see Figure 1). For example, the United Kingdom manufacturing base has contracted by two-thirds since 1980. The result in almost every Western manufacturing economy is unemployment, trade deficits, social unrest, and strategic vulnerability.

Western manufacturers have endured the brunt of the fallout for the past 40 years.

A closer examination of the five factors shows that:

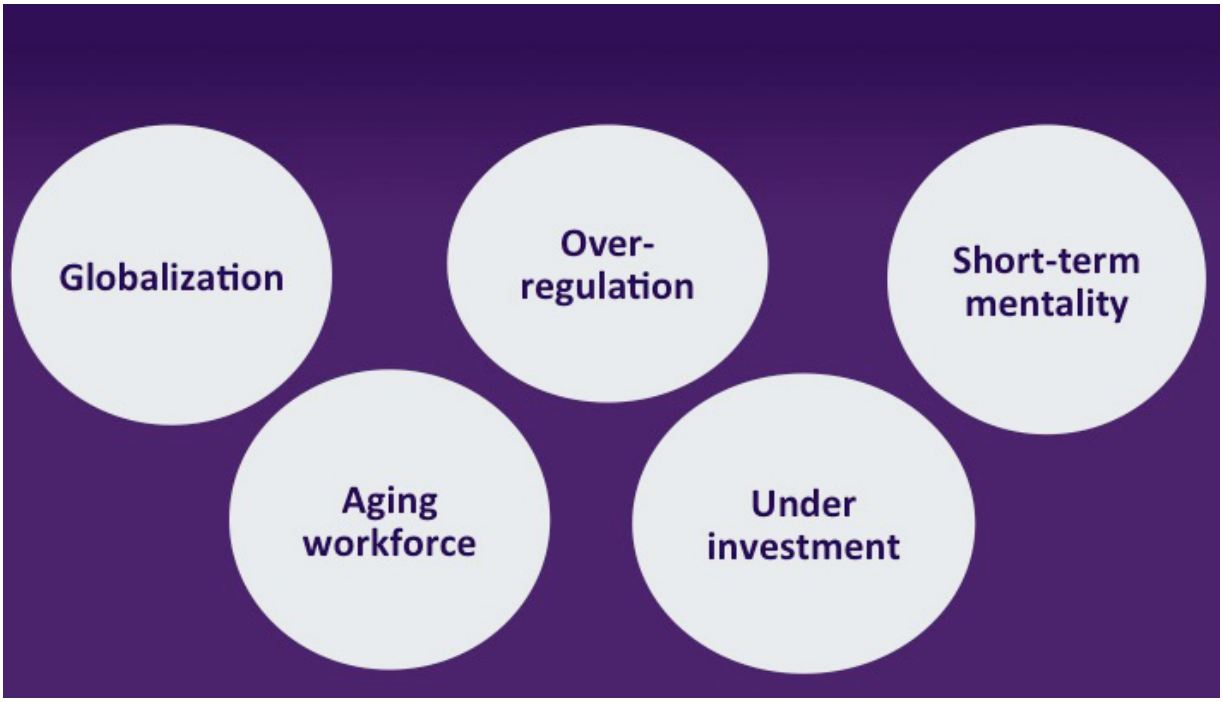
1. **Globalization benefits may no longer hold true.** The never-ending shift to low-cost manufacturing sites led to strategic advantages moving from Western economies to Eastern economies. That manufacturing migration started with moves to Japan, then Taiwan and South Korea, then Singapore, Malaysia, Mexico, and China. Today, every country remains vulnerable. For example, the growing costs of labor and intellectual property (IP) theft in China has led to manufacturing base shifts to Vietnam and Indonesia and, in some cases, a return back to domestic manufacturing in places such as the United Kingdom and the United States. While this global supply chain has benefited consumers with lower-cost goods, recent research studies show how the hidden costs of job loss, wage stagnation, and health impacts appear to outweigh

the benefits. Western economies have more incentive than ever to move to domestic production.

2. **Over-regulation has stifled the ability to invest and innovate.** The 40-year pendulum shift to greater environmental and societal concerns over unregulated capitalism has run its full cycle. Extreme regulation has led to increased energy costs, an inability to reinvest in modernization, and a shift away from domestic production. Labor rules have led to inflexible business models, a shift to automation, and moves to non-union environments. The overall societal upheaval from joblessness has led to a reexamination of industrial policy across Western democracies.

3. **Short-term mentality has led to profits at the expense of long-term mission.** The never-ending quest for quarterly profits at the expense of mid- to long-term growth rewarded many public company management teams with bonuses to make bad short-term decisions. With millions of

Figure 1. Five Factors Pressuring Western Manufacturers



Source: Constellation Research

dollars in income at stake for management teams, a plethora of poor decisions resulted in cost cutting to achieve bonuses. While there is always fat to cut, a majority of executive teams cut into the flesh and muscle, leaving their organizations in peril, with short-term benefits for shareholders and a few executives.

4. **Under-investment has left manufacturers less agile.** The focus on profit per sale without a sound long-term investment strategy led to cost cutting, senseless mergers, and deferred investment. Private equity firms, investment bankers, and corporate raiders flocked to weakened firms to unlock value by liquidating valuable long-term assets in equipment, IP, and real estate. The hollowing out of organizations such as Sunbeam and ITT resulted in bankruptcies and other disruptions.

5. **The aging workforce heightens the knowledge gap.** The aging workforce in Western economies and the extent of unemployment creates a knowledge transfer catastrophe. Why? The informal apprenticeship and informal, "tribal" knowledge passed on to each generation of workers have been broken. Every year that a country delays the ability to restart domestic production is another year when that knowledge and skill set undergoes a slow death and the costs grow to rebuild the skill sets in the work force.

JUMP START GROWTH WITH NINE ENTRY POINTS FOR DIGITAL TRANSFORMATION IN MANUFACTURING

Digital transformation calls for organizations to engage with stakeholders to transform business models through disruptive technologies. Manufacturers looking to jump start growth and overcome strategic pressures have turned to digital transformation as an ongoing program to transform their businesses. In Constellation's surveys, 61 percent of the Global 2000 manufacturers surveyed expected to benefit from digital transformation.

Digital transformation begins with design thinking, a methodology that unlocks solutions to questions that have not been asked before. Using empathy as the starting point, organizations put themselves in the shoes of their customers and stakeholders to rethink their business models. Design thinking can help manufacturers overhaul how they use technologies, redesign processes, and interact with customers and other stakeholders to create new business models.

Digital transformation calls for organizations to engage with stakeholders to transform business models through disruptive technologies.

Over the past seven years, Constellation has identified nine entry points for manufacturers to jump start growth with digital transformation (see Figure 2):

1. **Shift from product margins to services margins.** Manufacturers with low single-digit profit margins should shift from simply selling products to selling new offerings that bundle products and services to drive scalable growth and healthy margins. Examples of services that are scalable and drive growth include installation, field service, remote monitoring, and warranty management. Visible case studies, such as GE's and Phillip's transitions from product companies to services companies, provide evidence that legacy manufacturers can make the shift. Technologies used to enable the transition include artificial intelligence, augmented reality, Big Data, cloud, mobile, and Internet of Things (IoT).

2. **Develop post-sale business models.** As manufacturers transition to a post-sale economy, the product serves as the platform for new business models. As a result of the most recent CxO surveys, Constellation expects 78 percent of manufacturers to focus growth on post-sale business models by 2020. Organizations are moving from products to services, services to experiences, experiences to insights, insights to brand promises. Take the rise of Amazon's Echo and Echo Dot hands-free

voice-controlled devices. Amazon sells the product for a low entry price to enable mass adoption. While buyers purchase the product for a "cool" experience tool that drives conversations as a service, the long-term goal is for Amazon to capture insights in order to anticipate and sell more personalized services through the use of data. Amazon hopes to use insights to create new customer experiences that ultimately spark service offerings around new business models. The goal is using data and insights to deliver on Amazon's brand promise of one-click convenience. Technologies used in developing post-sales business models will include augmented reality, big data, blockchain, cloud, IoT, and mobile.

3. **Invest in direct-to-consumer.** Manufacturers traditionally work through distribution networks to gain access to markets. The system works if the distribution network delivers value-added capabilities and is responsive to the customer. But today's customers seek more responsiveness from brands

Figure 2. Nine Starting Points for Digital Transformation in Manufacturing

Source: Constellation Research

and manufacturers and the battle for the customer requires manufacturers to move closer to the customer. In fact, 57 percent of manufacturers have started direct-to-consumer programs. However, manufacturers must tread carefully to provide services such as warranty registration, over-the-air product updates, rapid recall, and personalization without creating channel conflict and network disruption. In some cases, manufacturers will own new product design, manufacturing, and distribution. Technologies employed for direct-to-consumer services include big data, blockchain, cloud, IoT, and mobile.

4. **Forecast supply and demand more precisely.** Using techniques such as mean absolute percent error (MAPE), mean percent error (MPE), root mean squared error (RMSE), tracking signals, and forecasting biases, organizations can improve their accuracy of supply chain and demand forecasts. Constellation believes that 60 percent of mission-critical data will reside outside of existing systems and be accessed, not owned. Manufacturers must prepare for a new set of supply and demand signals that affect forecasting techniques. Ability to assign lineage to data enables the aggregation and rollback of demand signals. Key disruptive technologies for more precisely forecasting supply and demand include artificial intelligence, augmented reality, automation and robotics, big data, blockchain, cloud, IoT, and mobile.

5. **Move back to domestic production.** A Boston Consulting Group study by Hal Sirkin and Michael Zinser demonstrated that not all Western manufacturing bases are non-competitive. According to the study, the lowest-cost manufacturing countries are Indonesia, India, Mexico and Thailand. China ranks fifth, Taiwan comes in at sixth, with the U.S. at seventh. Rising Chinese labor costs, decreasing U.S. energy costs, and improving productivity drive manufacturers to reconsider the U.S. The study showed that after complex supply chain costs, IP piracy, and quality issues, every dollar required to manufacture in the U.S. is equivalent to 96 cents in China – a relatively small difference. Taking

the study's findings into consideration, Constellation believes the U.S. is ripe for a manufacturing renaissance. Once the U.S. proves it is profitable to manufacture domestically, expect other previously high-cost countries to follow suit with similar policies. Consequently if manufacturers in previously low-cost countries such as Brazil, China, Czech Republic, Poland, and Russia must enact policies to offset wage increases, improve productivity, and compensate for higher energy costs. Constellation believes that additive manufacturing (such as 3-D printing), artificial intelligence, automation and robotics, big data, blockchain, cloud, IoT, and mobile play key roles in driving a return to domestic manufacturing.

6. **Maximize equipment value.** Organizations have used a number of techniques to optimize usage of capital equipment. From predictive maintenance to remote field service, organizations can now identify gaps in uptime. For example, at GE's transmission grid operations, the company knows when a powerline will go down eight to 10 days before it happens. Using capacity planning, organizations can also determine threshold capacity requirements to manage peak and average demand for equipment. The result – less spending for greater return on assets plus more rentals and access of services and outcomes for peak demand. Expect disruptive technologies such as artificial intelligence, augmented reality, automation and robotics, big data, blockchain, cloud, IoT, and mobile to be significant in maximizing equipment value.

Expect disruptive technologies such as artificial intelligence, augmented reality, automation and robotics, big data, blockchain, cloud, IoT, and mobile to be significant in maximizing equipment value.

7. **Streamline order to cash.** Finance process transformation revolves around increasing cash flows. Start by doing a statistical analysis of customer segments and non-standard processes. Analysis often shows that non-standardized collections, dispute management, and accounts receivable

terms can lead to cash being stuck in limbo. Focus on reducing days sales outstanding (DSO), improving credit management, reducing write-offs in dispute management, and shortening billing cycles to provide opportunities to increase cash flow. Most early adopters apply technologies such as artificial intelligence, automation and robotics, Big Data, and cloud to achieve these gains in cash flows.

8. **Increase automation and robotics.** Constellation projects that over three million industrial robots will be in use by 2020. While the current number of robots per 10,000 manufacturing employees is highest in South Korea, Japan, and Germany, the U.S. and even China are catching up. Expect more collaborative robotics, improved gripping skills, higher quality vision, and finer motor skills to improve robotics and automation. The landmark Tesla electric car plant shows the promise of profitability in small-scale and highly automated manufacturing. Key benefits of greater automation are higher productivity and reduced workplace injuries. Recent Constellation surveys of early adopter clients show that 46 percent of respondents expect to use artificial intelligence or machine learning to drive automation. Technology drivers of success in robotics and automation will include artificial intelligence, augmented reality, big data, cloud, IoT, and mobile.

9. **Improve uptime and optimization.** While not as sexy an entry point as others, uptime and optimization efforts can be transformed with new technologies. Data can improve outcomes in predicting shift schedule optimization, improving production planning, optimizing line changes, reducing equipment failures, streamlining energy consumption, and maximizing maintenance schedules. As more data is collected, more opportunities emerge to align the data by business process, mine for business insights, and make suggestions to improve uptime and optimization. Artificial intelligence, big data, cloud, IoT, and mobile play key roles in bolstering uptime and optimization efforts.

As organizations master these nine starting points, expect new investment in networks that will knit these entry-point projects together to form a co-innovation and co-creation platform. These network economies will build on the products and services and the technologies to transform the marketplace for manufacturers.

A MULTI-MODAL APPROACH PAVES THE WAY TO SUCCESSFUL DIGITAL TRANSFORMATION

The overhyped, bi-modal, two-speed approach to IT and digital transformation is a flawed fallacy perpetuated by ivory tower, non-pragmatic legacy research firms. Lessons learned from successful digital transformation projects emphasize an organizational design comprised of six key virtual or physical teams (see Figure 3).

The six teams exist in all successful transformation efforts:

- **Incremental innovation teams improve existing business models.** These teams have a mandate for creating faster, better, and cheaper capabilities in existing business models. Key team traits include domain expertise, a passion for improvement, an understanding of existing constraints, and a spirit of innovation.

- **Transformational innovation teams innovate with new business models.** Often seen as members of the tiger team (i.e. special operations), these people explore additional business models for piloting inside organizations. Key team traits include a penchant for disruption, disregard for existing rules, passion for innovation, and ability to deal with abstract concepts.

- **Concept-to-commercialization teams enable monetization.** This team must figure out how to take a proven concept from the transformational innovation team and incorporate a new business model with existing systems. Often, this team is a multi-disciplinary group of experts in

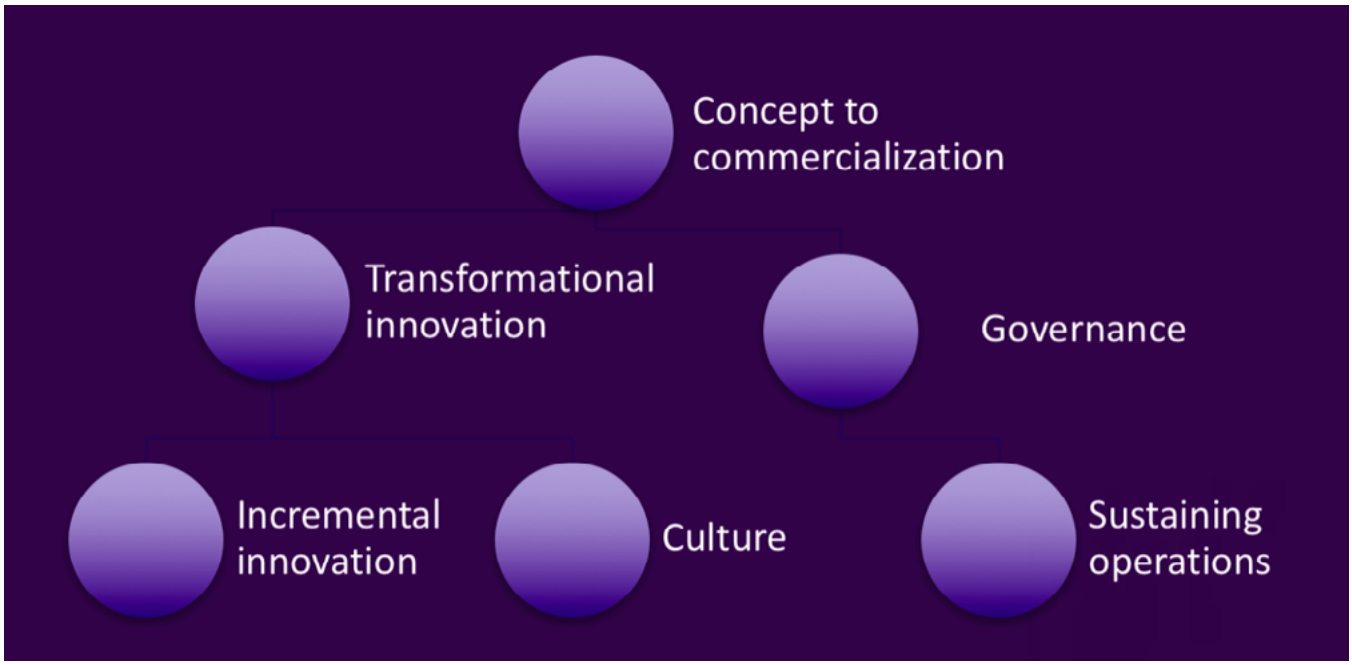
incremental innovation, transformational innovation, and sustainability of operations. Key traits include a high degree of creativity, disruptive thinking, political savviness, and understanding of human behavior and rewards.

- **Culture teams infuse harmony among the teams.** This team draws from different disciplines and sets the cultural norms among all the teams. This group must not only highlight the differences among the teams, but also find bridges between the differences to inspire innovation.

Constellation defines design thinking as unlocking solutions to questions that have not been asked previously. This requires a diversity of thought across multiple disciplines. In fact, an artist, architect, author, and accountant have different points of view that together can unlock innovation in problem solving and design.

- **Governance teams ensure overall organizational alignment and success.** This team must provide the ground rules and framework to ensure successful coordination among a variety of business

Figure 3. The Six Components of Successful Digital Transformation



Source: Constellation Research

objectives. In some cases, this team sets up the partnership ecosystem for co-innovation and co-creation. Key traits include policy-making experience, program management, compensation design, and political savviness.

- **Sustaining operations teams keep the lights on.** The bulk of an organization focuses on keeping the lights on. This team's goal is to deliver operational efficiency, rock-solid reliability, and massive economies of scale. Key team traits include attention to detail, strong work ethic, and adherence to standards and rules.

START WITH FIVE KEY STEPS TO MANUFACTURING TRANSFORMATION

Constellation offers five distinct recommendations for manufacturers setting off on the journey to successful digital transformation projects (see Figure 4). These five steps can help manufacturers and other types of companies to transform their businesses:

1. **Answer why your brand, enterprise or organization exists.** An organization must start with its mission. What experiences and outcomes should the organization be expected to deliver?

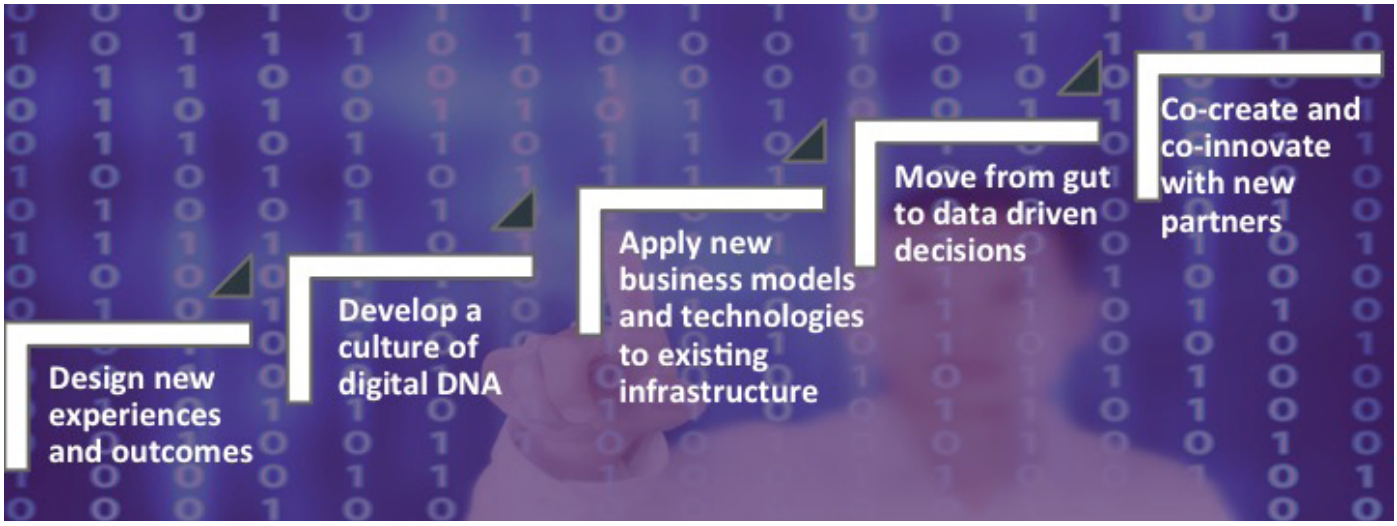
2. **Invest in digital artisans.** Balancing the right digital DNA inside an organization requires both right-brain and left-brain approaches. If an organization has many scientists, technologists, engineers, or mathematicians, it should add artists, ethnographers, anthropologists, design thinking experts, and story tellers. The goal is to inspire innovation from across multiple disciplines.

3. **Form (technologies, people, processes) follows function (business models).** The business model should be developed first. In fact, successful companies sometimes will deliver on more than one business model. Start from a core new business model, then figure out the technologies, people, and processes to support the business model. Design multiple layers of business models that support the end-to-end value chain.

4. **Move from gut-driven to data-driven decisions.** Data is the foundation of digital business. Every click, conversation, video, transaction, and interaction provides insight into future capabilities. Align the data to information flows and mine the data for insight. Take that insight and determine the next best action. From there, deliver a data-to-decisions capability for competitive advantage. Always start by asking what business problems need to be answered.

5. **Focus on co-innovation and co-creation with partners.** The future of an organization rests heavily on its ability to put a partner ecosystem in place. This will come from the orchestration of content (products, services, experiences, insights, and outcomes), networks (distribution models, channels, and suppliers), and technology platforms with each other. Most of these integrated capabilities have not been developed yet. The goal is to find partners who can co-innovate and co-create these capabilities with you. In some cases, traditional competitors may be the best partners in creating a common core.

Figure 4. Five Major Steps to Succeed in Digital Transformation



Source: Constellation Research

R "Ray" Wang

Founder and Principal Analyst

R “Ray” Wang is Founder, Chairman, and Principal Analyst of Constellation Research, Inc. and the author of the popular enterprise software blog, “A Software Insider’s Point of View.” He previously was a Founding Partner and Research Analyst for enterprise strategy at Altimeter Group.

A background in emerging business and technology trends, enterprise apps strategy, technology selection, and contract negotiations enables Wang to provide clients and readers with the bridge between business leadership and technology adoption. Wang has been recognized by the prestigious Institute of Industry Analyst Relations (IIAR) as the Analyst of the Year, and in 2009, he was recognized as one of the most important analysts for Enterprise, SMB, and Software. In 2010, Wang was recognized on the ARInsights Power 100 List of Industry Analysts and named one of the top Influential Leaders in the CRM Magazine 2010 Market Awards.

Wang graduated from the Johns Hopkins University with a B.A. in natural sciences and public health.
His graduate training includes a master’s degree from the Johns Hopkins University in health policy and management and health finance and management.

@RWang0 | www.constellationr.com/users/r-ray-wang

www.linkedin.com/in/rwang0

ABOUT CONSTELLATION RESEARCH

Constellation Research is an award-winning, Silicon Valley-based research and advisory firm that helps organizations navigate the challenges of digital disruption through business models transformation and the judicious application of disruptive technologies. Unlike the legacy analyst firms, Constellation Research is disrupting how research is accessed, what topics are covered and how clients can partner with a research firm to achieve success. Over 350 clients have joined from an ecosystem of buyers, partners, solution providers, C-suite, boards of directors and vendor clients. Our mission is to identify, validate and share insights with our clients.

Organizational Highlights

- Named Institute of Industry Analyst Relations (IIAR) New Analyst Firm of the Year in 2011 and #1 Independent Analyst Firm for 2014 and 2015.
- Experienced research team with an average of 25 years of practitioner, management and industry experience.
- Organizers of the Constellation Connected Enterprise – an innovation summit and best practices knowledge-sharing retreat for business leaders.
- Founders of Constellation Executive Network, a membership organization for digital leaders seeking to learn from market leaders and fast followers.

www.ConstellationR.com

@ConstellationR

info@ConstellationR.com

sales@ConstellationR.com

San Francisco | Belfast | Boston | Colorado Springs | Cupertino | Denver | London | New York | Northern Virginia
Palo Alto | Pune | Sacramento | Santa Monica | Sydney | Toronto | Washington, D.C

constellation RESEARCH