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JBA JOURNAL OF BUSINESS ANTHROPOLOGY

The Vision for the Future of Mobility: The Changing Relationship Between Innovation and Quality in the U.S. Auto Industry

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Abstract

The automotive industry is going through a transformation. Disruptive technologies and tools are shifting the business model from one of automobiles to one of mobility. To accomplish this shift, automotive companies are embracing acquisitions and partnerships. In a time when the consumer electronics industry is delivering new products to market at a rapid rate, automotive manufacturers must identify ways of getting new products and features to customers faster and with high quality to maintain or increase market share. We provide an analysis of interviews with global automotive company professionals to understand the impact that quality requirements have on innovation and the advanced product design process. The research contributes to the literature on innovation and quality, identifying organizational behaviors and practices that facilitate or obstruct the development of high quality fast-to-market innovations, particularly in the area of mobility.

Key words

innovation, quality, advanced product design, automotive, culture

JBA 9(2): 225-250
Fall 2020

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ISSN 2245-4217

Doi:
10.22439/jba.v9i2.6123

The automotive industry is going through a transformation. The business model of the last 100 plus years has changed to one that includes acquisitions and partnerships that move the automotive business model from one of automobiles to one of mobility. In Ford Motor Company's 2018 annual report, President and CEO Jim Hackett explains the factors that are driving this shift in the automotive market.

> *"Two forces are driving this disruption: rapidly advancing technology and innovation that offer the promise of increasingly intelligent vehicles and a deep need for a smarter transportation system – one that is cleaner, safer and less congested. It is the pairing of the two that will revolutionize the industry."* (Ford Motor Company 2018 Annual Report, page 4)

In 1903, inventor and businessman Henry Ford had a dream of replacing horse-drawn carriages with horseless carriages and automobiles powered by internal combustion engines (ICE). During this time, in Highland Park, Michigan, a revolution was starting in the automotive industry. Automotive plants were being driven by new technology to get more vehicles on the road. While this was progress in putting the world in motion by mass-producing low-cost vehicles, it also generated some consequences. Those consequences include mass congestion, pollution, inefficiencies and wasted energy, which are expected to increase with the growth of megacities[1] .

Now, once again, there are disruptive technologies and tools that are creating a modern revolution in transportation that can change how people live their urban lives and that are also changing the identity of automotive companies and how they are working to create mobility for the future. Mobility in the automotive industry involves getting people and goods from one destination to another, but goes beyond the actions of the traditional automotive industry of putting internal combustion engine (ICE) vehicles on the road, to include alternative sources of sustainable transportation such as electrified vehicles, autonomous vehicles, electric bikes, and electric scooters that take advantage of digitization.

Over the last two years, Ford has moved swiftly to change its business model. In the 2018 Annual Report, Ford outlines its mission to create a very different future. It states that it is reinventing its mission to become "the most trusted company, creating smart vehicles for a smart world" (Ford Motor Company – 2018 Annual Report). The report goes on to explain that all vehicles will be connected to one another and to the world around them. This new vision will require a connected world, including people, automobiles, buildings, bikes, and other transportation

[1] Megacities are defined as cities with populations greater than 10 million; https://www.msn.com/en-us/money/realestate/the-worlds-33-megacities/ar-BBUaR3v

options like trains and buses. To make this vision a reality, Ford has taken steps to acquire and partner with companies that can help the firm move faster, including partnerships and acquisitions with Lyft and Spin to support the development of other forms of connected transportation. Ford also announced during the 2019 Consumer Electronics Show that it is working with electronics company Qualcomm to ensure everything in cities speaks the same language. Ford has chosen cellular connectivity everywhere technology, also known as Cellular vehicle-to-everything, or C-V2X. According to the company's website,

> *"C-V2X is a technology that enables various people and entities in a city to share information. Using some of the most advanced wireless technologies in the mobile ecosystem, it allows vehicles to communicate directly with other vehicles (V2V), pedestrian devices (V2P) and roadway infrastructure such as traffic signs or construction zones (V2I)."* (social.ford.com)

In 2018, Ford acquired software company Autonomic to create the Transportation Mobility Cloud, or TMC. TMC would be jointly developed with Amazon's AWS cloud to advance vehicle connectivity and mobility experiences. Other partnerships that were established to be instrumental in delivering Ford's vision of smart vehicles in a smart world include those with Argo AI, rideOS, and the creation of AV, LLC for self-driving technology and solutions for the future.

Rapid technology changes in the consumer electronics industry influence the way consumers buy products. Ford understands that the automotive industry must identify ways of getting new products and features to customers faster and with high quality to maintain or increase market share. This accelerated product development process requires a strong connection between two, sometimes opposing, corporate strategies, innovation and quality, in order for an automotive firm to remain competitive. This study investigates organizational factors that impact the delivery of fast-to-market innovative technology in the automotive industry.

Innovation

In the book *Mastering the Dynamics of Innovation*, James Utterback explains that the rate of innovation is fastest during a product's formative years; this period is considered the fluid stage of innovation, as shown in Figure 1 (Utterback 1994). The automotive industry is currently in the fluid stage of technological innovation. As Utterback explains, this is the time in which "a great deal of experimentation with product design and operational characteristics takes place among competitors" (Utterback 1994, page xvii).

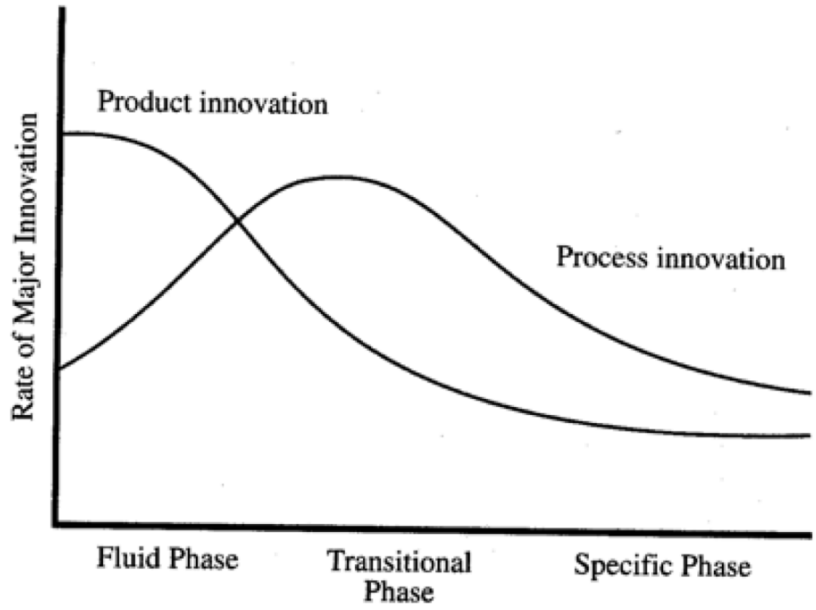


Figure 1. ***Dynamics of Innovation***

For the automotive industry, the competition in this space has changed dramatically, with traditional consumer electronics and digital firms moving into the automotive space in an effort to create a better product. New automotive firms, like Tesla, have identified new ways of getting new products and features to customers faster. With its digital platform, Tesla is able to provide customers with a unique feature or experience without having to go to a dealership for changes or updates. The feature is seamlessly "beamed in" to the vehicle over a cellular network or through a Wi-Fi connection. This new speed of innovation and feature introduction have required the traditional automobile manufacturers to revisit their normal product development processes.

Everett Rogers, in his book *Diffusion of Innovation*, defines an innovation as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption. If an idea seems new to the individual, it is an innovation." (Rogers 2010, page 12). This research study builds on the definition of an innovation as an idea that occurs early in the product development process, well before it reaches the end user.

Scholarly research tells us that innovation has become increasingly important to the survival of any organization (Stenmark, Shipman et al. 2011). Maintaining a competitive advantage with current processes, products, or services of an organization is no longer sustainable. On the contrary, organizations must strive to continually create new products and processes to achieve long-term success (Dess and Picken 2001; Tushman and Anderson 2004). The way innovation is managed within a firm can mean the difference between long-term success and early demise (Stefflre 1985).

Saleh and Wang's research on innovation management shows significant differences between the structures of highly innovative and

less innovative organizations. In addition to having an entrepreneurial strategy and rewarding climate, these authors argue that an innovative organization should have a structure that is flexible, synthesized, and have a collective orientation (Saleh and Wang 1993).

Quality

According to The American Society of Quality, or ASQ, quality is *"A subjective term for which each person or sector has its own definition. In technical usage, quality can have two meanings: 1. the characteristics of a product or service that bear on its ability to satisfy stated or implied needs; 2. a product or service free of deficiencies. According to Joseph Juran, quality means "fitness for use;" according to Philip Crosby, it means "conformance to requirements"* (www.asq.org/quality resources).

Literature on the topic of quality focuses on customer satisfaction and integrating quality tools and practices into all processes and functions of an organization to remain competitive (Lockamy and Khurana 1995). The seminal works of Deming (1982), Juran (1988), and Ishikawa (1985) set the foundation for scholars to establish the impact of quality on an organization and the important factors required for improved quality performance.

In the automotive industry, quality is an important factor for customers when they are looking to purchase a reliable vehicle. They depend on third party companies like Consumer Reports and JD Power to provide them with an automotive company's quality rating, and specifically for the vehicle they have an interest in purchasing. In an effort to assess their overall quality performance against the competition, auto makers also rely on the customer feedback from the JD Power issued Initial Quality Study (IQS) and U.S. Automotive Performance Execution and Layout (APEAL) Study. According to JD Power, IQS "serves as the industry benchmark for new-vehicle quality measured at 90 days of ownership and has proven to be an excellent predictor of long-term reliability, which may significantly impact new-vehicle purchase decisions" (www.jdpower.com/business/resource).

Intersection of Innovation and Quality

Literature shows that there are mixed results on whether innovation and quality can coexist (Prajogo and Sohal 2001). The challenge for the automotive industry is to achieve both technological innovation and maintain or improve quality and customer satisfaction at the same time. Recent literature on the future of quality management suggests there is significant opportunity for the development of stronger connections between innovation and quality (Evans 2013; Blank and Naveh 2014), but to be realized, collaboration across historically siloed

functional boundaries will have to take place that will require changes in long-standing cultural practices in communication and approaches to product development. This cultural transformation is difficult, especially in organizations like those in the automotive industry that have been around for 100 years (Briody, Trotter, and Meerwarth 2010). We propose that the first steps required toward achieving cultural transformation are 1) understanding how quality and innovation are defined, and 2) understanding how these two strategic areas are operationalized across the organization.

This research study is intended to uncover the current meaning held by the organizational groups responsible for innovation and quality performance and their perceptions about how the concepts of quality and innovation relate to each other. The three primary research questions guiding this study of innovation and quality are as follows:

1. How do executives working in advanced product development and those working in quality understand the meaning of innovation and quality?
2. Do executives in advanced product design and quality believe it's possible to integrate innovation and quality?
3. What do executives in advanced product design and quality believe is necessary to integrate innovation and quality?

The research questions are informed by both the practical problem of maintaining quality as the automotive industry faces a compressed product development cycle along with the accelerating demand for innovation, and by a body of literature about quality and innovation and how they both come together (or not) in the organizational context.

Drawing on the literature and interviews with corporate automotive leaders, this study provides insight into the current thinking about quality and innovation and how they can be achieved together.

Research Framework

A key area of focus for this research is to understand if executives are aligned on the meaning of quality and innovation and to understand if there is consensus on how the two corporate strategies can be achieved together. This research analyzed the interviews of 20 automotive executives in order to understand if the culture or subcultures of the firm support the delivery of high quality fast-to-market innovative technology to customers.

Prior studies show an innovation producing organization is continually learning and adapting to changes internally and in its environment (Shepard 1967). Supportive cultures in the innovation-producing organization encourage and accept good ideas; ideas are not

turned away. Supportive cultures recognize team members at all levels for good ideas, and they ensure the involvement and commitment of management in the innovation process.

On the other hand, an innovation-resisting culture puts up strong defenses against innovation (Shepard 1967). Shepard suggests that this type of culture, like a factory, wants to ensure a reliable repetition of prescribed operations. Scholars argue that innovation is often performed reluctantly in response to challenges (Miller and Friesen 1982) and point in particular to risks that stem from adapting to changes (Shepard 1967; Saleh and Wang 1993). A quality organization is considered innovation-resisting.

This article draws on the work of Kim Cameron and Robert Quinn (2011) on how to diagnose and initiate change in an organization. Their Competing Values Framework is a theoretical model that can be used to help understand an organization's cultural makeup and where the organization believes it should be to achieve its performance goals. Figure 2 illustrates the four categories or clusters of criteria that establish the model for the competing values framework. These four clusters of criteria define the core values that are used to make judgments about an organization's culture.

The four core values represent opposite and competing assumptions. The dimensions are shown in quadrants, with each quadrant showing a core value that competes with the core value diagonal to it, for example, clan or collaborate versus market or compete, and adhocracy or create versus hierarchy or control. The y-axis and x-axis show the culture range: from flexibility and discretion to stability and control on the y-axis, and from internal focus and integration to external focus and differentiation on the x-axis. Figure 2 provides more insight into the various characteristics for all four cultures.

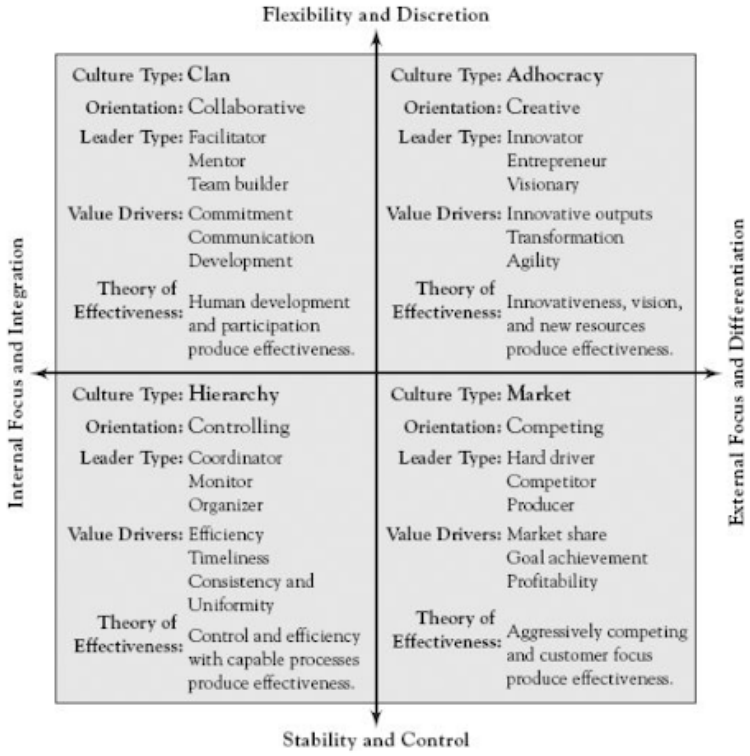


Figure 2. ***Competing Values Framework Categories***

According to scholars, a hierarchical culture would be rigid and would inhibit innovation by requiring people to focus on the quality processes rather than on the introduction of new ideas and processes (Morgan 1993; Glynn 1996; Zeng, Phan et al. 2015). This characterization is in line with the works of Imai (1986), Jha, Noori et al. (1996), and Zeng, Phan et al. (2015), mentioned previously, in that an organization that is focused on quality management requires formalization, standardization, and control.

An innovative organization from a cultural standpoint is linked directly to a culture of adhocracy (Cameron and Quinn 2011), which is in the upper right-hand quadrant of the competing values framework.

Given this information that a culture of innovation and quality are opposite and competing cultures, this research investigates specifically the team dynamics that are explained by the Competing Values Framework in the traditional automotive industry, which is an area of research that has not been explored.

Research Methods and Data Collection

A qualitative research approach was chosen for this study, focusing on interviews and participant observation. Qualitative research methods are informed by purposeful sampling (rather than random or statistical sampling), collection of open-ended data, analysis of text or images, and personal interpretation of the findings (Creswell 2014; LeCompte and

Shensul 2010).

The research focuses on business models and technologies being pursued in the automotive industry, specifically at a Fortune 50 automotive firm; hereto referred to as "the firm". The firm's executive leaders were asked questions about advanced product designs and the quality process to understand the team dynamics and impact on overall firm quality performance and advanced product design performance. Members of the firm who have experience in either quality or conceptual design, or both, were part of the interview process to assess the relationship of members in the advanced product development and the quality organizations.

This set of interviews with leaders of the conceptual design and quality organizations provided an understanding of the language used to communicate quality and innovation performance that permeates throughout the firm. Each interview took between 30 and 60 minutes; the length varied depending on the availability of the person being interviewed. On occasion, the interviewing process required that individuals be interviewed more than once. The interviews took place in Southeastern Michigan and Northern California, which are the locations of the automotive firm's engineering and research facilities.

The interviews were designed to elicit the perceptions of innovation performance and quality performance by analyzing the semantic and linguistic elements of the interview responses. This study focuses specifically on the team dynamics and organizational culture associated with conceptual design and quality. The interview questions were worded to capture the team members' experiences. The interviews were recorded, where approved, and put into transcript form after the interview. It was explained to each participant that the recorded information would be strictly confidential. Where applicable, a confidentiality agreement was part of the interview to help ensure a high level of trust between the interviewer and the interviewees.

For this study, experience in and an understanding of the automotive industry was beneficial in observing team member interactions as well as analyzing the data for explanations of the relationship between conceptual design and quality engineers. Atlas.ti was used to analyze and code the transcribed interviews and observations. Atlas.ti is a computer program used for the qualitative analysis of large bodies of textual, graphical, and video data. The interview transcripts coded in Atlas.ti were analyzed to uncover cultural assumptions and the behaviors associated with them. Interview questions also assessed the impact that team dynamics have on quality and advanced product design performance. The interviews with executives associated with conceptual design teams and the quality organization yielded information about the beliefs, values, and norms that are present

in the advanced product development process. The firm has many departments that are responsible for the quality and innovativeness of products that go to market. However, early on in the product development process, two departments are expected to work together to design and develop these products to ensure they meet customer expectations: advanced product design and quality.

To gain insights into team culture, the Competing Values Framework by Cameron and Quinn guided our understanding about how the leadership team perceives the overarching culture of the conceptual design and quality teams (Cameron and Quin 2011).

During the interviews, participants were asked specific questions relative to the corporate strategy around innovation and quality. Product innovation is concerned with creating something new or generating new ideas that are reflected in the changes of the end product or service offered by the firm (Prajogo and Sohal 2006). Questions for this study included: 1) What is your definition of innovation? 2) What is your definition of quality? 3) Are teams set up to deliver innovation and quality simultaneously? and 4) What culture do you believe is necessary to deliver both innovation and quality together? Interview responses reflected an evaluation of the quality and innovation of products, as well as how they compare with the firm's competitor offerings. The responses provided by the participants helped illuminate their perspectives on the impact that the corporate strategies of each have on the successful outcome of product performance relative to quality and innovation. An additional open-ended question offered participants the opportunity to comment freely on any additional items that the interviewees wanted to share relative to the topic of the intersection of innovation and quality.

The interviewees were chosen based on their current or prior roles in one of two areas: advanced product design, quality, or both, which will also be referred to as hybrid. The original list was generated based on those leaders that one of the authors had a prior working relationship with during time at the firm. The list was revised based on the recommendation of leaders from the original list. The interviews were binned into four categories: leadership level, gender, the interviewee's present organization, and the documentation method used for the interview (recording or field notes). The leadership levels of those interviewed include: vice president, director, chief engineer, and manager. Of the twenty interviews, three were managers, three were chiefs, nine directors, and five vice presidents.

A note was sent to each of the respective participants explaining the purpose of this research. It was explained that the research was being performed to understand the intersection of innovation and quality, including current team dynamics and implications for the organization, and on developing better processes and approaches for working as a team

on fast-to-market advanced product designs. It was explained that the goal of the interview was to learn the participant's perspective on how engineers working in fast-to-market advanced product design and those working in quality understand each other, if they share the same organizational culture, and if their interactions impact the output of advanced product designs. All interviewees were encouraged to be open and candid during the interview. It was explained that responses would be kept confidential and that multiple people within the firm would be interviewed. It was also explained that the study would be looking for general themes across the interviews and that the results would be summarized without identifying anyone specifically. Each participant was asked if the interview could be recorded. Some agreed, but others did not. Those that were recorded were transcribed; notes were taken for those that did not agree to have the interview recorded. All of the requests for an interview were granted, with each leader eager to share their views on the intersection of innovation and quality. There was only one interview that had to be rescheduled; all others kept their original time, with some going over the time that was allotted. This commitment to the interviews gave confidence that the participants would provide rich input for this study.

Once all of the interviews were completed, they were transcribed and analyzed for insights and trends using Atlas.ti. Codes and quotes from the interviews were included in the conceptual network analysis using the neighboring function in the tool. The Import Neighbors function in Atlas.ti allows a researcher to select a focal code and command the software to insert neighboring codes that have been applied to a segment of text just before or after the focal code segment, or to the segment itself, thus constructing a connected network view. While the study results reported in this article are an exploration of the relationships among the conceptual model constructs using the qualitative analysis tools described above, future work will leverage statistical methods and tools.

Results and Data Analysis

The research findings provide insight about interactions among team members in both the advanced product development and the quality departments. Each transcript was coded using key words related to the goals of this study. Key code words include innovation, quality, teams, network, and culture. Atlas.ti has a function that facilitates the creation of relations among codes in a network view for grounded theory development. Once coding was completed, the code "quality" was brought into a network view of the data to form a central node in conceptual network analysis. Co-occurring codes were pulled into the network using Atlas.ti's network function to produce the network shown

in Figure 3. The linkages or relations, which are shown by bi-directional arrows, were created based on the interviewees' comments and researchers understanding of the interviewee and his or her organizational context.

The conceptual networks show that interviewees considered quality to be a part of innovation. This is a very important and relevant connection when we consider that there is literature which suggests quality and innovation cannot coexist (Glynn 1996; Kanter 1984; Slater and Narver 1998; Tidd, Bessant, and Pavitt 1997; Wind and Mahajan 1997). It is also important to know that quality is perceived to be an integral part of innovation and not a characteristic that should be omitted when introducing fast-to-market technologies. The analysis also identified leaders and the quality engineers as having a direct impact on quality and innovation. This result suggests that both the leaders and the quality engineers of an organization have the potential to determine the success or failure of both the quality and innovation of fast-to-market technologies. Also in developing the conceptual network analysis, a code emerged called "quality: decision making". This code is a property of both the codes *leadership* and *quality engineers*. One of the interviewees associated with this code said, "But quality is part of the decision-making process," which speaks to the fact that quality is not the only factor when decisions are made about fast-to-market technologies but only a "part" of decision-making; cost and other factors along with quality must be considered in the product development process.

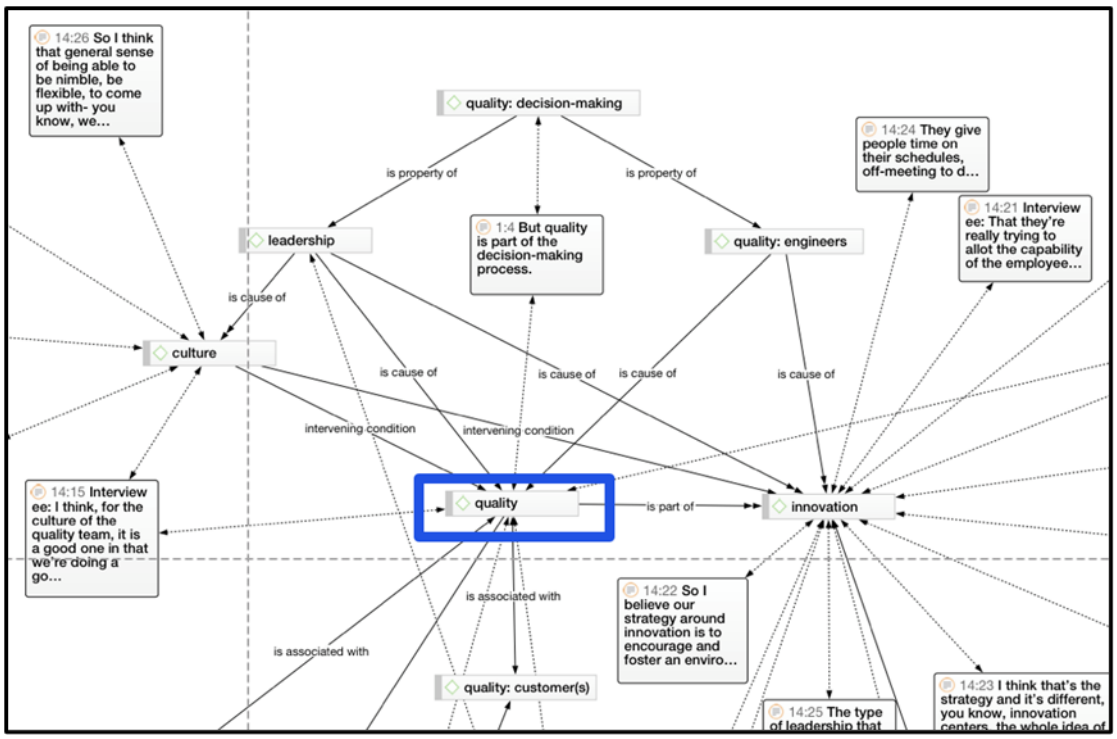


Figure 3. ***Quality Conceptual Network***

Quality and the Relationship to Customer Expectation

Further examination of the conceptual network associated with quality led to the code "quality: customer expectation." There were 30 quotations from 16 interviewees associated with the code "quality: customer expectation." Among those 16 interviewees, two were manager level, three chief engineers, seven director level, and four vice presidents. Vice presidents and directors mentioned customer expectations multiple times, which tells us that this concept is a key area of focus at a corporate level in the context of meeting or exceeding customer expectations. It is clear from the quotations that quality is defined by the customer. One of the interviewees mentioned the Kano model, saying "[the] Kano Model describes it, surprise and delight, defects and warranty elimination; things gone wrong, warranty and others; craftsmanship, fit and finish, all vehicle development." Kano's model of customer satisfaction includes three different elements (Matzler and Hinterhuber 1998). The first is "Must-Be" requirements, which are basic criteria of a product; if these requirements are not met the customer will be extremely dissatisfied. The second is "One-Dimensional" requirements, which are those requirements that are explicitly demanded by the customer; these requirements are linked to stated, specified, measurable, or technical performance (i.e. gas mileage). The third and final element is "Attractive" requirements, which are the product criteria that have the greatest influence on how satisfied a customer will be with a product; these are neither explicitly expressed nor expected by the customer. Attractive requirements are customer surprises and delights. (Matzler and Hinterhuber 1998). The same interviewee then goes on to say more about making it possible for the customer to do things flawlessly. Another interviewee explained the customer satisfaction situation, "We do really want to satisfy our customers…but there are a lot of ways to get there. I don't believe we've really laid out for ourselves what we need to do." This comment leads to thinking more about what must be done to satisfy the customer and the culture required to get there. It is worth expanding upon culture as it emerged as a concept in the interviews, both as it was evidenced internally in the company and how culture related to the customer.

Emergent Culture of Quality and Innovation

The interviewees were asked about the company culture, and the relationships of culture to how people think about innovation and quality and how culture might influence their actions. Culture was not defined specifically for the interviewees. Instead, we allowed them to respond to questions about culture using their own ideas about and descriptions of culture. We used culture as a code to highlight all the interviewees' comments about culture, and then created a network diagram around this

code to examine the context in which culture was talked about and to reveal the other codes associated with the culture concept.

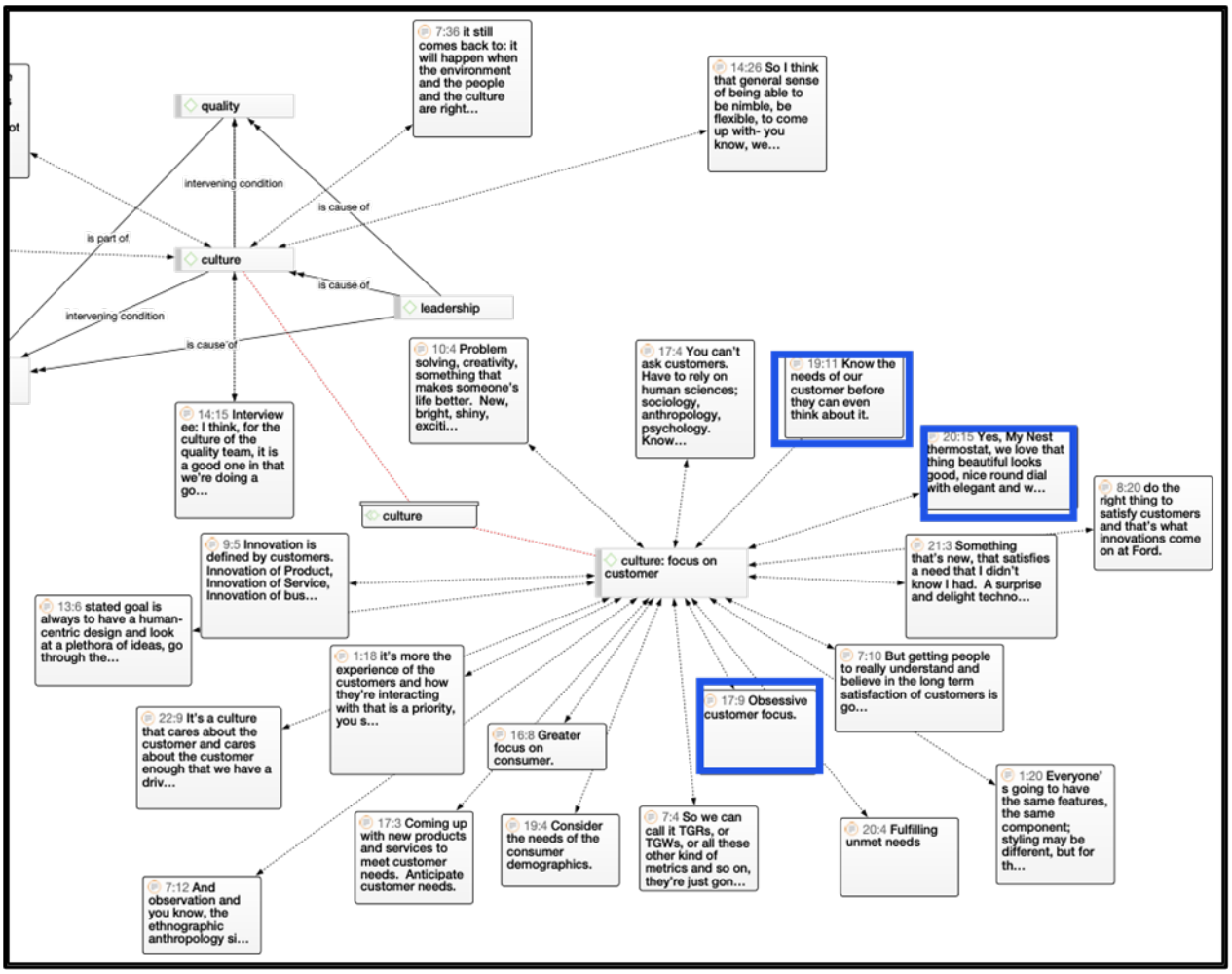
Our analysis indicates that the interviewees think about culture as partially responsible for determining outcomes for both quality and innovation, either favorable or unfavorable. From the perspective of the interviewees, having a culture that is nimble, flexible, and emergent can help ensure that innovation and quality coexist. One of the interviewees said, "it will happen when the environment and the people and the culture are right. It just happens." We interpret this to mean that when the culture is one that embraces flexibility and a level of risk taking, then quality and innovation can be delivered together. Another interviewee talked about how the culture in the advanced product team that they were a part of was a "good one" that was supportive of the integration of innovation and quality The interviewees were able to describe the type of culture they believed was critical to developing fast-to-market products that are also innovative and made with quality. However, they could not say specifically how they thought such a culture was created. For the interviewees, culture is something that emerges through interaction within the environment among the people doing the work. If both the environment and the people are "right" the culture will be "right". This was an interesting insight, because it leads us to conclude that the people in the organization believe that culture emerges but can't be managed. Instead the culture will be "good" or "right" if leaders in the firm foster an organizational environment that enables quality and innovation practices. We can say that the interviewees do not think that culture can be "forced" on them. However, based on their comments, it is possible for leaders in the organization to influence and shape the emergence of a culture conducive to both innovation and quality by managing conditions in the work environment. For example, leaders can create an organizational structure that is flat and one that promotes communication and collaboration across functional boundaries to increase the likelihood that a culture fostering both quality and innovation practices will emerge and lead to the building of both quality and innovative products simultaneously.

Focus on Customer in the "Culture" Conceptual Network

The conceptual network in our analysis centered around the term "culture" brought in all of the other connections that were also linked to innovation, quality, and leadership (See Figure 4). With culture as the central node in the network view, the direct connections to the code "culture: focus on the customer" prompted examination of what the interviewees had to say about the culture at the firm as it relates to the customer. Importing the quotations around this code brought in 19 quotations from various interviewees. Of the 19 quotations, seven

quotations were from five directors, seven quotations were from four vice presidents, two quotations were from one of the managers, and three quotations were from one of the chief engineers. There were a few quotes that stood out from others which are shown with a blue box around them. One quotation was from a vice p resident who said, “Obsessive customer focus”. This was in response to the question "What culture do you believe is necessary to deliver both innovation and quality simultaneously?” This same interviewee went on to mention that the firm spends most of its time being product focused and looks to marketing to handle the understanding of the customer. It was also mentioned that other companies good in quality and innovation don’t compartmentalize and that all teams innovate. One of the other interviewees talked about their own customer experience with a new name-branded thermostat. This interviewee spoke about the elegance and other features of the product, how the thermostat is a joy to use even down to the screwdriver that is included to assemble the thermostat, and that this company “hit all cylinders”. This comment was linked to the quote from one manager interviewee who said, we need to “know the needs of our customers before they can even think about it.” This interviewee went on to say that innovation and quality can be achieved together even when people are under pressure to get products to market fast. The results indicate that collaboration across areas of the company that usually work independently, as silos, is a condition for a culture that has a genuine focus on customers.

Figure 4. ***Culture Conceptual Network***



Innovation: A New Way of Doing Things

Quotations for the code "innovation" were pulled into the "quality" conceptual network to examine the relationship between the two concepts. A majority of the quotations that were connected in this network view were from only two of the interviewees, one a manager and the other a chief engineer. A couple of interesting linkages among the codes emerged with the quality and leadership nodes. Those quotes directly linked to quality and innovation were around leadership and the statements that if a company has the right leadership, then both quality and innovation can be achieved together. One interviewee talked about how the designs of new technologies can be finalized earlier in the product development cycle as a means of achieving both quality and innovation together saying, " it doesn't have to be an either-or scenario, it can be a both-and scenario." This idea is counter to the direction technology is headed today; design must be nimble and able to change later in the product development process. Another quote by the same interviewee that is linked to the innovation and quality nodes refers to how decisions are made: "Waffling one way or the other leads to making

decisions later, which impacts both quality and innovation. There has to be a balance and this company hasn't gotten there yet." Other quotations that were imported into the network view with the Atlas.ti "neighboring" function were around corporate strategy and include the quote: "I believe our strategy around innovation is to encourage and foster an environment that more employees can be more involved in innovation, so they have a better chance of creating new ideas, new technologies, new content, that can set us apart from our competition." This is one interviewee's view of the changing landscape at the firm. This same interviewee goes on to explain their definition of innovation, which is, "being able to drive new content, features, subsystems and components...to serve some customer in a unique way than what they have had before." This statement was in direct response to the question: What is your definition of innovation? A similar answer to the same question was, "innovation is doing something new," which led to the decision to import the codes associated with these quotes. Atlas.ti allows the researcher to display codes that neighbor or co-occur with a focal code but also to display quotations associated with those codes in the network view. The code "Innovation: new way of doing something" was added to the network and all of the associated codes and quotations were imported into the network view. Twelve new interviewees also were introduced into the network, which is more than half of the interview population. The quotations surrounding this new node, the code "Innovation: new way of doing something," can be viewed in Figure 5. These quotations support this "doing something new" meaning of the innovation concept, which is a very broad understanding of innovation and enables people in the organization to pursue multiple paths to achieve it, depending upon their context and what the environment allows or requires.

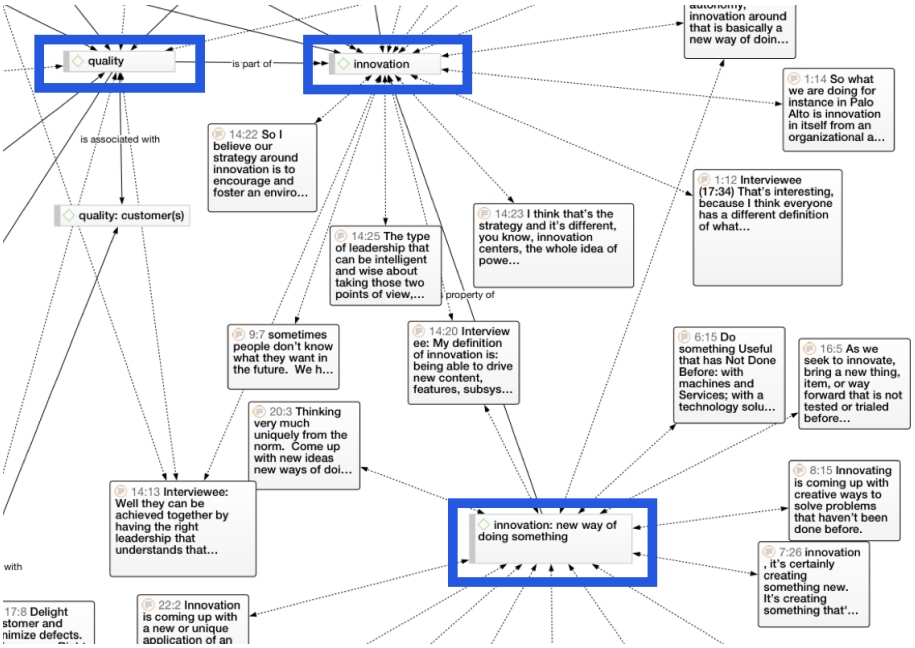


Figure 5. ***Innovation Conceptual Network***

Team Insights

Atlas.ti includes a function that allows researchers to specify how they believe specific codes, or nodes in the network, relate to one another. For example, two codes can have a causal relationship, where one code "leads to" another, a code can be "a part of" another code or a "consequence" of another code. There is a built-in set of relationships available for building links between codes, but the researchers also have the freedom to build their own relationship terminology and characteristics. The set of relationships that come with the software are based in Corbin and Strauss' (2008) grounded theory concepts. The researchers refer to the text of the interviews and interpret relationships based upon the context and patterns they see in the text.

When asked the question, "Are teams set up to deliver innovation and quality simultaneously?", there were mixed responses among the interviewees. Some felt the firm did a good job at working together to deliver both simultaneously, and others felt that there was still some work to do to bring teams closer together. Figure 6 shows the network diagram for the code group related to *teams*. Some of the codes imported into a network view to examine the relationships among them include *team: barrier, innovation team: requires communication, teams not set up right, teams set up properly, innovation and quality requires a cohesive team, culture: hierarchical, and organization: flat.* We touch on a few of the codes that surfaced with the *teams code* group, beginning with the code or node *innovation team: requires communication* node. A quote connected with this node is as follows: "Teams have to think more horizontally...bring together people from different disciplines. Have them

talk to each other and engage in a way that somebody working in discipline A never even thought about the application in discipline B and vice versa. And suddenly they're coming together and saying, 'I never even thought technology, or what I was working on would be used that way', and in fact when it's used in that way it turns out to be an innovation." The conceptual model in Figure 2 shows information exchange as a key factor in determining firm performance from a quality and advanced product design perspective. Another interviewee suggests, "...when the quality team gets involved there is tension. There is apprehension about including quality. Feel they will distract the team; [it] should not be that way." This comment can also be directly linked to the firm's organizational culture, which according to another interviewee is hierarchical, which leads to requiring a deeper understanding of the code *culture: hierarchical.* Importing the quotation that is linked to this code provides some insight. The interviewee mentions, "Ok [the culture] is changing and I'm trying to be part of that change to be a change agent to help that, but you can see it's changing. It's still hierarchical; it's still slow and inefficient depending on who's the decision maker." This comment would put the firm in the Hierarchy quadrant of Cameron's Competing Values Framework shown in Figure 2, but in order for the firm to be innovative it would require the opposing characteristic with a culture type of Adhocracy. The culture of the organization is slowly changing to become more collaborative and flatter. However, the question remains about how quickly this change can happen. Will the change happen quickly enough to achieve innovation and quality together when the push is to bring products to market quickly?

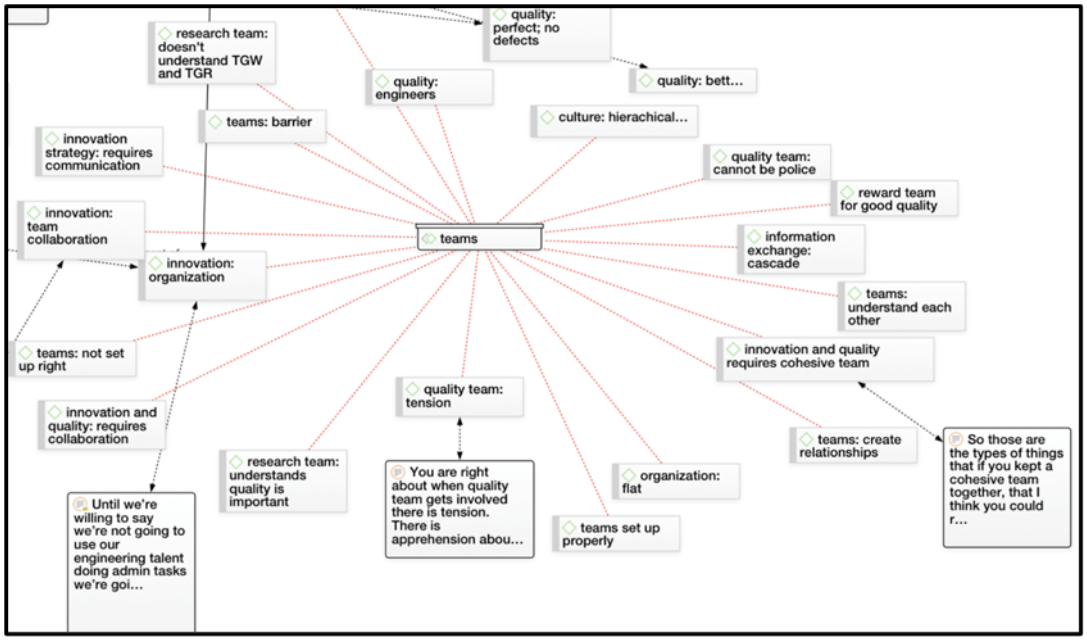


Figure 6. ***Team Conceptual Network***

It is also important to note that the interviewees who work in conceptual design, the group most responsible for advanced product

development, mentioned the word teams more often than those interviewees that were in the hybrid group (those who worked in both quality and advanced product development) and those who worked solely in the quality group (Figure 7). The different perspectives held by these group members indicates that part of the organization is changing faster than other parts. The integration of innovation and quality appears to be happening more quickly among the advanced product development engineers.

Table 1. ***Team Mentions***

Code Table	
Group	Number of times the term "Teams" is mentioned
Conceptual Design	21
Hybrid	14
Quality	1

Conclusion and Future Research

In a time when technology is changing at a rapid pace, traditional manufacturing industries that move at a much slower pace, like the automotive industry, must find ways to get product to market faster in order to remain relevant. These same traditional industries are competing with new non-traditional industries like consumer electronics that rely more on the nimbleness and speed of software. Companies like Tesla that make electric vehicles already and Rivian that is 3D printing trucks with electric engines are creating products that customers want and that can be updated with software overnight. Other factors that are driving change in the automotive industry include consequences of mass production, including congestion and air quality which will only increase as the number of megacities increases over the next thirty years. As seen over the last few years, the automotive business model is shifting from one of producing only vehicles to a model that embraces mobility more broadly. This shift in the business model creates an opportunity for businesses to acquire smaller companies, and to partner with companies that have the competencies to move quickly. In order for traditional automotive firms to compete in the new, fast-moving market, there will need to be a fundamental shift in how business is handled internal to the firms, in the cultural values and their associated practices. This study was conducted to understand the dynamics of getting technology to market faster in the traditional automotive industry. The feedback of twenty executives in the automotive industry provides insight into the

organizational factors that will enable high quality, fast-to-market, advanced product designs. In attempting to understand these factors, it was important to see first if there was a common understanding of innovation and quality. Each of the interviewees was asked for the definition of each concept, with most of them in agreement on the overarching definitions. According to the interviewees, innovation is considered something that is new to the user or customer or a new way of doing something. A common definition for quality is meeting or exceeding customer expectations and building on the KANO model of surprising and delighting the customer. These high-level definitions provide enough shared meaning across the advanced product development organization and the quality organization to enable different yet coordinated paths towards achieving common organizational goals, as long as team members communicate and exchange information.

According to the interview results, the factors that allow innovation and quality to coexist include collaborative teams, an innovation producing culture (enabling environment and leadership), and an obsession with the customer. Collaborative teams require members of that team to work together in achieving an agreed upon goal, so shared understanding is critical to their success. The results indicate that the organization is on the path to shared meaning of the innovation and quality concepts. However, while some of the interviewees believe the teams are already formed in a way that supports collaboration and innovation, there were others that believed it could be better or that the teams are not set up properly. This difference shows that there remains some level of work in understanding how teams should be set up to deliver fast-to-market technology while also delivering high quality. Practices to support the overall cultural values are not yet fully in place. An innovation-producing culture was another factor that the executives agree is required to deliver high quality technologies. According to Cameron and Quinn (2011), an innovation-producing organization has an adhocracy culture, characterized as creative and a leadership type of innovator, entrepreneur and visionary. Given there is a reference in the interviews to the culture of the firm being hierarchical or controlling, this finding would suggest there must be more of a shift in the cultural practices to those that support more creativity by flattening the organization, lessening control, and enabling idea generation and decision-making at lower levels. It was also confirmed by more than one of the executives that for innovation and quality to coexist the members of the organization must have an obsessive customer focus. Cameron and Quinn (2011) put forward the idea that this type of culture is a Market culture, one that is more competitive and goal oriented. Based on the researchers' observations, in recent years companies have incorporated human-centered design to ensure there is a conscious effort to ensure new designs and technologies take user experiences into account before they go to market. The practices in the traditional automotive company

that were the focus of this study are consistent with this trend. The research presented in this article is the start of a larger effort to understand how the identity of traditional automotive companies may be changing to respond to the new directions in the broader mobility landscape that is in large part driven by information technology and consumer electronics and the associated very competitive new market.

In a future study, a much larger number of survey participants will be asked an open-ended question about how they believe innovation and quality can be achieved together. Responses will provide further insights into what firm professionals believe are the keys to successful quality and innovation performance and how collaboration should work to achieve it. In addition, four items drawn from Subramaniam and Youndt (2005) will be used in a 7-point Likert scale where 1 is to a very light extent and 7 is to a very large extent: "Information is communicated," "We share information," "We exchange ideas with employees from different areas," and " We are encouraged to share our expertise." The survey will help in understanding how the various teams communicate with one another on a much broader scale than was possible with this initial qualitative study.

This preliminary, ethnographically-inspired, qualitative study of the changes occurring inside a traditional automotive company in a post-industrial era show how the identity of the company is transforming and pulling the culture with it. The company is moving from an identity embedded in transportation to one embedded in mobility and computing. It is moving from a hierarchical structure to one that is flatter. The digital environment is requiring engineers to become data scientists to innovate faster, leading to new partnerships with firms like Microsoft to create smart vehicles for a smart world. Future research will further broaden our understanding of how cultural values and practices are changing, and it remains to be seen whether the transformation can happen in traditional automotive organizations quickly enough to withstand the disruption brought about by consumer electronics and the data revolution.

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