Why Can Toyota’s Keiretsu Recover from Earthquakes Quickly?

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Abstract: The \textit{keiretsu}, or long-term stable business network that exists between Toyota and its suppliers, seems to demonstrate exceptional resilience in the face of natural disasters. Toyota shares production knowledge among the firms in its keiretsu through long-term kaizen-based inter-company learning activities (\textit{jishuken}). In this regard, we have confirmed that (A) in times of normal operations, jishuken adopt a flat structure of interpersonal connections among firms that facilitates mutual trust. From case studies, we also found that (B) in times of disaster response, the structure “switches” to a hierarchical one with a clearly delineated leadership to bring knowledge and human resources into play.

Keywords: disaster management, dynamic capabilities, Great East Japan Earthquake, Kumamoto Earthquake

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Introduction

When a supplier’s factory suspends production due to earthquakes or other natural disasters, the entire supply chain may fall into dysfunction (Fujimoto & Park, 2014). This is because each organization in the supply chain is resource-dependent on the others (Pfeffer & Salancik, 2003).

Therefore, a factory needs to have a disaster-response factory strategy (Fukuzawa, 2019; Wada, 2018), and there are two disaster recovery policies: (a) maintaining surplus resources during normal times and (b) possessing the capability to recover from a crisis quickly. However, maintaining surplus resources per option (a) lowers both inventory turnover and return on assets.

As a result, the Toyota Group and its suppliers have adopted a strategy that aligns with option (b), which enables a quick recovery from crises by using the problem-solving abilities rooted in their production knowhow, instead of stockpiling resources as in (a) (Fujimoto & Park, 2014; Whitney, Luo, & Heller, 2014; Wada, 2018). In this case, Toyota’s supplier network is characterized by the way that the assemblers and suppliers use their inter-organizational/interfirm relationships to deal with crises. For example, when Aisin Seiki Co., Ltd., had a fire, Toyota Motor led a number of other firms in offering support so that the firm could quickly return to normal operations (Nishiguchi & Beaudet, 1998).

The sharing of advanced production knowledge between assemblers and suppliers, including the relation-specific skills necessary to providing this type of support (Asanuma, 1989), characterizes the entire inter-organizational relationship between Toyota Motor and its keiretsu (Dyer & Singh, 1998). Without the solid long-term trust developed between suppliers and assemblers in keiretsu, opportunistic behaviors among firms (Williamson, 1983) will make this kind of knowledge sharing difficult (Asanuma, 1985,
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1989; Dyer & Singh, 1998). Without a trust-based relationship, it is possible that business partners could opportunistically demand deep price cuts when they share production knowhow with another company (Williamson, 1991a, 1991b), and firms will be reluctant to disclose such information (Sako & Helper, 1998).

However, although the Toyota keiretsu (Toyota’s supplier group) has long been considered an exemplary model of inter-organizational learning, it is still unclear how the knowledge that members have accumulated together as a result of the long-term relationships of trust during normal times has been utilized when disasters occur. Therefore, this article presents a hypothesis about effective disaster management and answers this question using case studies.

Method

This paper examines case studies of how the Toyota keiretsu’s production recovered in the aftermath of the 2011 Great East Japan Earthquake and the 2016 Kumamoto Earthquake. We interviewed Mr. Hiroaki Koda, general manager in Toyota Motor’s purchasing group (Fujimoto, Kato, & Iwao, 2016), on September 20, 2015, and Mr. Haruyoshi Hirano, executive vice president of Takeyama Foundry Co., Ltd. (one of Toyota’s keiretsu), on May 14, 2016. Each interview lasted about two hours. In September 2019, we sent a follow-up questionnaire 1 to both participants and received Mr. Hirano’s response on September 3, 2019, and Mr. Koda’s response on October 1, 2019.

1 The questions were: (1) About what percentage of the disaster response support team were you previously acquainted with? (2) What role did ordinary activities between your company and the other companies play in the disaster response? (3) What level of advance knowledge did the support team from Toyota have of the affected factory’s production facility layout, suppliers, work processes, process setup, etc.? (4) How was official leader at the time of the disaster recovery chosen?
Case Study

1. Case 1: Great East Japan Earthquake

Mr. Koda made the following comments during the interview and on the questionnaire. “The Great East Japan Earthquake caused severe and widespread damage and was characterized by the fact that it mainly affected suppliers at the secondary and lower levels of the supply chain.” “About 10 Toyota suppliers were affected by the Great Hanshin Earthquake, but about 600 suppliers suffered damage in the Great East Japan Earthquake.”

Immediately after the earthquake, Toyota Motor gathered data from Earthquake Response Headquarters, built up an understanding of the entire supply chain, and identified the critical auto parts that could seriously affect the assembler’s production. The most obvious of these were parts manufactured by Company R. “The fundamental idea behind restoring production is that priority should be placed on resuming (restoring) production at damaged factories,” he said. Regarding production at this factory, he commented, “The livelihoods of Company R’s employees were at risk, so our primary goal was to restore production, but if that proved to be impossible despite our best efforts, then we would have tried to transfer production to another factory owned by the same supplier.”

When he arrived at Company R, Mr. Koda had no personal connections and knew no one there. At the time, he had little knowledge of such things as the layout of the damaged factory’s production facilities, its suppliers, its work processes, or its process setup. However, he said, “Our internal support team included someone working in electronic production engineering at Toyota’s Hirose factory and some member from DENSO, which is in charge of electronic components, would have a certain degree of the required knowledge.”
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As for the damage inside Company R’s factory, a high-voltage cable had fallen, an acid exhaust duct had sustained catastrophic damage (semiconductor plants use large amounts of acid), and a tank containing acid was destroyed as well. About 150 chemical pumps had been flooded and were corroded. Although the structure had been sturdily constructed, we could clearly see the sky between the walls and the joists, so they had to be covered with vinyl sheets. The clean room, which needs to be kept airtight, was damaged, and some of the ceilings and walls had also collapsed. As a result, it was necessary to repair both the building itself and its infrastructure, and to fix about 1,700 expensive pieces of precision equipment within the factory through a program of maintenance and improvement. Company R had previously told the support team that it expected recovery to take about a year.

“Most manufacturers would go bankrupt if it takes over a year to recover. This isn’t just a problem for Toyota. It’s an issue for the entire global manufacturing industry, so we had to do something,” Mr. Koda thought. Therefore, “We put together an industry project team at the Japanese Automobile Manufacturers Association (JAMA) and headed to the site. Although Company R is headquartered in Tokyo, it had organized a local recovery team in the affected area. The number of companies working on the joint support team grew from there, until ultimately more than 60 companies were involved.”

According to Mr. Koda, the reasoning behind Toyota Motor’s heading this group of more than 60 companies was, “At the time of the Chuetsu Earthquake, which predated the Great East Japan Earthquake, we had been involved in support activities with JAMA. JAMA decided to work with Toyota as the leader of the support efforts.” In other words, Toyota Motor was officially designated as the leader of this group, and so the recovery work began.

The first task was to coordinate and map out the schedules of all the companies involved and then identify which repairs had to be
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finished by when. “After this, we identified those tasks that could be performed simultaneously, ascertained off-line set up, and envisioned possible construction bottlenecks. The make-up of the recovery team was constantly changing to best support its needs. We used Post-it notes to quickly and flexibly update the organization chart.”

Members new to the group had their strengths assessed and were given assignments. Although infrastructure reconstruction was initially estimated to take two-and-a-half months, it was actually completed in about 10 days. This is because the bottlenecks had been envisioned, and the task force worked together to eliminate them. Delegates sent from assemblers and other companies worked along with Company R, and “Even the equipment repair schedule was written in terms of how many weeks it would take to completely repair each device. If it seemed that we couldn’t keep to the schedule, we concentrated our resources and dealt with the delay so that manufacturing could resume. We succeeded in finishing the first lot on Day 13.”

Mr. Koda describes the conditions that enabled this recovery as follows: “The ability to recover is a question of having the ability to solve problems and make improvements (kaizen). We needed to standardize and write manuals based on our experiences with recovery as a matter of course, but the power of nature is strong, and unforeseen circumstances will always occur. It is therefore important to train staff to be able to make the correct on-site decisions, and it is essential to have personnel who can bring out the strengths of others through strong leadership.” On the topic of cooperating with the employees of other companies during a disaster response, he added, “From the standpoint of transcending corporate boundaries, setting goals, and tackling them in order from the top ranks of the corporation on down to those in the workplace, we were able to respond by tapping our experience from our regular jishuken
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(interfirm learning activities for productivity development and kaizen among Toyota’s keiretsu factories).

2. Case 2: Kumamoto Earthquake

The Kumamoto Earthquake occurred at 9:49 p.m. on April 14, 2016. Mr. Haruyoshi Hirano, Executive Vice President of Takeyama Foundry Co., Ltd., a firm that supplies auto parts to the Toyota Group, commented: “It was the first time in my life that I experienced such a big, big earthquake, and I thought that I might die, but at least, I got out of the building and am alive” (email sent April 14). Part of Takeyama Foundry’s Kumamoto Factory had just collapsed, exposing the building to rain damage, and much of its equipment had stopped functioning properly. The next day, April 15, Mr. Hirano mapped out the critical path of the restoration work by hand on a sheet of A0-size paper and embarked on the recovery work along with Takeyama Foundry’s employees. Foundry employees, including those who had been responsible for kaizen activities, immediately began working on repairing the equipment and reorganizing the production line by changing things like the equipment layout. Production was fully restored at 2:40 p.m. on April 15.

However, the situation suddenly changed when a second earthquake struck at dawn on April 16. The quake, measuring 7 on the Japanese seismic intensity scale, cracked the slate on the factory’s exterior and loosened bolts throughout the structure. As this was happening, Takeyama Foundry’s most critical casting equipment started a series of serious malfunctions. For example, the control panel used for iron melting stopped functioning, molds came out of their frames, and sand molds built up in the core, jamming the equipment. Furthermore, Mr. Hirano commented, “Of the five smelters, the coils on the two low-frequency furnaces burned out, causing irreparable damage.” (Except for emails, this quote and those that follow are taken from our interview and the questionnaire). As a
result, “They began diverting water into the high-frequency furnaces through their own power generation.” Therefore, on April 16 at 7:56 a.m., Mr. Hirano sent an email to Toyota assemblers and the authors, saying, “I regret to inform you, but production capacity on the accessory line will be dropping to about 30%. Please help us” (April 16 email). After receiving this email, Toyota Group Companies T1 and T2 dispatched a support team of 17 employees the following day, April 17.

The support team quickly arrived at the scene on April 20. About 40% of them were acquaintances of Mr. Hirano, having met him at regular jishuken inter-organizational learning events, and “Because people who know each other’s faces have an idea of who the other person is, we were able to tailor our requests according the skills of those involved. That is to say, for casting and other highly specialized tasks, we were able to ask for help from people who knew about melting furnaces and molding equipment, while asking people without specialized knowledge to focus on debris removal and other clean-up activities. More than anything else, the most useful thing of all was the network of colleagues who were all struggling with kaizen toward the same goals in ordinal jishuken. I was able to ask for a lot without hesitation.”

When the support team arrived, a project team was created around Mr. Hirano and one key person who worked on coordinating communications with the Toyota Group assemblers. Mr. Hirano explained how the leader was determined at the time, saying, “I basically decided on my own. First of all, the person had to have a cooperative spirit. That eliminated complainers and those who act as critics in hindsight. Since the team included outsiders, we had to clearly show the chain of command in a chart. The leader had to be someone with charisma. We were creating a temporary organization that didn’t necessarily need to be tied to the normal command structure. A simple chart showed organizational command. We held
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leadership meetings several times a day, clarified who would do what and by when, then codified it on paper and shared the information with the team.”

The recovery began with replacing the derailed frame of the casting equipment, which was followed by inspection and repair of the high-frequency furnaces’ electrical systems, then fixing the rainwater leaks, and repairing the rain-damaged electric furnaces. This series of operations was determined by the task force from T1 and T2 in “Excellence in First Response for Risk Management by the T Companies” (April 21 email). The actual work was carried out by the Takeyama Foundry’s kaizen and maintenance teams. According to Mr. Hirano, “Jishuken activities enabled us to identify and share how to control things and other priorities.”

In this way, normal kaizen activities had the positive effect of helping people get used to such things as minor changes in equipment, changes to layouts, and the creation of new mechanisms. The production recovery work reached its final stages when the conveyor belt was repaired. In this sequenced response, the 29 people from Companies T1 and T2 who were helping on April 23 rose to 34 by April 28. Takeyama Foundry’s Kumamoto Factory was thus able to resume operations on April 28, and the people involved held a barbecue to celebrate their success.

In a sequenced response, says Mr. Hirano, “It is important for the leadership to create a critical path by prioritizing things that can be controlled and that everyone moves along the same vector.”

Discussion and Conclusion

In the above two cases of the Great East Japan Earthquake and the Kumamoto Earthquake, the informal, flat (non-hierarchical) networks created by regular jishuken enabled the mutual accumulation of knowhow among organizations and the formation of
human networks transcending organizational boundaries. In particular, the regular accumulation of knowhow about kaizen, which is a method for solving production problems, has been useful during disasters. This is because kaizen and the restoration of damaged equipment are the same in that they are both ways of dealing with change.

However, this does not mean that regular knowledge-sharing alone will make it unnecessary for a firm to do anything else when dealing with an earthquake. When disaster strikes, Toyota Motor demonstrates leadership in forming project teams comprising supplier’s engineers and workers. For these situations, leaders are clearly identified in advance, and the system switches over to an officially organized and hierarchical temporary chain of command. The leadership is then able to determine the critical path for the recovery efforts, ensure that the organization’s members are acting in a unified manner, and quickly mobilize knowledge and human resources. Because of kaizen and jishuken among keiretsu in a flat organizational structure in normal situations, Toyota Motors and their keiretsu could share knowledge about the impact of changes to production equipment at the workplace engineering level. Additionally, management can quickly restore production during emergencies by switching over to a strong leadership style and utilizing the knowhow and personal connections developed during normal times.

In short, although the Toyota keiretsu holds a competitive advantage even during times of disaster recovery, the dynamic capabilities needed to respond to changes wrought by natural disasters (Fukuzawa, 2015; Kikuchi & Iwao, 2016; Teece, Pisano, & Shuen, 1997) require inter-organizational and interfirm relationships throughout the entire supplier system (Dyer & Singh, 1998).
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