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Pingsong Qian, Akitsu Oe

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The impact of organisational crisis on forgetting and relearning: an empirical study of unlearning in the Japanese electrical industry

Pingsong Qian*

Graduate School of Management,
Tokyo University of Science,
No. 1-11-2, Fujimi, Chiyoda-ku,
Tokyo, Japan
Email: linoqian@gmail.com
*Corresponding author

Akitsu Oe

School of Management,
Tokyo University of Science,
No. 1-11-2, Fujimi, Chiyoda-ku,
Tokyo, Japan
Email: oakitsu@rs.tus.ac.jp

Abstract: This research examines the trigger for top management team (TMT) unlearning and forgetting in organisational crises and the mechanism of their effects on organisational performance. The analysis uses a total of 2020 panel data from 202 listed firms across ten periods in the Japanese electrical equipment industry from 2008 to 2017, and multiple linear regression analysis using the random-effects model. The results demonstrate that TMT unlearning indirectly promotes organisational performance through the promotion of research and development (R&D) department unlearning. Furthermore, the occurrence of an organisational crisis promotes TMT unlearning and organisational forgetting. This study finds that although R&D department forgetting negatively affects organisational performance, R&D department unlearning has a positive effect, revealing the differences in the effects of forgetting and unlearning on organisational performance. Our study has theoretical contributions to research on organisational learning and organisational change and presents the importance of unlearning to firms and their stakeholders.

Keywords: unlearning; organisational forgetting; department unlearning; department forgetting; relearning; organisational learning; organisational change; top management team; TMT; electrical equipment; research and development.

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Biographical notes: Pingsong Qian acquired his Master of Management in 2022 from the Graduate School of Management of Tokyo University of Science. His research leans on organisational learning and R&D management of top management teams. His current job is a marketing executive at an advertising company in Japan. He is responsible for leading the business development of Japanese brands in the international market.

Akitsu Oe is an Associate Professor at the School of Management of Tokyo University of Science. Her current research focus is on absorptive capacity, network theory, entrepreneurship, history in theory, and knowledge transfer across time and regions. In recent years she has been the team leader of 'Knowledge creation that manages organisational inertia using multi-layered networks (JSPS KAKENHI Grant, No. JP21H00744)' and 'The impact of inter-organisational trust-based communities of practice network and geographical proximity on knowledge diffusion (JSPS KAKENHI Grant No. JP20K20763)'. She is the Vice President of the Japan Society for Management Information.

1 Introduction

Organisational learning for creating new knowledge is one of the most important phenomena for organisations (Prahalad and Hamel, 1993); however, organisational learning does not always positively affect organisations. For successful changes to be realised from organisational learning, unlearning, which is forgoing what has been learnt to learn something new (Hedberg, 1981), and forgetting, which is reducing old knowledge that influences organisational cognition and behaviour (Kluge et al., 2019), are important.

In recent years, unlearning has become increasingly important in organisational learning theory, but adequate conceptual and empirical research on unlearning is still lacking (Akgün et al., 2006; Klammer and Gueldenberg, 2019; Yang et al., 2014). Previous research has predominantly focused on the process of forgetting in unlearning (Yang et al., 2014). Forgetting causes loss of knowledge in an organisation (de Holan et al., 2004). Research reveals that when companies use forgetting, they are more likely to lose competitiveness, being unable to achieve their goals (de Holan and Phillips, 2004). In general, companies tend to be reluctant to employ forgetting, despite previous studies noting its positive effects on organisational performance (de Holan et al., 2004). However, unintentionally forgetting important organisational knowledge does have negative effects on an organisation (de Holan et al., 2004). Furthermore, organisations can be positively affected if they intentionally employ forgetting regarding existing knowledge, thereby recognising that existing knowledge may negatively impact organisational change and the acquisition of new knowledge (de Holan et al., 2004).

Previous research tends to treat unlearning and forgetting as having the same meaning (Klammer and Gueldenberg, 2019). However, according to the definitions of Hedberg (1981) and Tsang and Zahra (2008), unlearning involves two processes: forgetting and relearning. In other words, unlearning is the combination of forgetting and relearning, which involves the loss of knowledge and acquisition of new knowledge. In our study, the processes of relearning after forgetting too are adopted as unlearning. However, forgetting is defined as only forgetting; it is not accompanied by relearning.

It is vital to understand where organisational unlearning occurs. Zhao et al. (2013) suggested that unlearning is conducted on the individual, departmental, and organisational levels, and that individual unlearning promotes departmental unlearning, which in turn promotes organisational unlearning. Most previous studies focus on the organisational and individual levels, rather than the departmental level (Klammer and Gueldenberg, 2019). Our study focuses on unlearning and forgetting and investigates the mechanisms by which unlearning occurs between departments and the effects on organisational performance.

Our study aims to demonstrate the factors promoting unlearning in departments and their consequences on other departments and overall organisational performance.

2 Theory and hypotheses

2.1 Unlearning in organisational learning

Research on organisational learning focuses on how organisations adapt to environmental changes and the norms of their social environments (Kluge and Gronau, 2018). Organisational learning facilitates organisational change and development; the knowledge and learning capabilities of an organisation are an important competitive advantage (Prahalad and Hamel, 1993). Without effective organisational learning, organisations cannot improve their performance or remain competitive. However, organisational learning does not always have positive effects on organisations. Although organisations develop through continuous learning, social and technological change, misconceptions, intense competition, and social complexity make it difficult for organisations to develop sustainably and in the long term (Starbuck, 2017). If an organisation has a good understanding of its environment and can accurately predict the future, long-term and sustained learning can yield good results; otherwise, the organisation will acquire incorrect new knowledge, often leading to incorrect actions (Starbuck, 2017). Hedberg (1981) states that the environment surrounding an organisation is constantly changing, which often makes useful knowledge gained in the past obsolete, necessitating the learning of useful knowledge to adapt to the new environment. This is where unlearning becomes important.

Previous research suggests that unlearning is primarily a process of removing knowledge, beliefs, and routines from an organisation (Akgün et al., 2002; Hedberg, 1981; Klammer and Gueldenberg, 2019; Nystrom and Starbuck, 1984). In other words, unlearning is the change in beliefs and routines (Akgün et al., 2006). Tsang and Zahra (2008), after reviewing previous studies, define organisational unlearning as the discarding of old routines to make way for new ones, if any. Our study uses Tsang and Zahra's (2008) definition, which has been widely adopted by subsequent studies (Becker, 2019; Wang et al., 2017; Yang et al., 2014).

In unlearning, an organisation can adapt to changes in the environment and maintain or improve its competitive advantage by relearning after forgetting. Starbuck (1996) suggests that to overcome organisational crises, organisations should be suspicious of existing successes, look for potential sources of failure, and carefully consider outside opinions. Organisations' routines are continuously changing, reflecting changes in the company's external environment, and are gradually being updated, creating continuous unlearning and ensuring a successful adaptation to their changing environments (Becker,

2010; Tsang and Zahra, 2008). For example, if a company sets up a new division to internally manufacture another company's product, there is no need for unlearning as there is no old routine (Tsang and Zahra, 2008). Unlearning can be observed at the individual level. For example, start-ups have new organisational routines, but the members of the organisations need to learn these new routines (Tsang and Zahra, 2008). At the individual level, members may employ relearning after forgetting existing knowledge and beliefs to adapt to new routines (Miller and Martignoni, 2016). As a result, we consider that there is unlearning in newly established organisations because individual unlearning promotes the formation of routines through new knowledge acquisition (Zhao et al., 2013). Furthermore, newly acquired knowledge tends to become outdated (de Holan et al., 2004), and the organisation is encouraged to forget old knowledge and routines and relearn them. The relationship between forgetting and relearning is dynamic and complex, and a high degree of uncertainty exists regarding the impact of unlearning on organisations (Tsang and Zahra, 2008).

2.2 Previous research on forgetting and relearning

Organisational forgetting can occur through the organisational memory of errors and inadequacies (de Holan et al., 2004). Unintentional forgetting negatively affects an organisation, and that the knowledge of value in an organisation is dependent on organisational members (de Holan et al., 2004). In addition, unintentional forgetting of organisational knowledge due to factors such as staffing adjustments and disasters has been shown to negatively affect organisational reform and performance (Yang et al., 2014), and tends to reduce the competitiveness of an organisation (de Holan et al., 2004).

However, forgetting is not necessarily negative, and the importance of purposely forgetting existing knowledge to improve organisational efficiency is widely identified (de Holan et al., 2004). Forgetting can promote organisational change when existing knowledge is perceived to inhibit the acquisition of new knowledge (de Holan, 2011). Intentional forgetting of existing knowledge can improve an organisation's competitiveness by, for example, reorganising existing businesses to create new ones (de Holan et al., 2004). Therefore, organisations are likely to intentionally forget certain items or information in their organisational memory, such as organisational routines, to implement new strategies or realise their goals (Kluge and Gronau, 2018). For example, many camera companies have been affected by improvements in smartphone cameras. After withdrawing from the digital camera business, Olympus has decided to concentrate its management resources on the medical business, including endoscopes, and achieved organisational reform (Nikkei Money, 2021). As a result, their sales for the first quarter of 2021 were up 40% from the previous quarter (Nikkei Money, 2021).

In the aforementioned studies, forgetting is an aspect that can negatively affect organisations, departments, and individuals and can promote new learning (Agrawal and Muthulingam, 2015). Our study considers that forgetting is a loss of knowledge that may or may not foster subsequent new learning. Conversely, if new learning, or relearning occurs after forgetting, it has a positive effect on the organisation, but if it does not occur, it has a negative effect. In short, if forgetting leads to relearning, then it is unlearning, and unlearning positively affects organisations.

2.3 *Unlearning in the hierarchy*

Becker et al. (2006) suggest that while unlearning is important for organisations, learning by itself is not enough to enable long-term viability. Individual unlearning has the positive effect of knowledge acquisition and absorption (Leal-Rodríguez et al., 2015), facilitating knowledge transfer as well as innovation creation (Usman et al., 2018). Regarding the factors that cause individual unlearning, Becker (2010) proposed the following strategies: ‘understanding the need for change’, ‘assessment of new way’, ‘positive experience and informal support’, ‘positive prior outlook’ and ‘feelings and expectations. Matsuo (2020) suggests that managers’ abilities related to ‘decision making’, ‘motivation’, and ‘information gathering’ lead to individual unlearning and organisational learning, and that the higher a manager’s ability, the more likely they are to promote individual unlearning.

At the department level, Akgün et al. (2006) discussed unlearning in R&D departments, and its effects on the success of new products. The results show that crises and anxiety of the members in the department directly impact departmental unlearning. In other words, individual unlearning in crisis and anxiety promotes departmental unlearning among department members. Additionally, Akgün et al. (2006) showed that unlearning, which is a change in department beliefs and routines, positively influences the success of new products by incorporating new knowledge and information.

The above explanations regarded unlearning within each hierarchy; however, each level of hierarchy has an impact on the other levels (Cegarra-Navarro and Wensley, 2019). Zhao et al. (2013) identified that individual unlearning promotes departmental unlearning; furthermore, departmental unlearning promotes organisational unlearning. Cegarra-Navarro and Moya (2005) discuss the effects of individual and departmental unlearning on human capital and organisational performance. Their results indicate that individual unlearning promotes departmental unlearning and that intellectual capital, the knowledge and know-how needed to generate profitability, depends on departmental unlearning (Cegarra-Navarro and Moya, 2005). Therefore, unlearning is conducted at three levels: individual, department, and organisation.

The previous studies on unlearning show that it is a complex process and is important for both organisations, departments, and individuals. For example, Hitachi Ltd. of Japan’s electrical equipment industry, announced a loss of 787.3 billion yen in 2009 after the Lehman shock (Nikkei Money, 2021). To address this, Hitachi withdrew from existing television productions and cell phone operations and sold off 22 listed subsidiaries (Nikkei Business, 2021). Subsequently, they acquired an American information technology (IT) company for a large sum, concentrated their management resources in the IT field, and received a record net profit of 506.6 billion yen in 2021 (Nikkei Money, 2021). This sale of business or subsidiaries is forgetting and discarding old knowledge, and the acquisition of new knowledge, through business acquisition, is relearning after forgetting, which ultimately can promote organisational performance.

The difference between forgetting and unlearning has been noted in previous studies and discussed separately (de Holan et al., 2004; Akgün et al., 2006). However, few studies have combined both. Yang et al. (2014) included forgetting and unlearning in their study based on a questionnaire survey of Taiwan’s high-tech industry; they identified that organisational unlearning promotes radical innovation; whereas, forgetting decreases radical innovation. Moreover, forgetting demonstrated that external suppliers and consumers gave up on their expectations from the company (Yang et al., 2014).

However, Yang et al.'s (2014) study focuses on the organisational level and does not discuss whether the same results would be found at the departmental level. Therefore, in our study, we combine organisation and department, and discuss unlearning and forgetting.

2.4 Organisational crises and organisational forgetting

Organisational restructuring can take place owing to the factors that cause organisational forgetting (de Holan et al., 2004). For example, the size of the organisation may be reduced by discontinuation or disposal of business, or key employees may leave the company due to layoffs.

The external environment of a company is characterised by rapid change and unpredictability (Hedberg, 1981). According to Nystrom and Starbuck (1984), organisational crises occur from environmental instability and are an important factor that promotes unlearning. Many companies lose money or go bankrupt if they are unable to change their routines or respond to changes in their external environment due to a lack of organisational flexibility (Lyu et al., 2020). When firms realise that their knowledge and strategies are useless for survival, they tend to unlearn them (Teece, 2007).

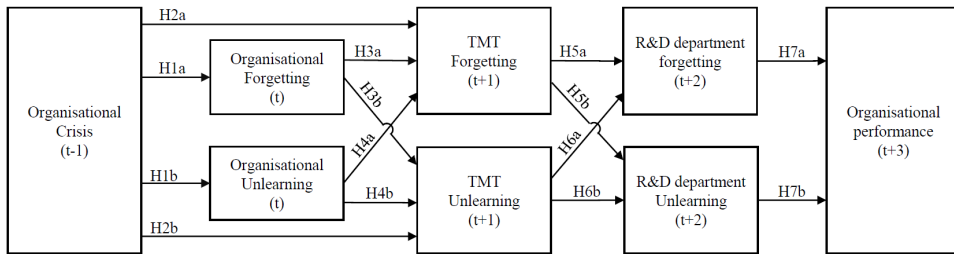
The top management team (TMT) is the department involved in such unlearning and strategic decision-making, and plays a key role in the survival and success of the firm (Nystrom and Starbuck, 1984). Discarding existing beliefs, routines, and knowledge through TMT decision-making can lead to business consolidation and the redistribution of resources. As a result, companies can adapt quickly and flexibly to a rapidly changing environment (Akgün et al., 2006).

As an impediment to this, Nystrom and Starbuck (1984) identified that TMT's behaviour is due to beliefs and ideas. As organisations often reflect what they learn through routines, these routines can become TMT's beliefs over time, resulting in organisational inertia that can lead to a crisis. Hannan and Freeman (1984) identified that 'structures of organisations have high inertia when the speed of their reorganisation is much slower than the rate at which their environmental conditions change'. Particularly, as successful experiences accumulate in an organisation, TMTs focus on organisational efficiency and become complacent, resulting in less organisational learning. For an organisation to survive, TMTs should forget old beliefs and behaviours that stem from organisational problems and subsequently acquire new knowledge (Nystrom and Starbuck, 1984).

Therefore, although an organisational crisis is an important factor that causes unlearning, we consider that it is important for organisations to implement forgetting as the first step to unlearning. The following hypotheses are proposed based on the assertion that organisational forgetting, resulting from divestiture or sale of existing businesses, will help an organisation overcome a crisis. A summary of the hypotheses presented in the following sections is shown in Figure 1.

Hypothesis 1a When an organisation is in crisis, it engages in organisational forgetting only.

Hypothesis 1b When an organisation is in crisis, it engages in organisational unlearning.

Figure 1 Hypothetical overall view

2.5 TMT unlearning and R&D department forgetting

Unlearning is triggered by challenges (Hedberg, 1981), for example, environment changes (Akgün et al., 2007), customer needs, laws and regulations changes (Cegarra-Navarro et al., 2010). When an organisation faces such problems, the direction of organisational inertia changes from successful experience to an inability to forget old knowledge and behaviours and a failure to complete subsequent relearning.

Starbuck (2017) suggests that companies need to decrease the number of structures and personnel for old tasks to incorporate new ideas and actions. Therefore, if a company undertakes a new project or business, it is likely to take on new ideas and actions if top management is reduced to being stuck in old strategies and beliefs about the environment. Organisational forgetting through divestitures has also been shown to cause employees, investors, and other stakeholders to doubt the abilities and undermine the credibility of TMTs (Starbuck, 2017). To address this problem, we offer the following hypotheses: starting with a company terminating a TMT member in a key position with the divested business for new members to be brought in to gain new trust from the organisation's stakeholders.

- Hypothesis 2a When an organisation is in crisis, it engages in only TMT forgetting.
- Hypothesis 2b When an organisation is in crisis, it engages in TMT unlearning.
- Hypothesis 3a If the organisation employs only organisational forgetting, it engages in only TMT forgetting.
- Hypothesis 3b TMT unlearning is when the organisation performs only organisational forgetting.
- Hypothesis 4a When organisations do organisational unlearning, it engages in only TMT forgetting.
- Hypothesis 4b TMT unlearning is when the organisation performs organisational unlearning.

The new TMT member may reject the ideas and actions of their predecessor, or find and use expertise, skills, patents, or other resources that were not of interest to their predecessor (Starbuck, 2017). New TMT members can easily transform the knowledge left by the removed TMT in their thinking and decision-making regarding strategy and rebuild it with a new strategy (Starbuck, 1983). Our study considers this to be the

acquisition of new knowledge of TMTs and believes that TMT forgetting through the sale of a business causes the acquisition of new knowledge.

To respond to market and customer needs, R&D departments need to constantly update established routines, knowledge, and ideas, and create innovation in their organisations (Akgün et al., 2006). R&D departments may also discard existing work procedures, information sharing mechanisms, and decision-making mechanisms within the R&D department by developing a business strategy involving the replacement of TMT directors (Akgün et al., 2006). This research considers that forgetting TMT, and the acquisition of new knowledge in TMT occur through the forgetting of the R&D department. Since the process of unlearning includes the processes of forgetting and then acquiring new knowledge, we consider that unlearning in TMT causes R&D department forgetting. Furthermore, the simultaneous occurrence of TMT forgetting and the acquisition of new knowledge in TMTs further strengthens R&D department forgetting.

Hypothesis 5a If the organisation employs only TMT forgetting, the R&D department employs only forgetting.

Hypothesis 5b If the organisation employs only TMT forgetting, the R&D department employs unlearning.

Hypothesis 6a When the organisation performs unlearning of the TMT, the R&D department performs only forgetting.

Hypothesis 6b When the organisation unlearns TMT, the R&D department unlearns TMT.

2.6 R&D department unlearning and organisational performance

Companies tend to stick to past successful experiences (Nystrom and Starbuck, 1984) and prefer not to change constantly. An organisation's existing routines are more likely to become 'capability traps' and prevent the acquisition of external knowledge (Morais-Storz and Nguyen, 2017). Arthur (1984) identify that 'the environmental implications of competency traps are considerable. In effect, learning produces increasing returns to experience (thus typically to scale) and leads an organisation, industry, or society to persist in using a set of procedures or technologies that may not be optimal'.

The abandonment of existing knowledge by the R&D department drives the acquisition of new knowledge (Akgün et al., 2006). Through this process, knowledge is reorganised to update existing knowledge and technology (Akgün et al., 2006). As a result, unlearning can be viewed as a catalyst for innovation (Becker, 2008). When unlearning is performed, routines and beliefs are updated, and innovation may be generated by applying new routines. This is because it encourages innovation and new products and services that are more likely to address market and technological issues. Therefore, by forgetting, the R&D department may discard existing knowledge, routines, and technologies, and bring in the adoption of new knowledge and technologies. The following hypotheses are proposed based on the consideration that this will result in improved organisational performance through the development of new products and successful innovations.

Hypothesis 7a If the R&D department only employs forgetting, the organisational performance will improve.

Hypothesis 7b When the R&D department employs unlearning, the organisational performance will improve.

3 Methods

3.1 Sample and data

Our study utilises panel data from 202 listed firms in the Japanese electrical equipment industry from 2008 to 2017. However, the analysis took a three-year lag for gross profit and, therefore, the panel data used in the analysis included ten periods.

The Japanese electrical industry in this analysis refers to the electrical machinery and equipment manufacturing industry; electronic components, devices, and circuits manufacturing industry; and information and telecommunications machinery and equipment manufacturing industry, which are classified as manufacturing industries in Japan's standard industrial classification by the Ministry of Internal Affairs and Communications (2013). According to the Ministry of Economy, Trade and Industry (2020) Industrial Statistical Survey, the equipment industry had 855,400 employees in 2019, placing it third in the overall manufacturing industry. From 2015 to 2019, the 'value of shipments by industry' in Japan's electrical equipment industry was 188.12 trillion yen, accounting for 10.59% of the total manufacturing industry (Ministry of Economy, Trade and Industry, 2020). These statistics indicate that the Japanese equipment

The corporate financial data and indicators of organisational crisis and organisational performance were obtained from Nikkei NEEDS-Financial QUEST. Data on business sales and acquisitions, an indicator of organisational unlearning, were obtained from the Official Gazette Information Retrieval Service. Information on executive member replacements for TMT's unlearning index was obtained from the Quarterly Report of Executives in the Toyo Keizai Digital Content Library. Changes in the patent field, as an indicator of R&D department unlearning, were taken from Patent Integration.

3.2 Measurement

3.2.1 Dependent variables

The number of dependent variables is seven, *organisational forgetting*(t), *organisational unlearning*(t), *TMT forgetting*($t + 1$), *TMT unlearning*($t + 1$), *R&D department forgetting*($t + 2$), *R&D department unlearning*($t + 2$), and *organisational performance*($t + 3$). Each variable is lagged, so the base year is described as t , and one year later as $t + 1$.

Organisational forgetting(t) is defined as the number of divestitures that did not involve business acquisitions. The calculation method was based on the Official Gazette Information Retrieval Service, a Japanese government database, using the keywords 'business divestiture' and 'company name' to find applicable data, and counting as 1 if the business was transferred to a company that is not a subsidiary and if no business acquisition occurred. For example, suppose the number of business divestitures at time t is 2. If business acquisitions occur at time t , the value is 0. If no business acquisitions at time t occur, the value is 2.

Organisational unlearning(t) is defined as the number of business acquisitions associated with divestitures. The calculation method was the same as described above and counted as 1 when the business was acquired by a company that is not a subsidiary and when the divestiture of the business occurs. For example, suppose that the number of business acquisitions at time t is 2. The value is 2 if a business divestiture at time t occurs, and 0 if no business divestiture at time t occurs. We created this variable because Nystrom and Starbuck (1984) state that when a firm is in an organisational crisis due to poor performance, it is more likely to survive the crisis through divestitures of its business or acquisitions of a new business.

TMT forgetting($t + 1$) is defined as the number of directors decreased if no additional directors were added one year after the divestiture of the business. The calculation was based on the number of directors who were not listed in the Quarterly Report of Executives in Nikkei NEEDS-Financial QUEST, even though they existed in the previous year, if no new directors were added when compared to those in the previous year. For example, on the one hand, if no directors have been added and the number of unlisted directors is 3 compared to the names of directors at $t + 1$ and t , the value is 3. On the other hand, if the number of added directors is not 0, the value is 0. Starbuck (2017) stated that a company on the verge of bankruptcy could survive through the replacement of its directors. We created this variable because we consider that the reduction in the number of directors associated with the replacement of directors will lead to the forgetting of past information and knowledge, as well as past organisational behaviour.

TMT unlearning($t + 1$) is defined as the number of additional directors with a reduction in directors one year after the divestiture of the business. The calculation method was based on the number of directors added to the Quarterly Report of Executives, if there was a decrease in the number of directors, compared to the previous year's entry for the names of directors. For example, when comparing the names of the directors at $t + 1$ and t , if the number of directors to be added is 3 and the number of directors reduced is not 0, the value is 3. If the number of directors added is 0, the value is 0. Starbuck (2017) stated that hiring a new executive not only brings new knowledge and ideas to an organisation but also allows the organisation to review its existing strategies and operations and restructure its business based on new strategies.

R&D department forgetting($t + 2$) is defined as the number of patent fields decreased without any additional patent fields being added after two years of business divestiture. The decrease in the number of patent fields is an indicator of R&D department forgetting, as it may result in a decrease or loss of knowledge. The calculation method was based on the patent database, Patent Integration, and was set to 0 if a new patent field was added to the patent field acquired two years after the divestiture of the business, compared to the patent field acquired one year after the divestiture of the business. If no additions were made, the number of patent fields decreased. For example, assume that the field of patents obtained at $t + 1$ is A, B, C, D. The fields of patents obtained at $t + 2$ are C and D. In this case, the fields A and B are not at $t + 2$, so the value is 2. Moreover, suppose that the fields of patents obtained at $t + 2$ are C, D, and E. In this case, the value is 0 because there is a new patent field E.

R&D department unlearning($t + 2$) is defined as the number of patent fields added with a decrease in patent fields two years after the divestiture. The calculation method was based on the number of patent fields obtained from the Patent Integration database two years after the divestiture of the business, compared to the number of patent fields obtained one year after the divestiture of the business. If a new patent field was added,

the number of fields added was used; otherwise, the number was set to 0. For example, suppose that the fields of patents obtained in year $t + 1$ are A, B, C, and D. Assume that the fields of patents obtained at $t + 2$ are C, D, and E. In this case, A and B are gone, and the value is 1 because the field of E is newly added at $t + 2$. Alternatively, suppose that the fields of patents obtained at $t + 2$ are A, B, C, D, and E. In this case, the field of patents is not reduced, and the field of E is newly added at $t + 2$, but the value is 0. This is based on Ardito et al. (2016), who found that changes in patent fields facilitate the acquisition of new knowledge.

Organisational performance($t + 3$) uses the gross profit three years after the divestiture of the business. Gross profit in Nikkei NEEDS-Financial QUEST was used for the calculation method. Similar to previous studies, gross profit is adopted as an indicator of organisational performance (e.g., Liao et al., 2015). Given that patent approval takes about nine months after several years of R&D (Japan Patent Office, 2019), our study used gross profit ($t + 3$) three years after the divestiture of the business (t), one year after the change in the R&D department patent field ($t + 2$).

3.2.2 Independent variables

The independent variables are *organisation crisis*($t - 1$), *TMT forgetting*($t + 1$), *TMT unlearning*($t + 1$), *R&D department forgetting*($t + 2$), and *R&D department unlearning*($t + 2$). Those other than the *organisation crisis*($t - 1$) have been explained in the previous section.

Organisation crisis($t - 1$) is used as the rate of increase in corporate deficit before divestiture of the *business*($t - 1$). If the net income was greater than 0, the value was set to 0, and if the net income was negative, the absolute value was calculated by dividing the deficit one year before the year in which the divestiture of the business occurred, by the deficit three years before the year in which the divestiture occurred.

3.2.3 Control variables

The control variables used in the analysis are *total assets* as a variable explaining the size of the firm; average *age of TMT* (Matsuo, 2020), and *net income per director* as variables explaining director characteristics; and *R&D intensity* (Lin et al., 2012) as a variable that explains the R&D capacity of an organisation. *Great East Japan earthquake dummy* is created as a variable to explain social conditions. All variables use values for the year in which the divestiture of the business occurred.

Total assets used data from Nikkei NEEDS-Financial QUEST. The *average age of TMT* used data from the Quarterly Report of Executives on the average age of directors. *Net income per director* is the company's net income divided by the number of directors for the year. This variable indicates the net income of the firm per executive, which is indicative of TMT performance. *R&D intensity* is R&D expenses divided by sales. The *Great East Japan earthquake dummy* is created to consider the impact of the earthquake and the resulting tsunami that struck mainly in the eastern part of Japan in March 2011. The data for the panel corresponding to 2011 was set to 1, and the data for the rest of the year was set to 0.

All control variables were standardised except for the *Great East Japan earthquake dummy*.

Table 1 Correlation and descriptive statistics

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1 Organisational performance ^f (t + 3)	0.23	0.95	1												
2 Total assets ^f	2.03	0.95	0.67***	1											
3 Average age of TMT ^g	5.30	0.99	0.07***	0.09***	1										
4 Net income per director ^g	14.29	1.00	0.08***	0.43***	0.04**	1									
5 R&D intensity	0.88	0.84	0.03	0.04*	-0.06***	0.00	1								
6 Great East Japan earthquake dummy	0.10	0.30	0.02	-0.02	-0.07***	-0.07***	0.02	1							
7 Organisational crisis(t - 1)	0.19	1.52	0.11***	0.05**	0.02	0.01	0.01	-0.02	1						
8 Organisational forgetting(t)	0.03	0.21	0.22***	0.23***	0.00	0.11***	0.03	0.02	0.19***	1					
9 Organisational unlearning(t)	0.01	0.09	0.27***	0.32***	0.04*	0.16***	-0.01	-0.02	-0.01	-0.01	1				
10 TMT forgetting(t + 1)	0.13	0.50	-0.04*	-0.04*	-0.04*	-0.01	0.00	-0.01	0.05**	-0.02	-0.02	1			
11 TMT unlearning(t + 1)	1.36	1.65	0.42***	0.32***	0.08***	-0.03	-0.04*	0.04	0.05**	0.23***	0.18***	-0.21***	1		
12 R&D department forgetting(t + 2)	0.89	3.76	-0.05**	0.08***	0.10***	0.11***	0.03	-0.06***	-0.02	-0.02	-0.01	0.00	-0.02	1	
13 R&D department unlearning(t + 2)	4.90	6.81	0.34***	0.37***	0.09***	0.18***	-0.01	0.02	0.04*	0.12***	0.12***	0.00	0.18***	-0.17***	1

Notes: N is 2020; ^f is standardisation; SD is standard deviation; TMT is top management team; R&D is research and development; *P < 0.10, **P < 0.05, ***P < 0.01.

Table 2 Results of random-effects model

		(a)			
No.	Variables	Organisational forgetting(<i>t</i>)		Organisational unlearning(<i>t</i>)	TMT forgetting (<i>t</i> + 1)
		I	II	III	IV
2	Total assets [#]	0.033*** [0.008]	0.036*** [0.007]	0.030*** [0.002]	-0.016 [0.014]
3	Average age of TMT [#]	-0.004 [0.005]	-0.005 [0.005]	0.001 [0.002]	-0.019* [0.012]
4	Net income per director [#]	0.007 [0.005]	0.007 [0.005]	0.002 [0.002]	0.002 [0.012]
5	R&D intensity [#]	0.003 [0.008]	0.004 [0.007]	-0.002 [0.002]	-0.003 [0.013]
6	Great East Japan earthquake dummy	0.013 [0.014]	0.015 [0.014]	-0.004 [0.007]	-0.014 [0.037]
7	Organisational crisis(<i>t</i> - 1)		0.020*** [0.003]	-0.002 [0.001]	0.020*** [0.008]
8	Organisational forgetting(<i>t</i>)				-0.051 [0.057]
9	Organisational unlearning(<i>t</i>)				-0.025 [0.129]
10	TMT forgetting(<i>t</i> + 1)				
11	TMT unlearning (<i>t</i> + 1)				
12	R&D department forgetting(<i>t</i> + 2)				
13	R&D department unlearning(<i>t</i> + 2)				
	Constant	-0.117 [0.073]	-0.124* [0.072]	-0.086*** [0.031]	0.233 [0.180]
	Observations	2020	2020	2020	2020
	Number of groups	202	202	202	202
	Obs. per group	10	10	10	10
	R-sq. within	0.001	0.014	0.010	0.003
	R-sq. between	0.227	0.293	0.615	0.033
	R-sq. overall	0.054	0.085	0.104	0.006

Notes: 1 [#] is standardisation; TMT is top management team; R&D is research and development; R-sq is R-squared.

2 Standard errors are in parentheses.

3 **P* < 0.10, ***P* < 0.05, ****P* < 0.01.

Table 2 Results of random-effects model (continued)

		(b)			
No.	Variables	<i>TMT</i> <i>unlearning</i> <i>(t + 1)</i>	<i>R&D</i> <i>department</i> <i>forgetting(t + 2)</i>	<i>R&D</i> <i>department</i> <i>unlearning</i> <i>(t + 2)</i>	<i>Organisational</i> <i>performance</i> [#] <i>(t + 3)</i>
		<i>V</i>	<i>VI</i>	<i>VII</i>	<i>VIII</i>
2	Total assets [#]	0.518*** [0.053]	0.265** [0.109]	1.381*** [0.265]	0.493*** [0.025]
3	Average age of TMT [#]	0.169*** [0.038]	0.373*** [0.085]	-0.429*** [0.162]	-0.002 [0.016]
4	Net income per director [#]	-0.322*** [0.037]	0.340*** [0.094]	0.080 [0.147]	-0.170*** [0.015]
5	R&D intensity [#]	-0.098* [0.053]	0.152 [0.099]	-0.182 [0.259]	0.011 [0.024]
6	Great East Japan earthquake dummy	0.199* [0.103]	-0.568** [0.277]	0.536 [0.392]	0.041 [0.040]
7	<i>Organisational crisis(t - 1)</i>	-0.015 [0.021]	-0.061 [0.055]	0.048 [0.008]	0.021** [0.008]
8	<i>Organisational forgetting(t)</i>	0.944*** [0.168]	-0.651 [0.429]	1.175* [0.664]	-0.215*** [0.067]
9	<i>Organisational unlearning(t)</i>	1.886*** [0.363]	-2.072** [0.962]	1.271 [1.399]	0.059 [0.142]
10	<i>TMT forgetting(t + 1)</i>		0.027 [0.169]	0.207 [0.148]	0.020 [0.025]
11	<i>TMT unlearning (t + 1)</i>		-0.052 [0.057]	0.181** [0.090]	0.066*** [0.009]
12	<i>R&D department forgetting(t + 2)</i>				-0.016*** [0.004]
13	<i>R&D department unlearning(t + 2)</i>				0.016*** [0.002]
	Constant	4.055*** [0.542]	-6.448*** [1.355]	3.016 [2.191]	1.503*** [0.221]
	Observations	2020	2020	2020	2020
	Number of groups	202	202	202	202
	Obs. per group	10	10	10	10
	R-sq. within	0.033	0.034	0.000	0.025
	R-sq. between	0.443	0.077	0.291	0.766
	R-sq. overall	0.178	0.032	0.126	0.534

Notes: 1 # is standardisation; TMT is top management team; R&D is research and development; R-sq is R-squared.

2 Standard errors are in parentheses.

3 * $P < 0.10$, ** $P < 0.05$, *** $P < 0.01$.

3.3 Statistical methods

Considering the multi-firm, multi-year structure of the data used in this research, we determined that the panel data method is appropriate for testing the hypotheses. In addition, the Hausman (1978) test was conducted using the control and independent variables for each dependent variable to select fixed and random effect models. The results showed that the model to be applied for each dependent variable was different. Therefore, we compared the results of the fixed and random effect models, and since the tendency of the analysis results was similar for both models, we considered that the same analytical model should be used to compare the results of the analysis. Therefore, we adopted the random-effects model, as it is a more efficient estimation method, with smaller standard errors of the estimator compared to the fixed-effects model.

4 Analysis and results

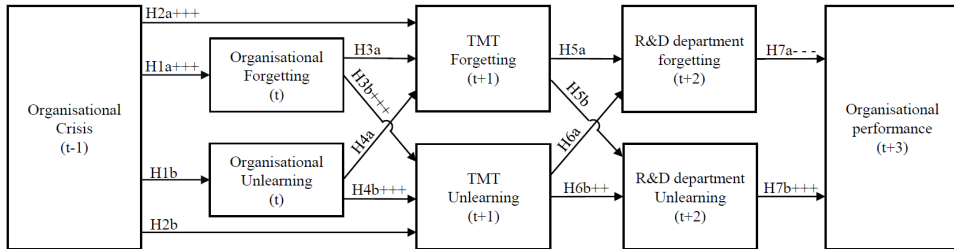
The results of Pearson's correlation coefficient and descriptive statistics are presented in Table 1. The maximum absolute value of the correlation coefficient between each variable was 0.67 for total assets and gross profit ($t + 3$). The maximum value of VIF, an indicator of multi-collinearity, was 2.66, which is below the threshold value of 10, and, therefore, no problem was found (Belsley et al., 2005).

The analyses of the random-effects model are presented in Tables 2(a) and 2(b). Model II shows that *organisational crisis*($t - 1$) has a positive effect ($p < 0.01$) on *organisational forgetting*(t). Therefore, Hypothesis 1a that when an organisation is in crisis, it engages in organisational forgetting only, is strongly supported. From model III, Hypothesis 1b that when an organisation is in crisis, it engages in organisational unlearning, is not supported, because *organisational crisis*($t - 1$) does not affect *organisational unlearning*(t). From model IV, *organisation crisis*($t - 1$) positively ($p < 0.01$) affects *TMT forgetting*($t + 1$); thereby supporting Hypothesis 2a that when an organisation is in crisis, it engages only in TMT forgetting. *Organisational forgetting*(t) and *organisational unlearning*(t) did not affect *TMT forgetting*($t + 1$), indicating that Hypothesis 3a that if the organisation employs only organisational forgetting, it engages only in TMT forgetting, and Hypothesis 4a that when organisations do organisational unlearning, it engages only in TMT forgetting are not supported.

From model V, *organisation crisis*($t - 1$) has no effect on *TMT unlearning*($t + 1$); therefore, Hypothesis 2b that when an organisation is in crisis, it engages in TMT unlearning, is not supported. Hypothesis 3b that TMT unlearning is when the organisation performs only organisational forgetting, is supported as *organisational forgetting*(t) had a positive effect ($p < 0.01$) on *TMT unlearning*($t + 1$). Furthermore, Hypothesis 4b that TMT unlearning is when the organisation performs organisational unlearning is supported, because *organisational unlearning*(t) had a positive effect ($p < 0.01$) on *TMT unlearning*($t + 1$). From model VI, *TMT forgetting*($t + 1$), and *TMT unlearning*($t + 1$) had no effect on *R&D department forgetting*($t + 2$). Hence, Hypothesis 5a that if the organisation employs only TMT forgetting, the R&D department employs only forgetting, and Hypothesis 6a that when the organisation performs unlearning of the TMT, the R&D department performs only forgetting, are not supported. From model VII, *TMT forgetting*($t + 1$) had no effect on *R&D department unlearning*($t + 2$). Thus, Hypothesis 5b that if the organisation employs only TMT

forgetting, the R&D department employs unlearning, is not supported. Hypothesis 6b that when the organisation unlearns TMT, the R&D department unlearns TMT, is supported, because *TMT unlearning*($t + 1$) has a positive ($p < 0.05$) effect on *R&D department unlearning*($t + 2$). From model VIII, *R&D department forgetting*($t + 2$) has a negative effect ($p < 0.01$) on *organisational performance*($t + 3$). Therefore, Hypothesis 7a that if the R&D department only employs forgetting, the organisational performance will improve, is not supported. *R&D department unlearning*($t + 2$) has a positive effect ($p < 0.01$) on *organisational performance*($t + 3$), supporting Hypothesis 7b that when the R&D department employs unlearning, the organisational performance will improve. These results are shown in Figure 2.

Figure 2 Hypothetical and analysis result overall view



Notes: 1 + is positive influence and - is negative influence.
 2 + $P < 0.10$, ++ $P < 0.05$, +++ $P < 0.01$.
 3 - $P < 0.10$, -- $P < 0.05$, --- $P < 0.01$.

5 Discussion

5.1 Contributions

Our study, using data from the Japanese electrical equipment industry, reveals the factors that promote TMT unlearning and forgetting in organisational crises and the mechanisms by which these factors affect organisational performance. We demonstrate that TMT unlearning indirectly promotes organisational performance through the promotion of R&D department unlearning. Furthermore, the occurrence of an organisational crisis promotes TMT unlearning and organisational forgetting. We find that R&D department forgetting negatively affects organisational performance; however, R&D department unlearning has a positive effect, revealing the difference between the effect of forgetting and unlearning on organisational performance.

Based on the foregoing results, our study has five contributions. First, previous research often demonstrates single-level unlearning and forgetting. Zhao et al. (2013) and Cegarra-Navarro and Wensley (2019) found that when the environment of the organisation changes, individual unlearning is transmitted through departmental unlearning to promote organisational unlearning, indicating that organisational unlearning has an impact on departmental and individual unlearning. Across the multiple levels of hierarchy from organisation to department, our study demonstrates that organisational forgetting and organisational unlearning have positive effects on TMT unlearning when organisations are in crises. Furthermore, we find that TMT unlearning

positively effects R&D unlearning. This is not only a major theoretical contribution to unlearning research but also a practical contribution, with important implications regarding the strategic success of the inevitable change of TMT directors for companies.

Second, unlike previous studies on unlearning and forgetting focused on questionnaires, our study uses archival data to identify the factors that promote unlearning and forgetting, and their impact on organisational performance. In previous research, relevant studies are mostly theoretical, and in the case of empirical studies, most of them are based on case analyses and questionnaire surveys of specific companies, and there are few empirical studies for many companies using archival data (Becker, 2019). Hedberg (1981) suggests that unlearning is provoked by difficulties in the organisation, and Starbuck (1996, 2017) shows through case analysis that organisational crisis causes TMT unlearning. Akgün et al. (2006), through a questionnaire survey of departments, show that an unstable environment has a positive effect of departmental crisis, sense of crisis, and departmental unlearning. Our study clarified the factors that cause unlearning by considering the rate of increase in losses from three years before the sale of a business as an organisational crisis, and by capturing the actual organisational behaviour of companies, such as the number of business sales, changes in the number of board members after the sale of a business, and changes in the number of patent fields. This is a major theoretical contribution, presenting the possibility of various indicators and analytical methods for future unlearning research using archival data.

Third, our study demonstrates unlearning and forgetting among departments. Previous studies mainly focus on only one organisation (e.g., Akgün et al., 2006; Nystrom, and Starbuck, 1984; Wang et al., 2017) or on the organisational and individual levels (e.g., Leal-Rodríguez et al., 2015; Starbuck, 1996), and there are few studies on multi-department unlearning and forgetting. Akgün et al. (2006), focusing only on an R&D department, explain that this department promotes the success of new product development as an organisational performance through unlearning. Our study expands on the findings of Akgün et al. (2006) and finds that organisational crises can lead to organisational and TMT unlearning, and then to R&D department unlearning. We demonstrate the mechanism of the indirect positive effect of unlearning. Furthermore, the results regarding the positive effects of unlearning within the R&D department on organisational performance are consistent with prior research. The above results are theoretical contributions to unlearning research.

Fourth, while forgetting and unlearning have often been confused in previous studies, a distinction has been made in recent years (Klammer and Gueldenberg, 2019; Kluge et al., 2019). Our study demonstrates the effects of forgetting and unlearning on organisational performance by means of a hypothesis constructed based on a definition that includes unlearning in the process of forgetting, after a close examination of the definitions used in prior studies. de Holan (2011) found that forgetting improves organisational performance, promotes organisational learning and relearning (Wang et al., 2013), absorbs new knowledge and creates innovation (Becker, 2018), and promotes organisational change (Akgün et al., 2006, Tsang and Zahra, 2008). Our study presents that R&D department forgetting has a negative effect on organisational performance. Using archival data, we demonstrate that forgetting is a loss of knowledge and does not involve relearning, which is the acquisition of new knowledge, and, therefore, forgetting will not allow an organisation to succeed. This result is similar to Yang et al.'s (2014) research, which found that forgetting promotes innovation creation,

but not organisational performance. The clarification of the role of forgetting in unlearning is a vital theoretical contribution to unlearning research.

Finally, the study results offer various suggestions on how organisations can strategically manage unlearning. First, it is common for companies with deteriorating performances to sell their businesses to survive. It became clear that TMT unlearning is the key to improving final organisational performance, and R&D forgetting without relearning has a strong negative effect on organisational performance. In other words, companies with deteriorating performances should be aware of implementing R&D unlearning from TMT unlearning. Furthermore, while resignations of TMT members are unavoidable for various reasons, even if the resignation of a TMT member seems to be disadvantageous, a company could avoid it by bringing in a new TMT member. In response to previous research that found that companies need to manage the direct or indirect effects of unlearning to conduct sustainable, effective, and efficient organisational learning, the importance of integrating unlearning into an organisational learning strategy is clear (Klammer and Gueldenberg, 2019).

5.2 Limitations and future directions

This study has a number of limitations. First, this research does not clarify the circumstances which lead to an organisation inability to learn, TMT forgetfulness, and R&D department forgetfulness. Our study focuses on the organisational crisis as a factor that promotes TMT forgetting and organisational forgetting. Although it also promotes unlearning, it does not affect organisational unlearning. Future research should examine the various factors that induce organisational unlearning, TMT forgetting, and R&D department forgetting with the following variables. Lee (2011) suggests that stressors such as workload, time pressure, job scope, and high responsibility have a positive effect of departmental unlearning. Variables such as individual entrepreneurial spirit and anxiety regarding the organisation may also promote unlearning.

Second, the data in this paper are based on firms listed in the Japanese electrical equipment industry, and it is unclear whether similar analysis would be possible for other industries. Previous research has focused on a broad range of industries, including case studies of specific companies and survey analyses. Even empirical studies using publicly available archival data may yield different results for different industries because of their different characteristics. Furthermore, the publicly traded firms included in our study have more resources and capacity to respond to drastic changes in their environments than smaller firms. However, prior research found that smaller firms have a significantly higher possibility of undergoing smaller firms are privately held, and relevant publicly available data are difficult to obtain; therefore, they are not included in our analysis. In future research, it will be important to examine the effectiveness of organisational unlearning in different organisational forms, comparing large firms with smaller ones.

Third, indicators other than gross profit, used in this study to determine organisational performance, can be used in future research to clarify whether unlearning and forgetting produce similar results, such as with regard to return on assets (ROA), which indicates the growth potential of a firm.

Finally, this research demonstrates organisational and interdepartmental unlearning through archival data, but does not focus on individuals, due to the difficulty of collecting archival data about individuals. However, since an organisation is made up of a set of people, unlearning related to individuals is also an important theoretical interest. In future

studies, we expect that data on unlearning related to individuals will be collected through questionnaires, and analysed in combination with the archival data on departmental and interdepartmental unlearning which were used in this paper. We believe that this will allow us to more clearly understand how individuals impact organisational and interdepartmental unlearning.

Despite the above limitations, we do not consider that they detract from the overall contributions of our study.

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