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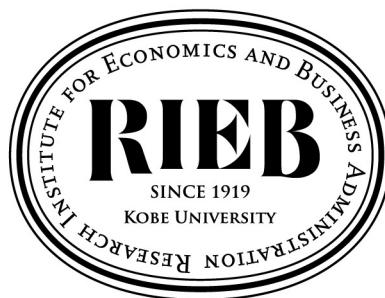
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**Theorization of Institutional
Change in the Rise of
Artificial Intelligence***

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Theorization of institutional change in the rise of artificial intelligence

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ABSTRACT

This study explores how professional institutional change is theorized in the context of the emergence of disruptive technology as a precipitating jolt. I conducted a case study of two Big four accounting firms in Japan on their initiatives to apply artificial intelligence (AI) to their core audit services between 2015 and 2017. The data shows the process for incumbent dominant organizations to collaborate and develop social perceptions about the changing but continuing relevance of their profession. The analysis suggests that the retheorization can advance even without concrete alternative templates when disruptive technology is perceived to have overwhelming influences, following multi-level steps progressing from internal to external theorization. This article proposes a grounded theory model of the process of professional institutional change: (1) Theorizing change internally at the field, (2) Developing solutions by experimentations in organizations, (3) Exploring solutions driven by individuals in organizations and (4) Theorizing change externally by organizations. It contributes to the profession and institutional scholarship by expanding our knowledge about the diversity of professional institutional field change process in this age of increasing technology influences on organizations.

Keywords: Institutional change, Professions, Artificial intelligence, Qualitative research, Grounded theory

This discussion paper is work-in-progress and intended as a means to promote research of interested readers. Please contact the author for its citation.

Success in creating effective AI could be the biggest event in the history of our civilization. Or the worst. We just don't know. ... We cannot know if we will be infinitely helped by AI, or ignored by it and side-lined, or conceivably destroyed by it.

—Stephen Hawking¹

One of the key interests of the profession research has been how professionals in established professional fields respond to challenges to their professions (Muzio, Brock & Suddaby, 2013). Among diverse challenges, past research has focused on the entry of new professions (e.g. Reed, 1996) and resulting inter-professional contestations over professional boundaries (Abbott, 1988; Bucher, Chreim, Langley & Reay, 2016). However, the recent exponential advancement of new technology, such as artificial intelligence (AI), is increasingly discussed as a more significant threat to many professions in its potentially substituting or marginalizing them (Hinings, Gegenhuber & Greenwood, 2018; Susskind & Susskind, 2015). This theory development case study research investigates the application of AI to audit services by Big four accounting firms in Japan, one of the largest national audit markets, with the research question of how emergence of disruptive technology leads to reactions in an established professional field—particularly the theorization of professional field change and its realization. The context was chosen because the field of audit has been studied as an exemplar case of a mature professional institutional field (cf. Greenwood & Suddaby, 2006), and is facing

¹ <https://www.cnbc.com/2017/11/06/stephen-hawking-ai-could-be-worst-event-in-civilization.html>, accessed on 30th March, 2020.

disruptive technology which could arguably substitute core tasks of the profession (Frey & Osborne, 2013). This article intends to make the following two theoretical contributions.

First, this study contributes to the profession research by exploring the understudied case of a threat from emerging technology to an established profession with the multilevel perspective. Past technology change studies for professionals focused on intra and inter-professional dynamics in organizations, such as how newly introduced digital innovations influence the work, interests, and relations of occupational groups (Barrett, Oborn, Orlikowski, & Yates, 2012; Petrakaki, Klecun & Cornford, 2016). The important question is how those reactions in organizations are linked with the macro professional field change, which is one of the central questions in institutional theory (cf. Zietsma, Groenewegen, Logue & Hinings, 2017). Professional actors, particularly knowledge workers, engage diverse stakeholders to market and legitimate their professional services against each other (Fincham, 2006). In the case of new technology shock, however, the conflict is not necessarily among professions, but also between the humans and perceived threats of machines. The incumbents, therefore, may not follow the existing predictions because there are no specific enemies of such power games. This study aims to fill this important gap by showing the process for incumbent organizations to collaborate and develop social perceptions about the changing but continuing relevance of their profession.

Second, this article contributes to institutional theory by exploring how the traditional

model of institutional change applies to the context of disruptive technology emergence as a precipitating jolt. The institutional change has been modeled as multiple phases, which require the successful problematization of the current state and justification of the new form (Tolbert & Zucker, 1996). Further study has been called for to explore its validity in various types of change (Greenwood, Suddaby & Hinings, 2002). The current case of technology change fits with one of the most important arenas of social change as the speed and influence of technology advancement are increasing more than ever (Leonardi & Barley, 2010). This study shows that the retheorization can advance even without concrete alternative templates when disruptive technology is perceived to have overwhelming influences, following multi-level steps progressing from internal to external theorization. The goal of this article is to advance our knowledge about the growing influences of disruptive technology on theories of professional institutions, by investigating an advanced case of professionals' proactive technology adoption and retheorization of their professional logic against the perceived technology threat.

THEORETICAL FOUNDATIONS

Professional field change and technology

Organizations conforming to an institution form an organizational field, a set of 'organizations that, in the aggregate, constitute an area of institutional life; key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce

similar services or products' (DiMaggio & Powell, 1983: 148-149). The profession is one of the prevalent institutions with professional institutional fields, which comply with the particular logic, identity and institutional arrangements for each profession (DiMaggio & Powell, 1983: 156; Siebelt, Wilson & Hamilton, 2017). Professionals continue professional maintenance work, so that they can maintain and develop institutional arrangements to protect their social state, legislative privilege, and professional boundaries over other professions (Currie, Lockett, Finn, Martin & Waring, 2012). Traditional profession study has highlighted the stability corroborated by 'repair' work of dominant professional organizations to negate unfavorable change (Herepath & Kitchener, 2016; Micelotta & Washington, 2013). As Muzio and colleagues (2013) pointed out, however, professional logics and institutional arrangements, as well as the balance between professional fields, actually fluctuate in the race for professional relevance and dominance by various stakeholders (cf. Malsch & Gendron, 2013). How professional fields change, rather than maintain the status quo, has increasingly attracted researchers' attention.

Particularly, among diverse sources of change, Hinings and colleagues (2018) notably advocated today's new digital technology as a radical change trigger to potentially transform professional fields. Digital technology, such as AI and analytics, shakes the field-level structure and changes the professional identity, autonomy and boundaries because it mobilizes professional knowledge—the very source of professional privileges. Meanwhile, past literature has intensively addressed the new technology influences on professionals at the organizational

level (Hinings et al., 2018, e.g. Barrett et al., 2012; Lifshitz-Assaf, 2018; Petrakaki et al., 2016). For example, in the classic cases of hospital CT scanner adoption by Barley (1986), radiologists' dependence on technologists for the new technology knowledge changed the social state and power balance of professionals. Also, Nelson and Irwin's study (2014) of librarians adopting the internet search highlights that professional identity can be reshaped by its interactions with new technology use in professionals' endeavor to maintain their relevance. This line of literature shows that new technology transforms the work and professional identity within organizations through sense-making and negotiations of individuals, and thus brings organizational change. It is still largely unclear, however, how such intra-organizational technology-driven change links with the macro professional field change. Past profession studies have suggested that even established professional fields have re-institutionalization to change both the structure and institutional logic (Reay & Hinings, 2005), and professional associations play a key role when the change is beyond the control of individual firms (Herepath & Kitchener, 2016). As Reay and Hinings (2005) pointed out, past profession studies have focused on the later phase of field change after the focal change was implemented, rather than how the change emerges. The process of how new technology leads to professional field change is one of the important missing questions, which needs careful inquiries into how we can model field change.

The process model of institutional change

In institutional scholarship, beyond professions research, a key issue has been pathways

of institutional change since the 1990s (Micelotta, Lounsbury & Greenwood, 2017). Several process models of institutional change have been developed, focusing on chronological steps observed at the organizational field level. First of all, Tolbert and Zucker (1996) notably proposed the three-phase model. The first phase is pre-institutionalization, in which the change in technology, legislation, or market forces leads to innovation and its habitualization, with exploration and learning of an alternative solution. The second phase is semi-institutionalization, in which inter-organizational monitoring and theorizing of the new custom lead to objectification and early diffusion in the field. Then the third phase of full-institutionalization follows, involving the sedimentation of those structures influenced by their positive outcomes, interest group resistance and advocacy. The model rightly suggested that institutional change follows a pattern of steps, and that theorization plays a key role by providing reasons for the legitimacy of an innovation to become a taken-for-granted object. Theorization involves two key tasks: Problematization and Justification. Problematization is the specification of general organizational problems, 'generating public recognition of a consistent pattern of dissatisfaction or organizational failing that is characteristic of some array of organizations'. Justification is done by giving them moral legitimacy and/or asserting pragmatic legitimacy, and 'developing theories that provide a diagnosis of the sources of dissatisfaction or failings, theories that are compatible with a particular structure as a solution or treatment' (p.183).

The model was further advanced by Greenwood and colleagues (2002). They suggested

the six-stage model: Precipitating jolts, Deinstitutionalization, Preinstitutionalization, Theorization, Diffusion and Reinstitutionalization, in which Theorization plays a key role. In their study of Canadian accounting firms incorporating the multi-disciplinary practice, the change was enacted in explorations of the new organizational form by large firms, responding to market environmental changes as the precipitating jolt. Then the new form implemented by dominant organizations was later legitimized gradually at the field level through the professional association. The model suggests that theorization, which is ‘the rendering of ideas into understandable and compelling formats’ (p.75), determines whether a set of innovations is institutionalized to change the institutional order or not. The study showed the iterative and sometimes long-lasting process of field internal theorization in highly professionalized change setting, whereas legitimacy is gained through diffusion itself in the cases of simple mimicry for practical concerns (p.61).

With our ‘sketchy’ understanding of theorization, Greenwood and colleagues (2002:75) called for further empirical studies in a variety of settings. Receiving the call, recent studies increasingly have explored the micro-driven institutional change (Micelotta et al., 2017), particularly with the practice perspective suggesting that professional institutional change can also emerge ‘from improvisations in everyday work, consolidates within an organization, and radiates to the level of the organization’s field’ (Smets, Morris & Greenwood, 2012: 877). This literature highlights that there are institutional change variations in the level of its origin—

change can emerge from the individual level—and thus have fruitfully implied the need for incorporating the multi-level perspective (Bridwell-Mitchell, 2016) because processes across levels actually influence each other in formulating change. Based on understanding of these scholarly conversations, I explored disruptive technology of increasing significance as the change trigger in a mature professional field, with a particular focus on the key process to understand institutional change: how theorization progresses in multi-level interactions.

METHODS

Research setting

AI audit in Big four accounting firms in Japan. Professionals and scholars have considered AI application to accounting and auditing since the mid-20th century (Vasarhelyi, 1989). With the recent rapid advancement of related technology, professional stakeholders have reactivated the new technology consideration (Issa, Sun, & Vasarhelyi, 2016). Besides diverse supply and demand side factors (cf. Kokina & Davenport 2017: 115), publications of sensational future scenarios triggered public disputes. Most notably, Frey and Osborne (2013) reported that computers with machine learning could replace 94 percent of accountant and auditor tasks in the US. The research spread speculations about the deterioration of the auditing profession (Financial Times, October 18, 2017). AI application to auditing is not an immediate shift but involves gradual steps of solution development in dozens of audit tasks

(Abdolmohammadi, 1999), and decisive solutions have not materialized, still at an exploratory stage with multiple proto-type solutions. On the one hand, there have been positive expectations of productivity improvement, superior managerial insights (Kokina & Davenport, 2017), and the prevention of accounting frauds which deteriorated trust in the capital market (cf. Mueller, Carter & Whittle, 2015). On the other hand, critical perspectives have arisen, highlighting the ‘overemphasized’ nature of accountants’ advertisements to win competitive bids, and limitations of currently available technology (Financial Times, September 18, 2017). In the audit profession, four global accounting firms, called the Big four—EY, KPMG, Deloitte, and PwC—dominate most national markets with their franchisee local firms. They have continuously invested in data analytics. As the head of technology and investments at PwC in the UK commented, it was ‘becoming very clearly apparent...that AI [was] going to have a huge impact on [their] business’, therefore they were ‘building stronger and stronger capability in that space’ (Financial Times, September 18, 2017). The contents and impacts of the new technology were being formed and negotiated globally.

The field of the auditing profession is globally semi-integrated but managed at the national level. The International Federation of Accountants (IFAC) integrates the profession and provides the International Accounting Standards (IAS) with the International Auditing and Assurance Standards Board (IAASB), while professional associations are managed in each country. In Japan, the Japanese Institute of Certified Public Accountants (JICPA) has been the

only CPA professional association since 1966. All professionally active CPAs in the country need to register with JICPA. As of September 30, 2018, the membership included more than 30,000 CPAs and 220 audit firms. The assurance market for listed companies has been dominated by Big four franchise firms as Table 1 shows. ‘Others’ include local large firms (e.g. Toyo and Taiyo), small firms and individuals.

Insert Table 1 about here

Big four firms have influences over JICPA through their staff contribution and strong ties with large corporations. Meanwhile, JICPA needs to incorporate interests of other members which lack investment resources and tend to resist technology adoption. JICPA and local CPAs are supervised by the Financial Services Agency (FSA). Due to major incidents of financial statement frauds since the 2000s (e.g. Kanebo in 2004, Olympus in 2011, and Toshiba in 2015), there has been strong call for the improvement of audit quality and control (JICPA, 2016a), but the auditor rotation system has not been introduced. A local large think-tank, Nomura Research Institute (NRI), published their report on potential influences of AI on professions with Oxford report authors (Frey & Osborne, 2013), arguing that 85% of national CPAs’ work was highly replaceable by machines in 10 to 20 years (NRI, 2015). JICPA made counter arguments; For example, its Director stressed irreplaceability of human accountants in an interview, suggesting that ‘CPA work is creative, requiring effective dialogue with clients’ (Nikkei, September 25, 2017). There have been significant domestic disputes over the future of the profession.

Study design and data sources

I conducted a qualitative study based on archival and interview data, as a suitable research design for theory elaboration on a rarely studied phenomenon (Edmondson & McManus, 2007). The data was collected at multi-levels: the organizational field (the Japanese audit profession), organizations (audit firms), and individuals (firm task force members). Interview data was collected from two Big four firms at their Tokyo headquarters, coded as Alfa and Beta. I chose the largest data source, Alfa, as the case example and used others as supplemental data to double-check potential deviations by firms. I chose them because they were named as the most advanced in their AI application development in the preparation discussions described below.

I collected data in three steps. First, I reviewed public literature in 2016 and 2017. The local literature included (a) published materials of FSA and JICPA, (b) those of local Big four firms, (c) articles of top professional magazines (e.g. Kaikei Kansa Journal by JICPA), and (d) related articles on the local business media. Additionally, I also checked literature in English: (e) publications by non-Japan Big four firms, (f) reports and presentations by IAASB, and (g) other business media articles in on the topic. Table 2 shows the list of collected archival data, which amounted to approximately 1,270 pages of A4 documents in Japanese and English.

Insert Table 2 about here

Second, I conducted one-hour preparation discussions with four partner-class accountants (without audio-recording and a prefixed questionnaire), each of whom corresponded to Big four

firms in June 2017. I used these unstructured discussions for the research design and interview questionnaire development. Third, I conducted 20 interviews with 21 members of case firms between June 2017 and September 2018 (Table 3). Each interview took from 1 to 2.5 hours, with an average of 1.45 hours (29 hours in total). All interviews, except for three, were audio-recorded and transcribed. I interviewed the most knowledgeable: partners in charge, AI task force members, and their advisors. Two were temporarily transferred to JICPA as members of its 'Future of audit' technical committee. Through interviews with Alfa, additional data was collected: sample weekly management meeting minutes of the AI audit task force in 2017.

Insert Table 3 about here

Data analysis

I adopted the grounded theory approach in order to discover key characteristics of a phenomenon (Strauss & Corbin, 1998), as a strategy for process analysis (Langley, 1999). I used a two-step coding approach because it is an effective way to balance researchers' creativity and analytical rigor, by distinguishing the meaning that informants addressed and the implications that the researcher distilled from the first coding results (Gioia, Corley & Hamilton, 2013). This approach was chosen due to its wide and increasing acceptance as the methodology of qualitative theory development (e.g. Gioia, Price, Hamilton & Thomas, 2010; Nag & Gioia, 2012). The analysis was conducted in the following iterative steps. Firstly, I developed a chronology of events at the field level based on the archival data. I also referred to the interview

data to confirm the order and timing of events. Secondly, I developed the case history of Alfa's AI audit initiative, using the interview data as the main information source with the supplement by the archival data. In the analysis, I checked contradictions among data sources and confirmed and adjusted the findings by follow-up exchanges with interviewees. Thirdly, I coded key concepts that emerged in the data source and grouped them into categories. This 'in-vivo coding' aims to capture the original meaning of what the informer tried to convey. Fourthly, I analyzed characteristics of relationships among the first-order concepts, with a particular focus on their common characteristics and ability to explain the phenomenon of interest. This step, similar to 'axial coding' (Strauss & Corbin, 1998), aimed to highlight emerging concepts through the lens of the researchers' perspective. Finally, I developed the map of two-type coding results, or 'data structure' (Gioia et al., 2013), which clarifies the link between the original data and extracted higher-order themes (Gioia et al., 2010). For the reliability of findings, I made statements of findings only when there were multiple supporting data.

Chronology of events

Studies by professional associations. Deep-dive discussions about AI application to audit officially appeared in global professional associations in 2015. The American Institute of Certified Public Accountants (AICPA) published a 184-page report on continuous auditing, with reference to possible AI application in the 2020s (AICPA, 2015). Interacting with US initiatives, the global professional association body, IAASB, launched the Data Analytics

Working Group (DAWG) in its Consultative Advisory Group (CAG) in early 2015.

Recognizing these international trends, the information technology (IT) committee of Japan’s local professional association (JICPA) set up a task force team in its digitization technical committee to study the technology’s impact on the profession. The JICPA IT committee published the research as one of its periodical reports on its website in March 2016 (JICPA, 2016a). JICPA soon published its English version as ‘The outlook for IT-based auditing: Approaches to next generation audit’ (JICPA 2016b). The “Future of audit” team, re-established with new members as a new technical committee under the IT committee, published three articles on *Kaikei Kansa Journal*, JICPA’s official journal, featuring AI researchers in July and August in 2016 and May in 2017. In the meantime, professional associations in other major countries also published visionary papers and technical guidelines in 2016 and 2017 (e.g. ICAEW, 2016).

Initiatives of Big four firms: After the JICPA vision publication, local Big four firms increased their activities to promote their data analytics and AI. Specifically, four types of initiatives were observed: creating new organizational units, establishing research alliances with universities, press-releasing the launch of new solutions, and publishing service brochures and business magazine articles. Table 4 summarizes their major initiatives.

Insert Table 4 about here

In Alfa, one of the local Big four firms, the following stream of events—with some

adjustments to maintain the firm's anonymity—was observed. Perceiving the rising public interest in the topic, based on inputs from their global group, competitor intelligence, and media articles, the head of Japan audit (Partner 3) considered the adoption of AI a significant managerial agenda. He decided to establish a new project organization and announced its launch to all local firm members in a large internal ceremony. Partner 3 began unofficial discussions with a few core senior members (including Partner 1 and 2), but Partner 3 intentionally kept their plan flexible so that they could continue testing and improving ideas. After the party, he sent an e-mail to all local firm members, calling for members of the new unit. Many firm members, from entry level accountants to experienced partners, applied to join the task force. The core members selected project members in two months. The new organization section involved three segments of members: (a) the core team (led by Partner 1, 2 and 3) with several dedicated staff to plan, facilitate, and organize various initiatives, (b) part-time members developing solutions in sub-teams in which three to five members were assigned, and (c) advisors, including both internal and external topic experts to provide expert knowledge. Then the new organization was officially established and publicly announced in a press release.

From proposals submitted by part-time members, the core team selected nine sub-team topics (specific audit task areas) and assigned corresponding sub-teams. Each team explored how their focal tasks could be improved with AI solutions. The team management was delegated to sub-team leaders. Sub-teams had occasional discussions to identify areas for

improvement and technological requirements. The core team helped sub-teams in information gathering, AI vendor search and negotiations when requested. The core team had weekly meetings for all project members to share progress updates, and periodical information exchange calls with overseas member firms. A sub-team leader and one advisor used their own personal overseas group expert contacts to explore latest news and available solutions. The themes of sub-teams were changed frequently during the first year, and some were abandoned and integrated into others by the core team, according to the updated priority. There was no member replacement and the core team added some new full-time staff in one year. The core team presented their progress to the local partner meeting each quarter. There was no information sharing with non-project members due to the confidentiality and premature on-going state of the project through autumn 2017.

The reference data was collected in another Japanese Big four firm, Beta. The analysis revealed that the process was highly similar in its chronological order and characteristics of activities to Alfa's, particularly in its top-down start, task-force organization launch and development, proactive recruiting of new project staff, and exploratory solution development.

FINDINGS

The data revealed that the theorization of professional field change progressed by multilevel steps, with Alfa as a sample firm case. Figure 1 shows the data structure of the

analysis result. Table 5 shows representative quotations, which corroborate the factors observed in the findings. These sequential researcher-induced second-order themes served as the basis for the grounded theory, which is discussed after the narrative of findings about each theme.

Insert Figure 1 and Table 5 about here

Theme A: Theorizing change internally at the field

The first step observed was the creation of a field-level consensus about the significance, relevance, and future vision of the technology impact. This step extended for approximately one year in 2015 and the first quarter of 2016, until JICPA published their report in March 2016.

The following three factors emerged from the data.

A-1: Trigger inspirations from the global professional community. The consideration of AI's impacts on the profession was perceived as originating from the influence of the global professional community. A comment of a Senior Manager exemplified the perceived influence: 'The beginning [of the discussion of AI application to audit] was from outside Japan. Japanese accounting standards themselves have originated and evolved from the translation of those in the US and Europe. Since most new initiatives, such as CAAT, centred around those standards, they are often inspired by the discussions in those origin countries' (Senior Manager 2). In the event history, discussions of AI application first emerged in the US CPA professional field, then IAASB, before the research publication by the IT committee of JICPA.

Importantly, the nature of the JICPA research was voluntary rather than mandatory,

without IAASB management control, as IAASB had only limited controlling authority over member associations in each country. Also, in Big four firms, projects of AI application to audit was under only loose global control. Big four local firms had their franchise agreements with the global headquarters, but were independently owned, and thus had significant room for local customization and innovation. As a Senior Manager of Alfa suggested, '[some] audit tool innovations in the past [had] been centrally developed as a global standard in the group, but AI solutions [were] being studied in each country' (Senior Manager 1). The control of AI initiatives by the global group was perceived as weak, as a Director of Alfa testified: 'There has been no strong central leadership....There have been no standard solution module release, concrete schedules or milestones in our global group' (Director 3). The reason behind this weak global control was perceived by Alfa task force members as the AI audit project's early experimental stage, without a fixed vision and consensus even in the global group.

A-2: Theoretical development within the local professional association. The national professional association (JICPA) worked as a facilitating unit to set the tone of the shared understanding on the topic in the national professional field. It had a need to incorporate small firms in dealing with the professional survival risk and published a report about problems and future vision of the profession. In the process, JICPA was a passive vehicle of Big four firms which were collaborating with but competing against each other.

Although each Big four firm already had its own research activities of data analytics by

2015, smaller field firms lacked resources and willingness to invest in the new technology. As a Director of Alfa suggested, ‘if one [viewed] the professional field as a whole, the story [was] different [from Big four’s perspectives]’ (Director 2). Recognizing the potential risk of the professional existence, JICPA perceived the need to ‘educate all the accounting professionals that their accounting knowledge would not guarantee their survival anymore, and to develop a shared sense of crisis, using various publications’ (Associate 2).

JICPA launched a task force team in its digitization technical committee in its IT committee to study the issue. The team published its research on the future of audit in March 2016 to ‘[explore] the developments in new, IT-based auditing approaches in Japan and overseas, and [provide] the outlook for the future’, in ‘seeking to investigate a form of the next-generation audit more in line with an age in which vast volumes of data could be handled through widely available IT’ (JICPA, 2016b: 2). The report highlighted three significant future changes. First, it suggested that digital technology would enable the revolutionary expansion of the audit data scope, enhancement of analytical rigor beyond human cognitive abilities, and increase of audit frequency. With new ways of data processing, such as image analysis, natural language processing, and external data crawling on the Internet, the report noted that the audit would be transformed from the current sample-based client internal data analysis to the full client data investigation incorporating automatic data reviews. The report also suggested that future AI solutions would enable the automatic and highly accurate detection of potential

accounting frauds and future estimations of key variables, such as the organizational or employee performance and corporate asset value. By connecting accounting systems between clients and audit firms, auditors could have automatic, thorough, and constant data sharing which shift the current quarterly audit toward the continuous audit. Second, the report implied that these audit process changes would significantly influence social perceptions of how auditors add value to their clients, and what the profession practically represents. The traditional image of auditors has been those who worked long hours processing a large amount of client paper data manually to find and check audit evidence. The tedious work has been perceived as a sign of their professional dedication to clients and the key process of professional development, in that junior auditors acquired the pattern knowledge of when to be cautious and which areas to focus in the current sample data audit. The audit process future change, however, would fundamentally transform the nature of work, with machines substituting manual tasks, shifting the auditors' source of value to the understanding and design of the automated technology system, and urging auditors to engage in the client top management advise on their performance by utilizing the data analysis. Third, the JICPA report presented the transformation in auditors' work style. Auditors have worked in teams in face-to-face settings, with partners dealing with client communications, managers managing day-to-day audit team operations, and associates conducting detailed audit tasks. Teams worked extremely long hours in quarterly busy seasons, with frequent client onsite work days. The report suggested, however, that

technology solutions would enable a highly efficient and flexible work style; one auditor could remotely monitor multiple clients at one's preferable working hours, checking daily monitoring results by AI, and intervene only in most highly prioritized issues, spending more time on advising on future performance improvement based on the data trends. The vision proposed drastic changes in the nature of the profession regarding its value for clients and required skills. The report also highlighted the conditions to enable the shift: data availability, auditors' new skills to manage big data and database, amendment of audit standards, and auditors' high-speed ubiquitous data access (pp.24-32). Meanwhile, the report did not mention what information systems would corroborate the work, and how audit firms could realize the future audit. As JICPA itself admitted, the report only 'overviewed the history of IT in the audit work, explained the areas for improvement in the current audit operations, and...elaborated on the preconditions under which the future of audit could materialize' (p.32).

Although JICPA played a key role in crystallizing the professional vision, as a Partner of Alfa pointed out, 'JICPA [had] limitations in their few resources' (Partner 3). Thus JICPA relied on knowledge and resources of member firms; the task force team consisted of Big four firm staff. On the one hand, these Big four members could bring their global group knowledge about best practices and available technological solutions beyond borders. On the other hand, as a Senior Manager of Alfa commented, Big four firms 'had [their] own interests to leverage those institutions to favourably change the national professional field', besides JICPA's public agenda.

In a sense, JICPA was ‘a vehicle of strategic use’ (Senior Manager 2) for Big four firms. Big four firms cooperated in the JICPA team, although they were competing in the audit market. As a former member of JICPA project explained, the collaboration was possible due to the benefit to keep the current institution of human accountants legitimate beyond short-term competitions: ‘In the end, Big four firms cannot significantly differentiate from each other. Even if one firm advances in an innovative solution, others will soon follow. Also it is difficult to create regulations or rules which are advantageous only for a particular firm.... Then it is reasonable to collaborate and set commonly acceptable new standards together’ (Associate 2).

A-3: Internalization of the change anticipation among field members. All interviewees were aware of the report. Having accepted the JICPA report as a shared field vision, members of field organizations anticipated a drastic change of the profession, with an image of the future of the profession as the collaboration of human accountants and AI tools.

The interviewees unanimously showed their agreement with the JICPA report’s change agendas and their urgency. The vision was perceived as ‘the natural course of events’ (Senior Manager 2). Behind the acceptance, accountants themselves had observed significant room for improvements in their audit tasks, as an Associate of Alfa pointed out: ‘It is unavoidable. Our audit tasks have continued to be too dependent on tedious manual work. If AI experts would seriously work on it, a large part of our tasks should be substituted’ (Associate 1).

Consistently with the vision, field organization members also showed their understanding

that no matter how AI would advance, ‘the audit without human intervention [would] be impossible, and the job of auditors [would] continue to exist’ (Senior Manager 3). They did agree with the substitution of some part of their work by AI solutions: ‘The time we spend for those tasks which are not necessarily dealt by accountants will tangibly decrease’ (Senior Manager 3). The logic of continuing relevance of their profession was that human accountants would be necessary to ‘educate AI’ (Senior Manager 3) or ‘communicate with clients’ (Partner 3), and thus they expected that ‘human accountants [would] continue to be required for the very survival of AI solutions’ (Senior Manager 3). This view of human-AI collaboration – aligning with the JICPA vision – was aptly summarized in a comment of the representative Partner of Alfa: ‘We expect humans and AI will conduct audit together. We want the audit of much higher value than today’s. We want to spend much more time on thinking and communicating. [For that purpose] we want to have AI or computers deal with tasks as much as possible’ (Partner 3).

Theme B: Developing solutions by experimentation in organizations

Sensing the need for change, local Big four firms launched or expanded their AI solution development teams. The analysis identified three sub-themes in the process.

B-1. Expectations of technical returns. In Alfa, task force members perceived that the project was motivated by expected technical returns of solving their staff shortage problem and improving the audit quality. As a Director suggested, ‘human resource shortage [had been] a serious problem...and AI [was] expected to solve it by its labour substitution’ (Director 2). The

positive expectation for productivity was observed among all interviewees. Besides, there was a shared expectation that AI would ‘enable the quality improvement of the audit, perhaps gradually, by replacing and supplementing judgements by human accountants’ (Senior Manager 2). Alfa task force members perceived that automatic analyses, based on big data accumulated in the past audit work, could outperform human professional judgments in certain tasks, such as estimating the future value of assets or identifying accounting frauds. The representative Partner of Alfa showed their positive expectations: ‘Since AI could experience thirty years of what a professional accountant experiences in a minute, it is possible that the audit could significantly be evolved and transformed, when AI would accumulate experiences of hundreds of professionals for dozens of years’ (Partner 3).

B-2: Perceived limitations of technology in the short term. Alfa task force members also perceived the limited impact of the technology in the short term. All interviewees mentioned bottlenecks. First, the lack of the electronic data formatting of their clients would hinder automatic data processing. A Senior Manager of Alfa pointed out the lack of properly formatted electronic data: ‘Most audit evidences are paper documents in the end. They are literary sheets of papers, manually written or typed and printed by PC... Those papers are stocked in cardboard boxes in our clients’ warehouses...Without their conversion to electronic data, the audit cannot be automated’ (Senior Manager 2). Second, the currently available technology was perceived as incapable in some key tasks such as local language processing. Combined with its limited data

amount and frequent use of implicit nuances, the local language seemed ‘extremely difficult to search and match technologically’ (Director 2). Third, many interviewees suggested that the nature of audit itself could hinder AI application. One problem was the limited amount of teacher data: ‘The fraud detection itself [did] not have thousands of data points in the history; it has been very rare’ (AD2). Another problem concerned the need for audit process clarification, as a Partner commented: ‘Audit firms conduct audit and also are audited. Then we cannot prove our due processes if we just get results by clicking one button... We need to be prepared for the due process audit by JICPA or the Certified Public Accountants and Auditing Oversight Board (CPAAOB) under the Financial Services Agency’ (Partner 2). Fourth, as a Senior Manager suggested, there was perceived difficulty in drawing objective and universally applicable conclusions in audit: ‘Estimations in accounting, to be honest, often require judgements... Even one assumption change could alter the overall outputs, and it is very difficult to judge whether the assumption is adequate or not’ (Senior Manager 3). Finally, the representative Partner of Alfa commented on the confidentiality as a hurdle: ‘Our client data should be protected as confidential, then we have an issue of how much we could share those data with external vendors in AI solution development’ (Partner 3).

B-3: Loose control of sub-teams, without concrete business plans and timelines. Alfa launched their task force organization with the full-time core team, and assigned part-time sub-teams for specific solution development. Their sub-team management intentionally allowed

experiments and explorations. As the representative Partner of Alfa summarized, the project did 'have no specific pre-set official goals' (Partner 3). Another Partner explained their intention: 'We have not set particular KPIs, as this project is just at its start-up exploratory phase.... It would be ideal to set KPIs as to what solution tools would be used in how many audit projects, or how much costs would be cut, and the like. It is still too early, however' (Partner 2). There were no KPIs because 'nobody knows (what KPIs to set)' (Partner 1).

The project showed its exploratory nature. One example was their frequent use of pilot studies to test prototypes. All sub-teams had tests of their solutions in ongoing audit projects with their close contacts, or in their own engagements. A task force member commented: 'The tool might be applicable for some clients but not for others, since the structure of data and information systems vary by clients. The model should be finalized after pilot studies in several firms, and then will be applied to all of our audit projects' (Senior Manager 2).

Another feature was their frequent and flexible task force team focus changes. Since the kick-off, the number of sub-teams and their topics were changed several times through the first year. The changes were made intentionally, as a Partner of Alfa admitted: 'Sub-teams have been often changed. We collect a broad range of ideas first, then update them if they would not work, in a trial-and-error approach' (Partner 2). Another Senior Manager of Alfa positively commented on the policy: 'Flexible and loose control was important for members' motivations, as they worked in sub-teams as the part-time basis. It would have become the most serious

problem if this project had been felt as a mandatory burden. Another reason was that AI audit has been still at the trial-and-error stage not only in Alfa [but also in the field], so it was extremely difficult to set a pre-set plan or themes for the next three years' (Senior Associate 1).

Theme C: Theorizing institutional change externally by organizations

Aiming at external audiences, Big four firms conducted marketing to position themselves as the key contributor to, rather than a victim of, the change. This step, observed after March 2016 as Table 4 shows, was characterized by the following two factors.

C-1: Opportunity and threat perceptions on the professional survival. Alfa task force members showed their perceptions of the context as an opportunity. They expected productivity improvement which could solve 'the staff shortage problem in the audit industry' (Associate 1). A Senior Associate explained their understanding of the benefits of AI: 'We often hear speculations that accountants' jobs might disappear, but what is being substituted now is only the very basic simple tasks, or routine tasks suitable for automation. Actually, most tasks in our job, the core part of our business, is to communicate with clients, or to develop ideas for clients' issues...The automation of the basic routine tasks would enable us to focus our resources on the communicative part of the job. That is rather an opportunity' (Senior Associate 1).

At the same time, several interviewees suggested that their motivations of AI adoption were to defend their position in the competition. They competed against other Big four firms over audit clients, as a Senior Manager of Alfa described: 'If other audit firms developed

excellent AI solutions, which could reduce the required time for the audit or detect more problems accurately, we could lose our clients. Other audit firms are definitely the potential threat' (Senior Manager 1). Besides, they considered more significant scenarios: particularly the development of alternative audit institutions without Big four firms. For example, some interviewees suggested the government intervention as a potential threat: 'If the national government would develop AI audit tools and become capable of managing the external audit without audit firms, the current audit institution itself would disappear' (Senior Manager 1). It was also considered that neglected disruptors might emerge from somewhere outside the organizational field: 'I feel somebody else, not Big four firms, might develop a decisive solution tool. It could be a start-up firm or ICT mega player, I don't know...Also some Big four alumni have already started to develop potential solutions in this area. There is a risk of sudden disruption if we watch only traditional direct competitors' (Partner 2).

Besides, they showed their motivations to establish their legitimacy and positive reputations in the business society. A Director of Alfa suggested their concerns about external stakeholder perceptions: 'AI has become a buzz word and we often have questions from our clients (about the future of AI and audit). If we had nothing to counter-offer, they could regard accountants as irrelevant and not necessary anymore...In the end, the story of AI substitution of human accountants is apparently a negative factor for our being. We need to be well prepared with a theory, when facing the questions of whether machines would replace us, by showing

that we are leading the AI solutions' (Director 2). At the same time, the AI audit project was perceived as a positive contribution to the professional social justice in the traditional sense: the quality assurance of financial reporting and prevention of fraud in the capital market. A Senior Manager of Alfa exemplified the motivation: 'The ultimate objective of this initiative is, I believe, the quality of audit...We should find and intervene when a company tried to manipulate financial results with a particular intention, and we should prevent financial reports not reflecting what is actually happening. For us audit firms, that should be the priority in this kind of project, I believe' (Senior Manager 3).

C-2: Proactive publications of the new logic with the positive framing. After the launch of their solution development initiatives, all local Big four firms continuously published their service brochures and business magazine articles with positive framings of the change. The first such article was authored by Azusa (KPMG) in July 2016 in *Kigyo Kaikei* (Corporate Accounting), a local prestigious magazine on the topic. The article, 'Audit task: From the age of sampling toward full-data', reviewed the evolutionary history of auditing, and explored the impact of data analytics technology (Ogawa, 2016). The article listed expected future changes—analysis automation, data standardization, invisible risk identification, and continuous auditing—following the JICPA's vision. The authors accentuated positive impacts on the productivity and quality of audit: 'These changes will make it possible for auditors to complete manually-managed repetitive processes in a more effective and efficient way, and thus

to conduct audit tasks at the deeper level by focusing audit resources on the areas which require more advanced judgements' (p.45). Azusa (KPMG) published four more articles in their periodical for their clients (*KPMG Insight*) and a business magazine, framing the change as an opportunity, until November 2017. Other firms followed proactive publications (see Table 5).

Theme D: Exploring solutions driven by individual firm members

At the individual level, Alfa task force members had a certain degree of authority to decide which specific audit tasks to focus on, what solutions to develop, and in what process and timelines their sub-teams work. Individual Alfa task force members explored specific solutions leveraging their own expertise on problems they identified in their day-to-day audit work. This step was observed after the launch of task force organizations, in 2016 and 2017.

D-1: Roles of individuals to guide specific solution design. Alfa task force members, at the individual level, shared a common view that the AI application would be the future of audit. However, how to achieve the future state was highly unpredictable in terms of which part of the job would be replaced by what kind of specific solutions. Their comments suggested their lack of confidence in those specifications. For example, a Manager of Alfa suggested that she did not clearly image how the ultimate AI audit would be realized: 'There do exist some tasks which could be done only by humans. Those will remain (regardless of AI application), but honestly I cannot identify which tasks they would be...we are just exploring how to approach, at this moment' (Manager). A Director of Alfa provided a comment with a similarly vague

understanding of detailed steps toward the full application of AI: 'People ask what would happen in 10 years. Nobody can tell, or at least, I personally cannot see it well' (Director 3).

Not having clear-cut scenarios of the detailed solution development, the core team of the task force relied on the knowledge and experience of individual sub-teams in their choice of audit tasks to address, AI solutions to apply, and external vendors to use. A Partner of Alfa explained the bottom-up process of the sub-team theme design: 'First we the core team asked the task force members to propose specific themes to work on....Then from the diverse ideas we got, we selected and allocated topics to the nine genres, according to the process flow of audit' (Partner 2). Individual sub-teams then worked on detailed planning of AI solution development, leveraging the members' experience as accountants to judge automation potentials. For example, a Manager of Alfa, a leader of a sub-team, suggested that she decided her sub-team focus by her professional expertise in a certain client segment: 'I have audited clients in [a sector] in my career.... I have thought a part of audit tasks in the sector could be well systematized, without significant issues, so I proposed my plan for the sector and launched my sub-team to pursue the idea' (Manager).

Theoretical model development

As shown in Figure 1, the analysis revealed four key themes in the process. By sorting the themes in order of their timing and level, I argue that a process model can be obtained on how technological change precipitated to the retheorization of professional logic (Figure 2).

The model suggests a chain of steps. First, the emergence of disruptive technology (AI in the case) – associated with risks of the professional survival and practical returns – leads to the internal theorization of professional change in a short period of time at the field level, facilitated by discussions in the professional association. Second, aligning with the agreed theory of change, field dominant organizations activate their organization-level solution development initiatives while adopting a particular organizational form (the AI solution development unit in the case) to incorporate the change. Third, in each organization, individuals are empowered to explore specific solutions that embody the change. Fourth, as the solution materializes, organizations engage in external theorization to legitimate their new logic and its solutions aiming external stakeholders: the local government, audit clients and recruiting candidates in the case.

Insert Figure 2 about here

DISCUSSION AND CONCLUSION

This multilevel study investigated how an established professional field theorizes and realizes field change, when disruptive technology emerges as a serious threat. The data revealed that the perceived rise of technology could correlate with professional logic change by the process in which incumbent organizations collaborate and develop social perceptions to incorporate the technology and maintain their own relevance, even without specific solutions.

On the one hand, the findings supported several predictions of existing theory. First of all, as Suddaby & Viale (2012: 427) aptly pointed out, the data showed that ‘professionals [engaged] in field reconfiguring institutional work as an inherent part of the process of professionalization’. Auditors’ professional work to theorize a new meaning, identity, and work was facilitated by the professional association as a place for consensus development for field members (Greenwood & Suddaby, 2006), even in the case of disruptive technology. Also, theorization positively correlated with the progress of change – the adoption of a new organizational form of AI and audit specialized unit and their new solutions – by explicit and shared problematization of the existing order in the field (Greenwood et al., 2002).

On the other hand, this study highlighted several distinct features of the early phase of professional institutional change driven by technology. Firstly, the data revealed the possibility of the field-level professional change without explicit professional boundary contestations. Theoretically, disruptions – such as new technology, social trends and regulations – can lead to change for professions in three aspects: field-level change, identity reformation and intra-organizational practice change (Howard-Grenville, Nelson, Earle, Haack & Young, 2017). Past studies have highlighted the latter two – the change in professional identity (e.g. Kyratsis, Atun, Phillips, Tracey & George, 2017; Reay, Goodrick, Waldorff & Casebeer, 2017) and intra-organizational practice (e.g. Barrett et al., 2012; Petrakaki et al., 2016) – and field level change have been discussed as the professional boundary expansion against other professions (e.g.

David, Sine & Haveman, 2013; Greenwood et al., 2002). This article shows that the incumbent professionals can proactively update their professional logic and institutional arrangements, not for expanding their boundary but for defending their state by incorporating new technology to their core. As Malsch and Gendron (2013) aptly implied in their study of accounting professional change, professionals could retheorize their professional logic, experiment new forms and change their field, in order not to change their relevance. One contribution of this study to the profession research is the exemplification of peculiar self-transformation efforts by an established profession in the perceived significant threat from emerging technology.

Secondly, the analysis suggested the understudied link between internal and external theorization. Most existing research has narrowly focused on theorization as a process targeting organizational field internal members to develop a consensus (Greenwood & Suddaby, 2006; Greenwood et al., 2002; Smets et al., 2012). It is also important, however, to pay attention to theorization toward external audiences to justify the institutional change in the society (Micelotta & Washington, 2013). Organizations utilize both internal and external theorization in dealing with an institutional logic shift (Gawer & Phillips, 2013). The present case suggests that internal theorization—consensus making for change and future vision development within an organizational field—can be followed by external theorization—proactive marketing of the change vision targeting external stakeholders. Another contribution of this study is to show that these two types of theorization form an institutional change process as an integrated flow.

Thirdly, the current study revealed that the emergence of disruptive technology could cause a professional field change with peculiar order in its process. Namely, contrary to most existing research, theorization could occur even before the emergence of a specific new structure or template to be legitimated, correlated with the strong anticipation of the significant threat for the professional survival. Traditionally, theorization has been discussed as the process in which localized deviations from prevailing conventions become abstracted, and thus made available for wider adoption (e.g. Tolbert & Zucker, 1996). On the contrary, the content of emerging technology as in this case has evasive and socially constructed nature (Orlikowski & Scott, 2008). Through the lens of the technology social constructivism perspective, what a certain set of newly introduced technology specifically represents, how it influences organizations, particularly how the technology's usefulness is perceived, and how people use the technology, are a social construction (Leonardi & Barley, 2010). With the growing pace and impacts of technology advancement today, the significance of technological change is increasing as it destroys organizational competency (Romanelli & Tushman, 1994) and disrupts the institutional order as a 'jolt' (Meyer, 1982). In the data, rapid problem identification and internal theorization of a future vision were observed even without specification of concrete new templates. When internal theorization was observed in 2015-16, there were practically no such solutions of AI audit because potential solutions were only in their early research phase. The rise of new technology and its potentially devastating influences on the profession were

linked with the wide acceptance of the need for theorization of a professional vision in which the current professional institution could maintain its relevance. Relatedly, two key factors in theorization, namely problematization and justification (Tolbert & Zucker, 1996), also showed deviations from predictions of past literature. Specifically, problematization in the internal theorization was a short and smooth step without significant conflicts and negotiations, rather than a long-term iterative problem endorsement (Greenwood et al., 2002). Furthermore, justification was done not only by professional legitimacy (Greenwood et al., 2002), but also by practical motivations: productivity and quality improvement. One possible explanation would be that the change was driven by the perceived threat of the disruptive technology for their professional survival, which could easily form field members' common interest. This study contributes to institutional theory by clarifying these particular features in the institutional change process in the case of disruptive technology emergence as a precipitating jolt.

What implications could we extract from the analysis? I argue that one potentially important perspective would be the possibility of the proposed model as the institutional change in the age of disruptive technology, when exogenous changes with great magnitudes are increasing and speeding up. With the increase of available technology to provide alternative solutions, institutions could be increasingly challenged by new technology and field outsiders as its users. Institutional research to date has highlighted the insider-driven institutional change, which 'does not necessarily entail a significant redistribution of power, capital, or membership

in a field; dominant actors may do things differently, but they often remain dominant' (Maguire & Hardy, 2009: 148). Incumbents may resort to 'defensive institutional work', or 'purposive action of individuals and organizations aimed at countering disruptive institutional work' by outsiders seeking to change or discard existing practices, which is particularly relevant to outsider-driven deinstitutionalization as insiders attempt to defend existing practices (p.149). How defensive institutional work plays out, in a variety of settings such as the legal professional jurisdiction change (Micelotta & Washington, 2013) and climate change (Lefsrud & Meyer, 2012) has begun to be a focus of recent literature. In the case of exponential rise of disruptive technology, however, traditional defensive institutional work may be too late if the incumbents wait and see who would develop what kind of specific solutions or logics before they design counter proposals, as the institution could soon become marginalized by the substitutive new technology. In the context of AI audit, for example, external actors—such as the government, IT big houses, or start-ups by Big four alumni, which could develop effective alternative systems and establish a completely new institution—could be the most important risk for Big four firms. It could be assumed that as outsider-driven institutional change becomes increasingly likely due to the technology advancement, defensive institutional work may become critically important for the survival of incumbents so that their theorization proactively would begin at a very early stage, even without specific solutions. As disruptive technology significantly affects the very survival of a wide range of organizations and professions

(Susskind & Susskind, 2015), such defensive institutional work—or one could call it ‘defensive offense institutional work’ as preventive attack against potential and sometimes invisible enemies—could be more frequently observed in broader situations beyond the professional field of accounting and auditing.

In conclusion, this study revealed a process model of professional institutional change by disruptive technology in a highly institutionalized context. It contributes to professions and institutional scholarship by expanding our knowledge about the diversity of institutional change process and technology influences on organizations. As any research has its shortcomings, the current paper has several limitations, particularly in its data coverage of the two-year time scope and focus on Big 4 firms. Additionally, it is important to carefully consider the generalizability of the findings. Professionals resist external innovations in their nature, but they sometimes incorporate the change if the perceived influences of innovations are significant (Lifshits-Assaf, 2017). One boundary condition of the proposed model is the existence of new technology which is perceived as a significant threat to the profession. Furthermore, the case context is a mature professional field, dominated by a limited number of extremely large and powerful firms. Those dominant firms have sufficient resource to influence on the professional association and develop their own technological solutions, but firms in professions without such oligopolistic structure may have difficulties to follow such strategy. Further study on the variation by the structure of professional fields would greatly enrich our knowledge about the mechanism of

how disruptive technology affects diverse professions. Also as another potentially fruitful area for future research, the proactive retheorization observed in the current study could be discussed in the frame of the strategy of legitimation (Suchman, 1995) or institutional strategy (Lawrence, 1999), with a more explicit focus on the nature of deployed tactics. For example, institutional strategy has been discussed in its two components: membership strategy (whom to involve) and standardization strategy (how to make it legitimate) (Lawrence, 1999: 165). The current findings could address other neglected strategic factors such as the timing of theorization (when to take actions) that could also significantly influence outcomes.

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TABLE 1
Assurance Service Market in Japan

| Accounting firm | Big four franchise | Rank | Revenue (Bil. Yen)* | Share (# of clients)** | Share (market cap of clients)** |
|-----------------|--------------------|------|---------------------|------------------------|---------------------------------|
| Shin-Nihon | EY | 1 | 80.6 | } 73.2% | } 91.4% |
| Azusa | KPMG | 2 | 69.9 | | |
| Tohmatsu | Deloitte | 3 | 52.4 | | |
| PwC Arata | PwC | 4 | 17.5 | | |
| Kyoto | PwC | 7 | 3.5 | | |
| Others | - | - | - | 26.8% | 8.6% |

*The revenue of the year 2016-17 for Shin-Nihon and Tohmatsu and 2015-16 for others.

**The share among 3,630 locally listed companies in 2015.

Source: JICPA

TABLE 2
List of Archival Data

| Data source | | Content | Amount |
|---------------|--|---|--|
| Local | Big four firms | Service brochures/press releases | 19 items, 253 pages |
| | | Professional journal articles | 10 articles, 74 pages |
| | JICPA | Official brochures/reports on its website | 4 items, 61 pages |
| | | Professional journal articles | 4 articles, 16 pages |
| | Professional journals | Professional journal articles | 12 volumes in 2017* Approx. 400 pages |
| Other sources | Articles with 'AI audit' on Nikkei papers (the top local economy paper) The Financial Services Agency documents | 39 pages | |
| Global | Big four firms | Global reports and presentations (by non-local group firms) on websites | 6 items, 69 pages |
| | IAASB /AICPA | Official reports, presentations and meeting minutes on their website | 5 items, 259 pages |
| | Other sources | Business magazine/website articles on Big four, technology and audit | 97 pages |
| | | | Total: 1,270 pages |

* These volumes include articles by Big four firms and JICPA.

TABLE 3
List of Interviewees

| Firm | Interviews | Interviewees | Duration (hours) | Interviewee roles |
|-------|------------|--------------|------------------|---|
| Alfa | 16 | 13 | 22.5 | Audit firm head, Executive in charge of AI audit, Task force (TF) Partner (section head), TF members (Senior Manager, Manager and Associate), TF member (temporarily transfer to JICPA), Advisors to the TF |
| Beta | 4 | 8 | 6.5 | Executive in charge of AI audit, TF senior manager, TF members (Manager and Associate), TF member temporarily transferred to JICPA, Advisor to the TF |
| Total | 20 | 21 | 29 | |

Note: Two interviews for Alfa and another for Beta were not audio-recorded.

TABLE 4
Initiatives on Data Analytics by Big Four Audit Firms in Japan

| Firm | Major initiatives | | |
|--------------------------------|--|--------------|---|
| | Date | Type | Detail |
| Shin Nihon -EY | Jun. 2016 | Alliance | Research collaboration with Professor Shuto (U. Tokyo) on automatic fraud detection simulation |
| | Jul. 2016 | Solution | Installation of the accounting fraud prediction model based on externally available data |
| | Nov. 2016 | Organization | Launch of Assurance Innovation Laboratory |
| | Jan. 2017 | Publication | Article on ‘Information Sensor’ |
| | Apr. 2017 | Publication | Article on ‘Information Sensor’ |
| | Jun. 2017 | Publication | Article on ‘Kigyo Kaikei’ |
| | Jul. 2017 | Publication | Article on ‘Kigyo Kaikei’ |
| | Nov. 2017 | Solution | Development of the automatic irregular journal entry data detection |
| Azusa -KPMG | Jul. 2014 | Organization | Launch of Next generation audit technology research centre |
| | Jul. 2016 | Publication | Article on ‘Kigyo Kaikei’ |
| | | Publication | Article on ‘KPMG Insight’ |
| | Nov. 2016 | Publication | Article on ‘KPMG Insight’ |
| | Aug. 2017 | Publication | Article on ‘Nikkei Big Data’ |
| | Nov. 2017 | Publication | Article on ‘KPMG Insight’ |
| Toh- matsu - Deloitte | 2012 | Organization | Launch of Deloitte Analytics |
| | Sep. 2016 | Publication | Brochure, ‘Audit analytics’ |
| | Nov. 2016 | Publication | Article on ‘The auditor (Kansa-yaku)’ |
| | Dec. 2016 | Solution | Launch of updated ‘SAS Fraud Detection Framework’ |
| | Apr. 2017 (Spring- Autumn 2017) | Solution | Patent protection of AI text analysis technology |
| | | Publication | Serial articles, ‘Audit innovation has a great impact on your business’, on ‘Diamond Quarterly’ |
| | Sep. 2017 | Publication | Article on ‘Kigyo Kaikei’ |
| | Oct. 2017 | Solution | Patent protection of machine learning technology |
| | Dec. 2017 | Organization | Launch of a shared service office, Audit Innovation & Delivery Center |
| PwC Arata -PwC | Oct. 2016 | Organization | Launch of AI Audit Research Lab |
| | Nov. 2016 | Alliance | Research collaboration with Shiga University on data analytics |
| | | Publication | Article on ‘PwC View’ |
| | Mar. 2017 | Publication | Article on ‘The Finance’ |
| | Jun. 2017 | Publication | Article on ‘Nikkei Big Data’ |
| | Aug. 2017 | Publication | Brochure, ‘Audit technology and AI Audit Research Lab’ |
| | Oct. 2017 | Organization | Launch of a shared service office, Audit Assistance Office (later renamed as Technical Competency Center) |
| | | | |

TABLE 5
Representative Data and Quotations Underlying Second-order Themes

| First Order Code | Data Type | Representative Data |
|--|-----------|--|
| Theme A. Theorizing change internally at the field | | |
| A-1. Trigger inspirations from the global professional community | Archival | (Prior discussions in the global professional community) <ul style="list-style-type: none"> • AICPA and IAASB research and discussions were available before 2016. |
| | Interview | (Inputs from the global Big four group) <ul style="list-style-type: none"> • ‘We always watch information and resources of other member firms, then, if relevant, we proactively study and install theirs’. (Senior Associate 1) (Loose global control and local customization in the Big four group) <ul style="list-style-type: none"> • ‘There are no particular orders or pressures from overseas. If there are some tools that work somewhere, we simply use their tools. If we have something good, we would introduce ours. That’s the way’. (Director 3) |
| A-2. Theoretical development within the local professional association | Archival | (Professional future vision publication by JICPA) <ul style="list-style-type: none"> • JICPA IT committee ‘Future of audit’ team published its report in March 2016. |
| | Interview | (Need for JICPA to incorporate small firms) <ul style="list-style-type: none"> • ‘The field of non-Big four accounting firms is really chaotic. Many are practically run by individual accountants, who can’t deal with changes if audit standards would involve too sophisticated technology issues, so they naturally have negative opinions’. (Associate 2) (JICPA as a vehicle for Big four firms) <ul style="list-style-type: none"> • ‘Honestly speaking, we do want to use the association to guide the discussions for our own benefits’. (Associate 2) (Collaborative competition) <ul style="list-style-type: none"> • ‘Maybe the current situation is that [Big four firms collaborate but compete]. It’s difficult to imagine deeply working with competitors when researching this kind of important solutions’. (Senior Manager 3) |
| A-3. Internalization of the change anticipation among field members | Interview | (Acceptance of the need for change) <ul style="list-style-type: none"> • ‘10 years later, the current audit tasks themselves will have been completely transformed, though nobody can predict what exactly the future state will be’. (Senior Associate 1) (Belief in the human-AI collaboration as the to-be state) <ul style="list-style-type: none"> • ‘If what we audit might turn to be AIs or completely automated, AIs could complete auditing independently. The reality is not, however; the object of auditing is people, still requiring so many tasks which would be possible only by human work. As long as our job is to audit what humans in our clients have conducted, AI would have difficulties in completely replacing us’. (Partner 3) |

Theme B. Developing solutions by experimentations in organizations

| | | |
|---|-----------|--|
| B-1. Expectations of technical returns | Interview | <p>(Expectations and need for productivity improvement)</p> <ul style="list-style-type: none"> • ‘As I have been a professional in the coalface, I hope for man-hour reduction most’. (Associate 1) • ‘If we’ll be able to complete a 100-hour task in five hours, we should use the 95 hours for other tasks which will make the audit more effective’. (Partner 2) <p>(Expectations for quality improvement)</p> <ul style="list-style-type: none"> • ‘If we’ll have AI prepare materials for our judgements or propose key data areas to search for, that will make it easy for us to focus on important issues and greatly improve audit quality, I think’. (Director 2) |
| B-2. Perceived limitations of technology in the short term | Interview | <p>(Insufficient data formatting)</p> <ul style="list-style-type: none"> • ‘Our processes and reference data vary by clients and projects in the current audit. We need to standardize our processes and digitize our data to automate, in the first place’. (Senior Manager 1) <p>(Limitation of data sample size)</p> <ul style="list-style-type: none"> • ‘[As for cases of frauds which are very rare] we may not have sufficient input data, or teacher data, for machine learning to educate AI’. (Senior Manager 2) <p>(Limited applicability of the currently available solutions)</p> <ul style="list-style-type: none"> • ‘We’ve deeply studied since the launch of our organization, and actually it is not true [that] there are many technology solution options which are immediately available’. (Partner 1) <p>(The nature of audit as a potential bottleneck)</p> <ul style="list-style-type: none"> • ‘Processes are more important than conclusions in audit. What’s important is how we made judgements, based on what kind of information sets, and we need to keep records of that all for the external audit’. (Partner 1) • ‘What we are concerned most is confidentiality. We can never share our clients’ data with other audit firms’. (Partner 2) |
| B-3. Loose control of sub-teams, without concrete business plans and timelines | Archival | <p>(Frequent and flexible task force team focus changes)</p> <ul style="list-style-type: none"> • The number and focus of Sub-teams changed several times in the first year |
| | Interview | <p>(Lack of detailed official task force goals)</p> <ul style="list-style-type: none"> • ‘We see our goals only vaguely, or we don’t’ at all actually....The future will depend on what will become possible by new approaches. We’ll progress while seeking our ways’. (Director 1) • ‘If we set timelines when using the emerging technology still under development, we will end up compromising somewhere. So, we don’t have specific fixed plans’. (Manager) <p>(Testing by pilot studies)</p> <ul style="list-style-type: none"> • ‘We may start pre-tests in some audit teams, and if those pilots will succeed, then we’ll officially install [the solution] next year’. (Senior Manager 3) • ‘We’ll keep updating our approach, like “Let’s do it if anybody has an interesting idea”’. (Partner 1) |

Theme C. Theorizing change externally by organizations

| | | |
|--|-----------|--|
| C-1. Opportunity and threat perceptions of professional survival | Interview | (Competitions over technology among audit firms) <ul style="list-style-type: none">• '[Will AI influence the audit market share?] It Should. Directly and definitely'. (Senior Manager 2) (Perceived risks of the sustainability of the audit profession) <ul style="list-style-type: none">• 'Perceptions can change. Think about it. We don't necessarily need audit firms' 'OK' sign. We can use whatever alternative services, if those are available'''. (Director 3) |
| C-2. Proactive publications of the new logic with positive framing | Archival | (Big four firms' local publications on new technology) <ul style="list-style-type: none">• 'Audit analytics is Deloitte's advanced methods to realize efficient and effective audit, by identifying data correlations and trends beyond human auditors' rules of thumb, based on the analyses and visual presentations of corporate financial/non-financial data which have not been sufficiently used in the traditional audit'. (Deloitte Tohmatsu Brochure, 2016)• 'We aim to further advance the audit and improve our quality, by combining the long professional experience of auditors and advanced digital technology'. (Shin Nihon (EY) Press release, November 6, 2017) |

Theme D. Exploring solutions driven by individual firm members

| | | |
|---|-----------|--|
| D-1. Roles of individuals to guide specific solution design | Archival | (Empowerment of sub-team leaders in Task force management) <ul style="list-style-type: none">• Approaches/timeline were delegated to sub-team leaders in periodical meetings |
| | Interview | (Perceived uncertainty of the future) <ul style="list-style-type: none">• 'Nobody has the right answer, to be honest. In that sense, we expect and rely on various ideas of each member'. (Partner 2) (Personal exploration) <ul style="list-style-type: none">• 'As I have a long experience of my own [in the sub-team theme], I'm now planning how AI can be used in that particular process'. (Senior Manager 2) |

FIGURE 1
Data Structure

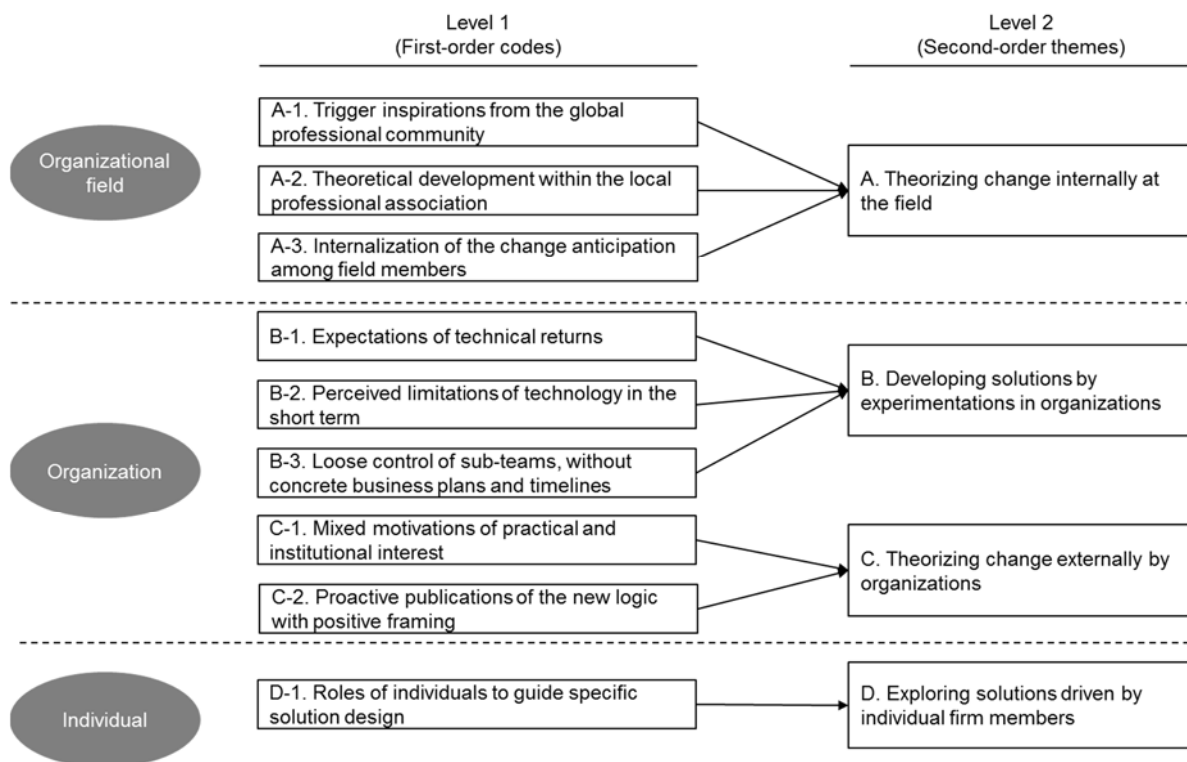


FIGURE 2
Grounded Theory Model

