Inter-Organizational Conference as a Learning Platform: Learning Process of Flight Procedure Designers

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Abstract
Work experience explains over 70% of learning by individuals. Therefore, individuals must continue learning through daily experience. Two research streams of “experiential learning” of management personnel and “expertise” of specialists have explored individual learning processes. However, there is a research gap between these two research streams. More studies are needed on the learning process of hybrid personnel engaging in both technical and managerial tasks. To fill this gap, this study explores the learning process of such hybrid personnel, “flight procedure designers” (FPDs), who design flight routes for aircraft, focusing on their learning in communities. This study employed “mixed methods,” consisting of both qualitative methods using semi-structured interviews and quantitative methods using a questionnaire survey. Results indicate that FPDs learn through experiences such as daily work, stepping out to the unknown, and learning in communities, both in and across organizations. Among them, learning by participating in inter-organizational conferences is one of the most important learning opportunities. FPDs utilize such meetings as communities of practices (CoPs). We found that secondary CoPs exist and accompany original, formal CoPs. A formal CoP provides a secondary CoP with subjects for discussion and opportunities to meet. Meanwhile, the secondary CoP provides the formal CoP with inspiration to find a new agenda and enhance the participants’ sense of belonging to the formal meeting. Hence, a formal CoP and secondary CoP are in a reciprocal relationship. Regarding its theoretical contributions, first, this study revealed the dynamism of the learning of individuals in interorganizational communities. Second, this study introduced the concept of the secondary CoP. With this concept, we illustrated the reciprocity between a formal CoP and a secondary CoP, along with their functions.

Key Words: experiential learning, expertise, community of practice, social platform
JEL Classification: M 19, D 83
1. Introduction

Over 70% of learning by individuals can be explained by work experience (e.g. Morrison and Brantner, 1992). This means that organization members have to continue learning through daily experience, because off-the-job training (Off-JT) is not sufficient for acquiring the skill needed for the job.

In one research stream of “experiential learning,” prior studies have analyzed how management personnel learn through various experiences, addressing the learning process and the types of experiences that promote their learning. Another stream of “expertise” study focuses on how subject experts, such as surgeons, develop their expertise.

However, there is a research gap between these two research streams, with experiential learning studies focusing on management personnel and expertise studies focusing on experts. That is, studies are limited on hybrid personnel engaging in both technical and managerial tasks.

One example of such hybrid personnel is flight procedure designers (FPDs), or personnel who design flight routes for aircraft. While an FPD’s job has technical aspects, they must also take care of managerial issues and be involved in coordination with various stakeholders frequently. As new technologies on aircraft navigation have been developed and implemented recently, the job of FPDs has become more important. However, studies on skill and learning of FPDs remain scarce.

This study analyzes the experiential learning of FPDs, focusing on learning in communities. In the next chapter, we review past studies on experiential learning, expertise, and communities of practice (CoPs). We also introduce the job of FPDs. For the empirical part, this study employs “mixed methods” (Creswell, 2003) consisting of both qualitative study (chapter 3) and quantitative study (chapter 4). Finally, a discussion is conducted in chapter 5.

2. Theoretical Background

2.1 Experiential Learning

Over 70% of learning by individuals can be explained by work experience (e.g. Morrison and Brantner, 1992). This means that organization members have to continue learning through daily experience, because Off-JT is not sufficient for acquiring the skill needed for the job. However, just experiencing events is not sufficient either. According to Kolb (1984), the experiential learning process consists of four stages: (1) concrete experience, (2) reflective observation, (3) abstract conceptualization, and (4) active experimentation. This implies that reflection after experience is one of the vital elements of learning.

Prior studies tried to identify what types of “concrete experiences” promote learning of organizational leaders and managers. McCall (1988), based on interviews with executives, classified types of developmental experiences into four categories: (1) assignments (starting from scratch, fix it / turn it around, project / task force, [expansion of work] scope, line to staff
switch), (2) other people (role models, values playing out), (3) hardships (business failures and mistakes, demonstrations / missed promotions / lousy jobs, subordinate performance problem, breaking a rut, personal traumas), and (4) other events (coursework, early work experiences, first supervision, purely personal).

In general, scholars support the typology of the experiences above. However, learning process differs among job type. Matsuo, Wong, and Lai (2008) found that IT project managers and IT consultants follow different learning paths, with different types of experiences. Hence, it is important to note the difference among the domains in the learning and developmental process.

2.2 Expertise

Another research stream related to experiential learning is expertise research. Expertise studies aim to identify the nature of experts’ prominent performance and the process through which they acquire the performance. Ericsson (1996) proposed a “10-year rule” where approximately 10 years are needed to become an expert. However, simultaneously, Ericsson (1996) states that 10 years of experience do not automatically guarantee expert performance. Recent studies claim that the duration of experience itself has only a weak influence on performance acquisition (Ericsson et al., 2009). In other words, the contents of experiences are more important than the duration itself. For example, the step of “reflective observation” in Kolb’s (1984) experiential learning process is one of the key elements to learn more from given experiences.

Among the features that promote acquisition of work performance is “deliberate practice” (Ericsson, 1996, 2001; Ericsson and Lehmann, 1996). Deliberate practice refers to training activities structured to include well-defined tasks with a certain level of difficulty, informative feedback, and opportunities for repetition and error correction (Ericsson, 1996). Similarly, Burton et al. (1984) proposed a concept of “increasingly complex microworlds.” In this “world,” individuals are located in a situation where there tasks become increasingly complex. Hence, individuals can learn effectively more and more complex tasks in a gradual manner.

2.3 Community of Practice (CoP)

A common feature among prior studies are that many experiences involve interactions with other people. Therefore, interactions with others in communities are inevitable when studying individual learning.

Since the 1990s, many studies have tended to regard learning as activities conducted in communities. Lave and Wenger (1991) observed a process in which a learner shifts his or her participation from the periphery to the center of the community and conceptualized it as “legitimate peripheral participation.” Such a community is referred to as a “community of practice” (CoP). A CoP is defined as “a group of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by
interacting on an ongoing basis” (Wenger et al., 2002, p. 4). CoPs play an important role in the development of skills of various domains (Wenger et al., 2002).

Nowadays, research addresses various types of CoPs from a local workplace (e.g. Wenger, 1998) to a schoolteachers’ online community (e.g. Hur and Brush, 2009). One dimension characterizing CoPs is the distinction between formal and informal CoPs. Formal CoPs refer to those formally recognized or supported by formal organizations (Wenger et al., 2002), whereas informal CoPs are not similarly recognized. Of note is the fact that an informal CoP has unique benefits. The most useful information rarely flows down the formal chain of command in an organization, and it can be obtained through an informal network (Powell, 1990). Geiger and Turley (2005) also found that informal groups in sales teams address information that formal meetings cannot address, such as the personality and reputation of their client. They called this kind of information “off the record” information (p.64).

Another dimension is the distinction between “within organization” and “across-border” CoPs. In the case of an “across-border” CoP (Nakanishi, 2016), which consists of members belonging to different organizations, members sharing common interests transfer knowledge from one organization to another through continuous interaction. In modern borderless society, it seems such border crossing has more importance in individual learning.

2.4 Flight Procedure Designers (FPDs)

While researchers have examined the experiential learning of management personnel and the expertise of technical experts as well as CoPs that support these learning processes, there is a research gap between these research streams; studies on hybrid personnel engaging in both technical and managerial tasks are limited. This paucity should be addressed for two reasons. First, technical divisions are often managed by personnel who have spent most of their career in technical tasks; eventually, they move to new positions that involve both technical and managerial tasks. Second, particularly in modern society, more middle managers are “playing managers” who cannot concentrate on managerial tasks.

To address this problem, this study examines the learning of “flight procedure designers” (FPDs), specialists who design flight procedures of aircraft. Flight procedures refer to predefined routes of aircraft, established mainly for takeoff, climb, arrival, approach, and landing. An FPD is an expert responsible for the establishment of flight procedures. An FPD’s main tasks include but are not limited to (1) initial planning, (2) collection and validation of data, (3) conceptual design, (4) coordination with stakeholders such as aircraft operators and air traffic control (ATC) organizations, (5) detailed design, (6) charting, documentation and storage, (7) safety assessment, and (7) validation of designed flight procedures (ICAO, 2009a). For designing flight procedures, FPDs must satisfy various requirements, such as safety, efficiency, aerodrome/airspace capacity, and noise reduction. Measures on the satisfaction of these requirements are not clearly defined. They often conflict, with different priorities on a
case-by-case basis. While an FPD’s job has technical aspects, FPDs also have to act as managerial personnel; they must manage the entire project through coordination with other parties. Thus, FPDs are a hybrid personnel engaging in both technical and managerial tasks.

The efficient development of flight procedure design capability is crucial to respond to the community’s expectation for the establishment of more flight procedures as a result of the implementation of new aircraft navigation technology. Hence, an FPD’s job is becoming more important (ICAO, 2010). International Civil Aviation Organization (ICAO), one of the United Nations’ specialized agencies in charge of international civil aviation, has developed and published a guidance material for the training of FPDs (ICAO, 2009b).

The manual, while it has globally been applied to the development of training programs of FPDs, has limitations. First, it was developed in line with a training theory originally meant for real-time tasks such as pilots and air traffic controller (ATCO). However, the task of FPDs are not conducted on a real-time basis; rather, FPDs are engaged in long-term projects. This means the cognitive mechanism and learning process of FPDs are different from that of pilots or ATCOs. For example, FPDs need to manage the progress of projects and relationships with stakeholders, which pilots or ATCO are not involved in. Meanwhile, FPDs must, and can, rely on their information network consisting of their peers to ask questions, as their task is not conducted on a real-time basis. Second, FPDs must solve “ill-defined problems” in which goals and the means to achieve them are not clearly defined. As stated above, flight procedures must satisfy multiple requirements without clear evaluation criteria. There is no single best design. These characteristics of an FPD’s job are different from that of a pilot or an ATCO, in which “if-then” scenarios are defined in a better way. Third, ICAO training manual (ICAO, 2009b) mainly focuses on Off-JT without sufficient attention paid to experiential learning. It is not feasible to teach all skills to solve the ill-defined problems that FPDs must solve in Off-JT. It seems that FPDs need much more experience to acquire the skills to handle unknown problems.

In summary, for the development of an aviation society, more analysis is needed of the experiential learning process of FPDs.

2.5 Objectives

As stated above, we identified two problems. First, theoretically, there is a paucity of research on hybrid personnel engaging in both technical and managerial tasks. Second, practically, we need to study the experiential learning process of FPDs. Therefore, this study explores the experiential learning process of FPDs, especially focusing on learning in communities. The research questions are as follows:

RQ1: What kind of experiences facilitate and improve learning by FPDs?

RQ2: What role do communities play in the learning process of FPDs?

Our study is exploratory in nature. Hence, we applied a qualitative research method to examine our research questions. Study 1 addresses qualitative research using interviews.
Additionally, we conducted quantitative research using a questionnaire survey to improve the validity of the findings of the qualitative research. The quantitative research is addressed in Study 2. Such a strategy of combining qualitative and quantitative research is referred to as mixed methods (Creswell, 2003), or triangulation. Mixed methods, using multiple perspectives, improve the objectivity of the findings (Creswell, 2003).

3. Study 1: Qualitative Research

3.1 Method

In Study 1, we conducted interviews and analyzed the data using modified grounded-theory approach (M-GTA) (Kinoshita, 2003), a sophisticated version of grounded-theory approach (GTA; Glaser and Strauss, 1967; Strauss and Corbin, 1998). GTA is broadly applied to qualitative studies on psychology, social science, etc.

First, a focus group discussion was conducted in December 2009 to identify the questions to ask during interviews and the assumed scenario. Experienced Japanese FPDs (5–10 years’ experience) and the author (facilitator) participated in the discussion, which lasted for 1 hour.

We selected informants from the participants of “P Conference” (PConf). PConf, which develops international standards of flight procedure design, is one of the technical panel meetings organized by ICAO. The participants of PConf are considered suitable to collect the data necessary for this study because they are nominated as subject experts by State government or international organizations. Upon selecting informants, having sufficient work experience as a FPD is applied as the primary criterion, with balance between the countries and the types of organizations they belong to considered. As a result of the integrated process of GTA, the number of informants became six. This number was not determined at the planning stage, but during the analytical process upon “theoretical saturation” (Glaser and Strauss, 1967), at which no more code could be generated. Informants are indicated as “A”, “B”, “C,” etc., hereinafter. They are working in five European and American countries, their mean age is 51 years, and their mean years of experience as FPDs is 19 years. They belong to State authorities, public corporations, or private companies. Before working as FPDs, they worked as ATCOs, pilots, or engineers.

Semi-structured interviews were conducted between December 2009 and March 2010, in English, supplemented by follow-up correspondences via e-mail. Main questions were on (1) personal history before starting working as a FPD and the trigger for the job transition, (2) job experiences that promoted learning and the contents of the learning, and (3) participating communities (in and out of the workplace) and the content of learning. Voices were tape-recorded with permission. Each interview lasted 58 minutes (mean value).

Voice data were transcribed, and “codes” related to our research topics were extracted from the transcript. Then, related codes were summed up into sub-categories and categories. Finally,
upon completion of the analysis of informant F, we determined that we had reached a theoretical saturation and terminated data collection and analysis.

3.2 Result

3.2.1 Knowledge Required for FPDs

Expert FPDs possess broad knowledge in a variety of domains as well as that for flight procedure design (Table 1).

<table>
<thead>
<tr>
<th>Domain</th>
<th>Contents</th>
<th>Applied upon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft operation</td>
<td>Performance, behaviour, manoeuvrability of aircraft, etc.</td>
<td>Assessment/judgement of flyability of flight procedures</td>
</tr>
<tr>
<td>Navigation system</td>
<td>Accuracy, confidence level, limit, etc., of navigation system</td>
<td>Assessment/judgement of flyability of flight procedures</td>
</tr>
<tr>
<td>Navigation system database coding</td>
<td>Rules on the coding of flight procedures into navigation system database</td>
<td>Assessment/judgement of “codability” and flyability of flight procedure</td>
</tr>
<tr>
<td>Flight inspection and flight validation</td>
<td>Knowledge of how flight inspection/validation pilots fly and check the flight procedure</td>
<td>Preparation of documents that support effective/efficient flight inspection/validation</td>
</tr>
<tr>
<td>Air traffic control (ATC)</td>
<td>Knowledge of how ATC controls air traffic and related rule</td>
<td>Assessment/judgement of if the flight procedure supports efficient and safe ATC</td>
</tr>
<tr>
<td>Aerodrome facility</td>
<td>Aerodrome infrastructure (runway, lighting, obstacle limitation surface, etc.)</td>
<td>Assessment/judgement of what kind of flight procedure can be established at a given aerodrome and what kind of mitigation is needed for insufficient infrastructure</td>
</tr>
<tr>
<td>Environment (noise)</td>
<td>Requirements by local communities and on the techniques to meet them</td>
<td>Development of optimum flight procedure that meets various requirements as far as this is practicable</td>
</tr>
<tr>
<td>Geodesy</td>
<td>Geodesy in general and tolerance/error in survey/positioning</td>
<td>Estimation of tolerance in judgement of usability and limit of acquired data</td>
</tr>
</tbody>
</table>

The fact that FPDs need knowledge of various domains influences the required types of experiences FPDs must go through.

3.2.2 Experiences that Promote the Learning of FPDs

The experiences that promote the learning of FPDs are classified into 4 categories and 10 sub-categories (Table 2).

Among the types of experiences, Off-JT consisting of lectures and practical exercises is for acquiring the basic knowledge and skills needed to conduct job tasks. Daily work consists of experiences such as assistant work, gradual transition, and trial and error. Through these types of experiences, FPDs acquire basic knowledge and skills further and integrate them. Through experiences classified as stepping out to the unknown, FPDs reconfirm their knowledge and improve their ability to apply their knowledge flexibly. As a result, they become able to make judgement from a higher viewpoint by taking compromising perspectives into account. Such experiences also allow FPDs to feel confident in their own jobs. Through learning in
communities, both in and outside the organization they belong to, FPDs acquire knowledge of experiences and mental models of others.

Of note is the fact that it is crucial for FPDs to learn in communities through interaction with others. All informants emphasized this fact. Therefore, we elaborate on the learning in communities that characterizes the learning of FPDs.

### Table 2: Experiences that Promote the Learning of FPDs

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-category</th>
<th>Definitions</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off-JT</td>
<td>Training</td>
<td>Participating in various types of training to acquire knowledge and skill needed to conduct job tasks</td>
<td>Basic knowledge and skill needed to conduct job tasks</td>
</tr>
<tr>
<td>Daily work</td>
<td>Assistant work</td>
<td>Acquiring sub-skills and related knowledge through assistant works and chores</td>
<td>Basic knowledge and skill needed to conduct job tasks</td>
</tr>
<tr>
<td></td>
<td>Gradual transition</td>
<td>Transiting gradually from simple tasks to more difficult tasks</td>
<td>Knowledge of relevant domains</td>
</tr>
<tr>
<td></td>
<td>Trial-and-error</td>
<td>Making multiple options for one flight procedure and modifying them when necessary</td>
<td>Accurate work</td>
</tr>
<tr>
<td>Stepping out to the unknown</td>
<td>Difficult tasks</td>
<td>Tackling difficult tasks to complete them</td>
<td>Knowledge of relevant domain</td>
</tr>
<tr>
<td></td>
<td>Work in different situations</td>
<td>Learning through work at situations different from daily work</td>
<td>Integration/restructuring of knowledge</td>
</tr>
<tr>
<td></td>
<td>Accomplishment by oneself</td>
<td>Dealing with tasks to complete them by oneself where available resources are limited</td>
<td>Knowledge, experiences, and mental model of others</td>
</tr>
<tr>
<td>Learning in communities (Within organization)</td>
<td>Workplace learning</td>
<td>Sharing knowledge through collaboration with a superior and colleagues, with technical instructions and mental support</td>
<td>Practical application of skill</td>
</tr>
<tr>
<td>Learning in communities (Across organizations)</td>
<td>Collaboration with other organizations</td>
<td>Collaboration with other types of organizations, professions, and domains, including coordination of interests and policies</td>
<td>Knowledge of relevant domains</td>
</tr>
<tr>
<td></td>
<td>Learning through participating in meetings (conferences)</td>
<td>Acquiring knowledge of relevant domain by participating in inter-organizational meetings, and contributing to the learning of others</td>
<td>Feedback Knowledge, experiences, and mental model of others</td>
</tr>
</tbody>
</table>

#### 3.2.3 Learning in Communities

It is essential for FPDs to learn in communities for two reasons. First, they are working in relatively small offices, as predicted prior to the study. Learning in small offices with a limited number of experts leads to limitation in sharing knowledge. FPDs need supplemental sources. Second, FPDs need to learn about various issues, as shown in Table 1. In addition, some knowledge is not available in their organizations. At the same time, some other organizations possess such knowledge, and informants acquire experience and knowledge effectively by participating in communities outside their organizations. Moreover, to accomplish their task,
FPDs need “tacit knowledge” (Polanyi, 1983) of others. For example, they must rely on pilots’ recognition when making a judgement about the flyability of the flight procedures they designed. In such cases, FPDs refer to comments and ideas of other professionals.

Learning in community is further classified into workplace learning, collaboration with other organizations, and learning through participating in meetings, as discussed below.

**Workplace learning.** Workplace learning through interaction with a superior and colleagues is the most basic learning opportunity as well as Off-JT. In workplace learning, FPDs acquire knowledge they cannot obtain through Off-JT. Additionally, FPDs get instructions from their superior about their attitude as a professional. The superior provides mental support as well.

**Collaboration with other organizations.** FPDs must coordinate and make decisions collaboratively with other organizations such as airlines and air navigation service providers (ANSPs). Such opportunities act as important learning opportunities. First, FPDs acquire new knowledge not available at their own organizations, such as on the performance and functionality of a new type of aircraft, from employees of airlines. Second, they reconfirm their knowledge through collaboration. Informant F confirmed that his knowledge is correct and valid through technical explanations to those from a different technical background and knowledge during a project in a developing country.

**Learning through participating in meetings.** All informants regard participation in interorganizational meetings (conferences) with other organizations as the most important learning opportunity, as they can effectively acquire knowledge that is not available in their own organizations. Such meetings include, but are not limited to, international/regional meetings/conferences for policy-making, coordination, and technical working group meetings for the development of technical standards. Reflecting the fact that the informants are PConf participants, all informants regarded PConf as the most important learning opportunity.

Concerning PConf, two CoPs exist and contribute to the learning of FPDs: PConf itself as a formal CoP and a secondary CoP formed spontaneously through participating in PConf. These two CoPs have different learning contents, although some overlap (Table 3). Of note is the fact that the formal CoP and secondary CoP are in a reciprocal relationship, as the bottom portion of Table 3 shows.
Table 3: Two Communities Accompanying PConf

<table>
<thead>
<tr>
<th></th>
<th>Formal CoP</th>
<th>Secondary CoP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objectives</td>
<td>Development of technical standards</td>
<td>Learning of individual members</td>
</tr>
<tr>
<td>Main contents of learning</td>
<td>Backgrounds, logics, rationale of published information (international standards, etc.), and relevant future trends</td>
<td>Others’ experience, knowledge (past problems and solutions) Reconfirmation of the validity of one’s own idea Trends of other technical domain</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Formal</td>
<td>Free and relaxed</td>
</tr>
<tr>
<td>Contents of communications</td>
<td>Limited to those in line with the formal objectives of the meeting</td>
<td>Widely covering the contents not addressed in the formal scene</td>
</tr>
<tr>
<td>Reciprocal functions</td>
<td>Providing the secondary CoP with the subjects to discuss and the opportunity to meet together</td>
<td>Providing the formal CoP with inspiration for formal agenda and clues to solve problems Enhancing the sense of belonging to the formal CoP</td>
</tr>
</tbody>
</table>

Participants of PConf are interconnected with common skills in, and strong commitment to, flight procedure design. Therefore, we regarded the groups of informal communication in the right column of Table 3 as one CoP, because they satisfied the definition of CoP (Wenger et al., 2002, p. 4). One informant confessed his feelings on PConf:

E: So, I believe it’s very important to be involved and on top of which because there are so few designers in the world it’s important to share that knowledge. I mean the reason I come to these panels is I want to be a part of it, I want to help, I want to make sure that my state is heard, because we have an opinion, we have experience; we have different experiences, the experience from other places. So if we can help and make an improvement then it’s better for everybody, better for you, better for me.

The characteristics of learning at these two CoPs are as follows. At the formal CoP, participants acquire diverse knowledge through the discussion at PConf. By participating in discussions for the development of new technical standards, participants acquire knowledge on the background, logic, rationale, etc., of international standards of flight procedure design. Additionally, they learn about the future trend of air navigation technology.

Meanwhile, at the secondary CoP, participants discuss various issues that the formal CoP cannot address because of the scope of the conference and time constraints. For example, informant E learned about the preceding cases of other countries with regard to new technology that his country was going to implement. Participants also exchanged technical information on other industries. In particular, there exist only a few aircraft manufacturers in the world; it is difficult to find a contact point with them only through daily work at home. Therefore, secondary CoPs formed at international meetings are important for obtaining knowledge related to aircraft issues:
A: We cannot have like 400 PConf members, but at least, as you say, have your network points. I think that’s enough. Not everybody needs to be in such an organization, but no – I also have some key people like [Z]. And obviously [Z] teaches for me flight operations also if there is something I don’t know when it’s especially airliner related. I know a lot about cockpit operations, but they are more on the small aircrafts and not on the commercial airliners. So, I also have my guys I can call like [Y] when it’s more in the airbus family. And I have another guy who flies more in the Turboprop airline business on Dash8 and stuff. And I have my Geodesy guys that I can ask things. So, I think that’s important to have a network\(^5\).

In particular, PConf is suitable for obtaining knowledge on various domains because of the wide technical background its participants have. This fact is supported by a formal but flexible boundary; while its “members” are formally nominated by State governments, they can be accompanied by “advisors” on their discretion.

Additionally, informal communication during secondary CoP also addresses issues that participants can hardly ask about during the formal meeting because of feelings such as “I do not want to be seen as ignorant by others” or “I cannot ask such a too-basic question”. They also refrain from asking questions that cannot be answered in front of many people.

At the same time, informants not only collect but also positively disclose knowledge to others. This attitude of participants supports learning at a secondary CoP as follows:

D: You should exchange because you need to have information from other experts. So, if everybody is open you can be an expert in everything not because you are an expert in every field but because you know an expert.

As shown in the comment by informant D, PConf participants have the mentality to contribute to others actively. According to informant D, the fact that the activities at Conference P are not of a commercial nature contributes to the creation of such an atmosphere. Actually, he states that some other technical meetings organized by the same organization have a very different, businesslike atmosphere.

One of the reasons that learning at secondary CoPs is important for the learning of FPDs is the limitation of workplace learning:

D: You have some exchange and each one give his own point of view, his own experience. I think it’s very difficult to have a very small staff of procedure designer, one or two procedure designer. Even if we get some courses, probably it’s difficult to progress. If you mix together experienced procedure designer and a new one, it’s a good process to implement the experience.

Informant E also emphasizes the importance of knowledge received from different experiences:
E: The experience of other people and, as I’ve learned, the European experience, the American experience, the Japanese experience, has been different to my own. So, being able to come to this forum and discuss any concerns I have and what I have learnt, I believe, not only makes me but it makes everyone else better as well.

Hence, a secondary CoP acts as an important learning opportunity where participants can obtain knowledge that is difficult to obtain elsewhere. Additionally, as informant E commented, informants indicate a strong sense of belonging to PConf. It seems that this sense was enhanced by the effectiveness of the learning they experienced and by the attachment formed between participants.

3.3 Discussion

The result indicates that FPDs learn through various types of experiences (Table 2). The informants emphasized the importance of such experiential learning in addition to formal training courses. While some types of experiences classified into daily work and stepping out to the unknown (e.g., difficult tasks, work in different situation) correspond to those identified by McCall (1988), others (e.g., trial and error) reflect the unique aspects of FPDs’ job.

The learning process of FPDs is illustrated as follows. After formal training, they start their work with assistant work. Subsequently, through gradual transition and trial-and-error, they become competent FPDs. Additionally, with the experience of stepping out into the unknown, such as difficult tasks, work in different situations, and accomplishment by oneself, they get closer to the status as experts. This process is in line with the concept of “deliberate practice” (Ericsson, 1996, 2001; Ericsson and Lehmann, 1996), where activities are well structured with a certain level of difficulty, informative feedback, and opportunities for repetition and error correction. This also matches with the characteristics of “legitimate peripheral participation” (Lave and Wenger, 1991) and “increasingly complex microworlds” (Burton et al., 1984), where learners gradually shift their responsibilities from trivial tasks to important ones with heavier responsibility. Moreover, the process in which FPDs acquire basic skills through trial and error and integrate knowledge as a result of reflection upon failure supports Kolb’s (1984) four-step experiential learning process.

It was also revealed that FPDs rely on CoPs consisting of multiple organizational members. In particular, the secondary CoPs accompanying formal CoPs play important roles in learning. Secondary CoPs have specific features as follows. First, secondary CoPs have the function of addressing information that formal CoPs can hardly address. This is in line with claims by prior studies on the informal flow of information (Powell, 1990). Informants utilize secondary CoPs to confirm the validity of their own knowledge. This is one example of “off the record” information (Geiger and Turley, 2005). Second, a formal CoP and its secondary CoP are in a reciprocal relationship (Figure 1).
A formal CoP has two functions. First, it provides information that can be a subject of discussion at a secondary CoP (subject-provision function). It would be natural for the issues at the formal CoP to be a trigger for a discussion at the secondary CoP, as the issue is of common interest to community members. Second, the formal CoP provides participants with opportunities to meet together (opportunity-provision function). This function enables participants to interact with others and to maintain a social network. With this function, participants of the secondary CoP can meet together without additional cost by utilizing opportunities for attending formal meetings even if they live in a diverse area.

In contrast, the secondary CoP provides the formal CoP with inspiration to find new agendas and clues to solve problems (inspiration fiction). Discussions at the secondary CoP often facilitate problem solving at the formal meeting, according to the informants. There are two sources of the inspiration function. First, relaxed atmosphere at the secondary CoP facilitates flexible discussion and thinking. Those who cannot speak during formal meetings because of a lack of self-confidence may provide important information during a break. Participants may form a rapport with reduced mental distance. Second, “off the record” information (Geiger and Turley 2005), which cannot be addressed at the formal meeting, may become a clue to solve a problem. Note that the most useful information flows not formally, but informally (Powell, 1990).

The participants not only collect but also provide knowledge to others actively. Informant E confessed that he would like to help others by contributing to discussions. Finally, as a result of informal interaction with others, the informants get to feel that they really belong to the formal meeting, which is the basis of the secondary CoP. In other words, secondary CoPs enhance the participants’ sense of belonging to the formal meeting (identification function). The informants regard PConf not just as an instrument to collect information but also as a part of their identity. Hence, the interaction at secondary CoPs activates original formal CoPs.

Such reciprocity between formal and secondary CoPs, with these four functions, is a specific feature unique to secondary CoPs, which a single CoP does not have.
4. Study 2: Questionnaire Survey

In Study 1, we identified the characteristics of experiential learning of FPDs. Study 2 aims to validate the findings of Study 1 through a quantitative survey.

4.1 Method

We conducted a questionnaire survey in June 2017, in Lisbon, Portugal, at the venue of the Instrument Flight Procedure Conference, organized by a civil aviation educational institute. Questionnaire sheets were distributed on paper and collected by posting them into a return box. Among a total of 50 participants, we collected 35 completed answers (return rate 70%). Among 35, 25 were FPDs, while others were government safety regulators, engineers, consultants, training specialists, pilots, data suppliers, etc. Question items were (1) age, (2) gender, (3) years of experience in aviation, (4) current job, (5) years of experience in flight procedure design, (6) previous job, (7) types of organizations the respondents belong to, (8) the number of FPDs in the respondent’s organization, (9) types of experience that contributed to the respondent’s expertise, (10) expected topics to be discussed in conferences, etc.

4.2 Results

Hereinafter, the results are indicated only for FPDs (n=25). Demographic data are as follows. Mean age was 39.2 years old, with standard deviation (σ) = 7.5 years; male = 19 (76%) and female = 6 (24%). Years of experience in aviation (both civil and military) was 13.9 (mean), 12.0 (median), with 9.4 (σ), 3 (minimum), and 41 (maximum). Years of experience in flight procedure design was 7.4 (mean), 6.5 (median), with 6.0 (σ), 0.3 (minimum), and 20 (maximum). They belonged to ANSP (16), independent (third-party) flight procedure design service provider (FPDSP) (6), airport operator (2), and state authority (1).

4.2.1 The Number of FPDs in the Organization

The number of FPDs in the organization the respondent belonged to was 4.0 (mean), 3.0 (median), with 2.5 (σ), 2 (minimum), and 11 (maximum). Comparing the number between ANSP and FPDSP, mean number of FPDs in ANSP was 4.6, while that of FPDSP was 2.5. ANSPs, which normally provide state-level service, have a significantly larger number of FPDs than FPDSP (p < .05). However, considering the median (3.5), it seems that some ANSPs do not have a sufficient number of FPDs. This fact supports the findings of Study 1 that learning in CoPs consisting of employees of multiple organizations is essential for FPDs.

4.2.2 Previous Job

Previous jobs that FPDs had been engaged in include ATCO (9), engineer (8), pilot (4), aeronautical information services (AIS) (4), and others (8). Additionally, 8 out of 25 FPDs had multiple types of experience (e.g., ATC and engineer). These results indicate that FPDs came from various technical backgrounds.
4.2.3 Types of Experience that Contributed to FPDs’ Expertise

The questionnaire asked the respondent to check the types of experiences that contributed to their expertise (multiple choices were allowed; choices were not mutually exclusive).

Figure 2: Types of Experience that Contributed to FPDs’ Expertise

The respondents indicated that previous job, training, daily work, project, meeting, and collaboration with other organizations improved their expertise. We also asked respondents to describe how these experiences improved their expertise. The results generally support the results of Study 1. FPDs obtain very basic knowledge of aviation through their previous job, which they apply to their job as FPDs; 22 (88%) out of a total of 25 FPDs chose their previous job to indicate the type of experience that promoted learning. This means that experiences of any type of job can be useful for flight procedure design. Basic skill obtained through training also acts as a basis for their job. Learning during daily work is also important. One respondent commented that he shared his problems and expertise with his colleagues in both his own section and other sections. Another stated that he also learned from mistakes, as indicated by “trial and error” in Study 1.

Through projects, they learned what they could not learn through daily work situations. During a project for a new technology implementation, a respondent exchanged knowledge with people from different domains. One respondent said that he learns others points of view from other participants/contractors by participating in projects. Another felt that he was obliged to follow new technologies and regulations, which result in learning. FPDs also learn how to manage projects. This is one of the differences between FPDs and other real-time professionals; FPDs tackle relatively long-term projects lasting for months, whereas pilots and ATCOs work on a minute-hour-day basis.

Respondents learn by attending meetings and conferences organized by ICAO, international organizations, State authorities, etc. They obtain knowledge of new technology from other participants and also gain self-confidence in their own knowledge. They also utilize meetings and conferences to establish a social network to acquire knowledge in the future. These findings support the results of Study 1.
4.2.4 What to Learn at Conferences and Meetings

The questionnaire asked about the expectations to interorganizational conferences (multiple choices were allowed). The results are shown in Figure 3. Beside the topics on flight procedure design itself, the respondents indicated a diverse range of topics (Table 4). Of note is the fact that it is difficult to learn some items in FPDs’ own organizations. This also shows that FPDs needs to attend conferences and meetings to learn.

Figure 3: Expected Topics in Conferences

Table 4: Expected Topics of Conferences

<table>
<thead>
<tr>
<th>Items</th>
<th>No.</th>
<th>%</th>
<th>Original Possessor of the Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight procedure design</td>
<td>23</td>
<td>92</td>
<td>Flight procedure designers (FPDs)</td>
</tr>
<tr>
<td>Navigation database</td>
<td>16</td>
<td>64</td>
<td>Navigation database supplier</td>
</tr>
<tr>
<td>Flight validation/inspection</td>
<td>16</td>
<td>64</td>
<td>Flight validation/inspection pilot</td>
</tr>
<tr>
<td>Cockpit crew procedure</td>
<td>14</td>
<td>56</td>
<td>Pilot</td>
</tr>
<tr>
<td>Global navigation satellite system</td>
<td>14</td>
<td>56</td>
<td>Engineer</td>
</tr>
<tr>
<td>Avionics</td>
<td>12</td>
<td>48</td>
<td>Engineer</td>
</tr>
<tr>
<td>AIS &amp; Cartography</td>
<td>12</td>
<td>48</td>
<td>AIS/cartography specialist</td>
</tr>
<tr>
<td>Geodesy</td>
<td>11</td>
<td>44</td>
<td>Geodesy specialist</td>
</tr>
<tr>
<td>Quality management system</td>
<td>9</td>
<td>36</td>
<td>Flight procedure designers (quality manager)</td>
</tr>
<tr>
<td>Air traffic control (ATC)</td>
<td>7</td>
<td>28</td>
<td>Air traffic control officers</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>6</td>
<td>24</td>
<td>Engineer</td>
</tr>
<tr>
<td>Safety management system</td>
<td>6</td>
<td>24</td>
<td>Safety manager</td>
</tr>
<tr>
<td>Organization issues</td>
<td>6</td>
<td>24</td>
<td>Manager / subject expert</td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

a: In general, unavailable in air navigation service providers (ANSPs)
b: In general, unavailable in independent flight procedure design service providers
c: Aeronautical information services
4.3 Summary

In general, the result of the questionnaire survey supports Study 1’s findings. FPDs seek learning opportunities outside their organizations for two reasons: the limited number of designers in their own organizations and the necessity to obtain a wide variety of knowledge unavailable in their own organizations.

FPDs learn through various experiences, including daily work, projects, meetings, and collaboration with other organizations. Among these, FPDs regard interorganizational meetings and conferences as one of the most important learning opportunities. This is because these conferences are a collection of knowledge on topics relevant to flight procedure design, as shown in Table 4.

5. Discussions and Conclusion

This study explored the experiences that promote learning of FPDs, a type of hybrid personnel. It identified the importance of learning by participating in interorganizational meetings, especially secondary CoPs. Subsequently, we validated these findings through a questionnaire survey.

The theoretical contributions of this study are as follows. First, this study revealed the dynamism of the learning of individuals in interorganizational communities. Second, this study introduced the concept of the secondary CoP. With this concept, we illustrated the reciprocity between a formal CoP and a secondary CoP, along with their functions (subject provision, opportunity provision, inspiration, and identification).

Practical implications retrieved from these findings are as follows. Management of organizations should recognize the value of secondary CoPs and utilize them as learning platforms. Attending training and/or seminars requires additional costs, such as training fees and opportunity costs for suspended work. However, learning at secondary CoPs requires little additional cost because of its nature where formal meetings accompany it. In secondary CoPs, people may meet employees of other organizations tackling the same problems. Hence, they can acquire knowledge that is difficult to obtain through daily work and can validate their own skill and knowledge with feedback from others.

We provide an additional practical implication to the civil aviation domain; organizations in charge of flight procedure design should take the uniqueness of the job of FPDs and their experiential learning process into account while developing FPDs’ training program. As we discussed, FPDs need a variety of knowledge (Table 1) and experiences (Table 2). Such characteristics are different from those of pilots and ATCO, who learn mostly through line operations and Off-JT. The management of organizations in charge of flight procedure design should, noting that learning process differs among job type (Matsuo et al., 2008), avoid directly applying the training methodology of real-time task personnel, such as pilots and ATCO, to
FPDs. In particular, the managements should provide FPDs with appropriate learning opportunities such as participation in interorganizational meetings.

This study is subject to limitations. First, this study was conducted on a single research site: flight procedure design. We should be careful when generalizing our findings. However, we believe that our findings are valid in other domains where it is essential to learn outside learners’ own organization. Modern society is borderless. People interact with others outside their organizations. In such a borderless society, our findings would be applicable to various domains. Second, the number of informants and sample number of questionnaires may not be sufficient. Further research in other domains is needed.

Acknowledgement

I am grateful to the informants and participants of the questionnaire survey for providing valuable information on the topic of study.

Notes

1) This qualitative study is based on Nakanishi (2013).

2) “P Conference” (PConf) is a pseudonym for a technical meeting organized by ICAO. PConf sessions are held twice a year to develop international criteria for flight procedure design. Each session lasts two weeks. PConf consists of approximately 40 participants nominated from ICAO member States. They are subject experts of domains related to flight procedure design, such as FPD, pilot, ATCO, aircraft system specialist, and navigation database specialist.

3) “Flyability” refers to an indicator representing how pilots can fly the flight procedure easily and safely. For example, a simple flight procedure that can be flown without maximum aircraft performance achieves high flyability.

4) ANSP is an organization that provides services such as ATC to aircraft operators. ANSPs are often established and operated by State governments.

5) Square brackets [ ] in informants’ comments indicate individuals’ name replaced by the author for maintaining the informants’ privacy.

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