

Pattern Mining Patterns

A Search for the Seeds of Patterns

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This paper presents the *Pattern Mining Patterns*. “Mining” is a phase in the process of Pattern Languages for identifying overlapping meanings or relationships among ideas. We wrote 121 patterns based on Iba Laboratory’s empirical knowledge on mining, through ten years of creating various pattern languages. In this paper, we describe its objective and the creation process, along with six patterns in full text: *Starting from Chaos*, *One to One Comparison*, *Talking while Moving*, *Hidden Meanings*, *Doubting Clusters*, and *Discovering the Islands*. All the patterns are presented in the appendix as a list of pattern names.

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1. INTRODUCTION

After *A Pattern Language* by Christopher Alexander was written (Alexander et al., 1977), it was also applied to various fields other than architecture. While *Design Patterns* (Gamma, et al., 1995), *Fearless Change* (Manns and Rising, 2005) and other types of Pattern Languages were subsequently published, Iba Laboratory has been creating more than 1,000 patterns in the field of human actions for over a decade. The works from Iba Laboratory include *Learning Patterns* (Iba and Iba Laboratory, 2014a) for creative learning, *Presentation Patterns* (Iba and Iba Laboratory, 2014b) for creative presentation, *Collaboration Patterns* (Iba and Iba Laboratory, 2014c) for creative collaboration, *Generative Beauty Patterns* (Arao et al., 2012) for women to live beautifully and lively, and *Words for a Journey* (Iba and Okada, 2015) for living well with dementia.

There are three phases in Iba Laboratory’s process of creating Pattern Languages: mining, writing, and symbolizing (Iba and Isaku, 2016). Out of all, mining is the phase of extracting valuable seeds of patterns from good practices. The first step to create a Pattern Language is to mine knowledge and capture them in the form of patterns. This phase is very important since we cannot create good patterns without mining good practices.

There are various approaches to pattern mining. Iba and Isaku proposed “Holistic Pattern-Mining” (Iba and Isaku, 2012), a method in which members work in groups to write down rules or tips that are important about the subject onto sticky notes. In “Mining by Interview” (Rising, 1999) or “Mining Interview Patterns” (Iba and Yoder, 2014), they mentioned to mine by obtaining tips from the interviewee. Another approach mentioned by Akado et al. (2015) is “Pattern Mining Workshop”, a pattern mining done in style of workshop which also enables participants to reflect and recognize their

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lifestyle through the dialogue. Although tips for mining experiences by interviews or brainstorming have been articulated, tips for clustering and drafting the patterns that follows, remain unrevealed.

Therefore, the authors decided to write out the approach for pattern mining based on our experiences as 121 patterns. In this paper, we present the creation process and the objective of “Pattern Mining Patterns,” and introduce all 121 patterns. We introduce six patterns in full pattern format, which especially talks about Iba Laboratory’s unique clustering process using the KJ method.

2. THE MOTIVATION FOR CREATING PATTERNS ON MINING

A pattern is written from essential “elements” that are extracted from pattern mining. In the process of creating a pattern, collecting necessary information for the pattern is a prerequisite. This is when pattern mining plays its role to obtain the required information. The extracted valuable ideas then become the seeds of a pattern. The information obtained through the process of mining is important since it directly affects the quality of patterns.

Gathering enough seeds to write the knack of mining enables the pattern content to be comprehensive. In pattern mining, taking note on subtle yet vital impressions during the process is necessary for creating relatable and original patterns. Also, minding the overall atmosphere and your feelings during the conversations are important as well. A productive and fulfilling mining is important to make a meaningful pattern language.

Although pattern mining is an important phase in order to create a complete pattern language, our past pattern languages on pattern mining only captures the phase partially. That is what motivated us to organize the tips and create a comprehensive pattern language on pattern mining. Through extracting and adding hidden tips to our past works, 121 comprehensive patterns were created consisting of additional new patterns and revised patterns.

3. THE CREATION PROCESS OF PATTERN MINING PATTERNS

This section explains the process of creating the “Pattern Mining Patterns,” element mining, element clustering, and seed making (Figure 1).

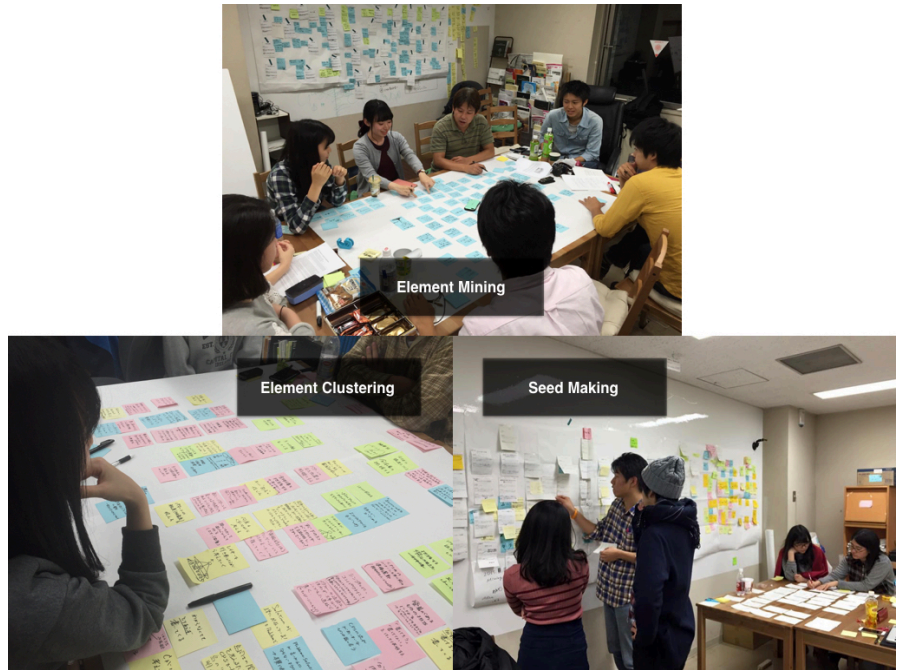


Fig. 1. Creation Process of *Pattern Mining Patterns*.

3.1 Element Mining

The first step is to discover “elements,” which are the key information of patterns consisting of Context, Problem and Solution. To discover “elements,” the authors held mining interviews with Takashi Iba, who has created many patterns in his laboratory, and Takuya Honda, who is one of the authors of “Collaboration Patterns.” Honda had abundant knowledge and experience on pattern mining for 3 years as an Iba Laboratory member.

During mining interview, we kept in mind to ask questions that relates to Solution, Problem, and Context. We first asked what interviewees really want to share with friends or newcomers to find out the *Important Matter*. In order to understand *Prevented Problems*, we then asked what would happen if they didn't do the *Important Matter*. Furthermore, to *Grasp the Context*, we asked the situation or the condition in which the *Important Matter* becomes necessary, or the *Prevented Problem* is likely to occur. Consequently, we discover the “element.” It is essential to take notes on sticky notes when listening to interviewees' stories.

Additionally, we wrote down our project members' tips for mining patterns onto sticky notes from the experiences of creating Pattern Languages such as “Words for a Journey,” (Iba and Okada, 2015) “Global Life Patterns” (Matsuzuka, *et al.*, 2013), and “Parenting Patterns” (Sasabe, *et al.*, 2016). As a result, we were able to thoroughly write down Iba Laboratory's empirical knowledge and ideas of pattern mining out on sticky notes.

3.2 Element Clustering

After element mining, we organized sticky notes by compiling similar elements, divided them into clusters, gave names to each cluster, and connected them according to their meanings by using “KJ Method (Kawakita, 1967).” When using the KJ method, ideas thought to have similar attributes are grouped together and placed close to each other. These similarities must not be mere superficial resemblances; core traits and functions must be observed and talked through before the connection between two notes is made. In this step, we added sticky notes with ideas from “Mining Interview Patterns” and “Holistic Pattern-Mining Patterns” as additional elements.

Then we divided the groups into three categories bottom-up. We named the categories A, B, and C. A talk about “Element Mining,” collecting key information that is needed to write the patterns through “Mining Interviews” and “Collaborative Introspection.” B is “Element Clustering,” organizing the ideas from “Element Mining” by compiling similar ideas, dividing them into clusters of ideas and connecting them according to their meanings. C is “Seed Making,” giving names to each cluster and shaping essential points from each cluster into *the Seeds of Patterns*. After dividing groups into three categories, we placed “Element Mining,” “Element Clustering,” and “Seed Making” as the highest conceptual level patterns of the overall structure. With this structure, we viewed each cluster from the top to consider missing “elements” and conducted additional “Element Mining.” This way, we were able to comprehensively represent practical knowledge by observing the entire structure from the top, of what was organized bottom-up.

3.3 Seed Making

The third stage was to extract essential message from each cluster into a single note. We wrote down the cluster's essential meaning as a 'label' on each note. On the rest of the note are sentences of Context, Problem and Solution. We call this note the “C-P-S”: Context, Problem, and Solution.

At this stage, we also reviewed the entire structure from the top to consider the missing “element.” We focused on the relationships between each “C-P-S.” In the completed pattern language, each pattern has relationships with other patterns. So, we pay attention to the whole structure and relationships, leading us to reflect and reconsider each pattern's meaning. As a result, the seeds of patterns were made while creating the whole structure of the Pattern Language at the same time.

4. PATTERN MINING PATTERNS

In this section, we introduce the *Pattern Mining Patterns*. *Pattern Mining Patterns* consists of 121 patterns for extracting valuable seeds to create good patterns. This pattern language is organized into

three categories; A: *Experience Mining*, B: *Drawing a Map*, and C: *Digging for the Seeds of Patterns*. Psychological researches tell us how we process information better when structured, so the patterns are organized into three categories, which are followed by detailed patterns in groups. With five levels of abstraction, this pattern language sums up to 121 patterns.

4.1 Pattern Language for Creating Pattern Language

Pattern mining is the first out of three phases, mining, writing, and symbolizing, in creating pattern languages. In the *Pattern Mining Patterns*, we define pattern mining as a quest for unearthed treasure; the seeds of the patterns(Figure 2).

4.2 The Structure of *Pattern Mining Patterns*

Pattern Mining Patterns are divided into three categories A, B, and C. Each category is then divided into three groups such as A1, A2, and A3. Finally, those groups are again divided into A111, A112, A113, which are *Group of 3* constructed by *Optimal Structure* (Figure 3).

In A: *Experience Mining* to collect the points in making a roadmap for treasure hunting, we listen to interviewees and collect the valuable points. The valuable points as we call in this paper are fragments of peoples’ experiences and memories. We probe deeper into some of the fragments to understand and illuminate the entire experience. In B: *Drawing a Map*, we write a map on paper that expresses the pattern language you are trying to create by combining the clues you collected. When you realize that what you heard from someone is similar to another, the island will appear in the map. In C: *Digging for the Seeds of Patterns* we actually try to unearth the seeds of the patterns based on the map. At this point, it is still not a complete pattern language, but we define this process as “mining,” in which *the Seeds of Patterns* are discovered and will develop into a pattern during the writing phase. To ascertain what *the Seeds of Patterns* are and grasp it, we “grow” the seeds into plants. It is the *Pattern Mining Pattern’s* role to help grow the seeds for the writing phase.

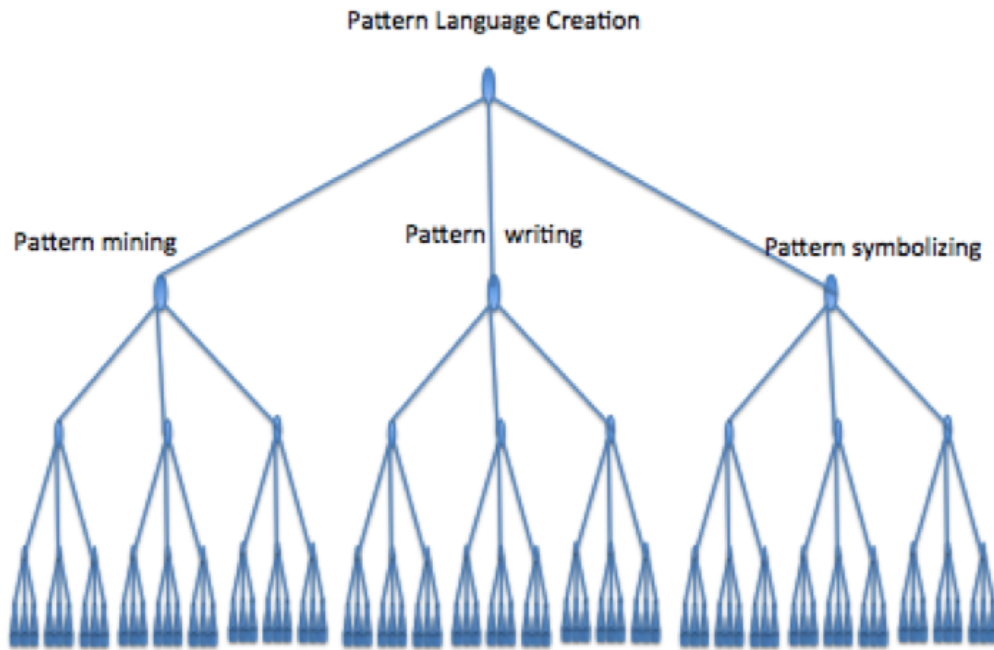


Fig. 2. Whole structure of a pattern language for creating pattern language.

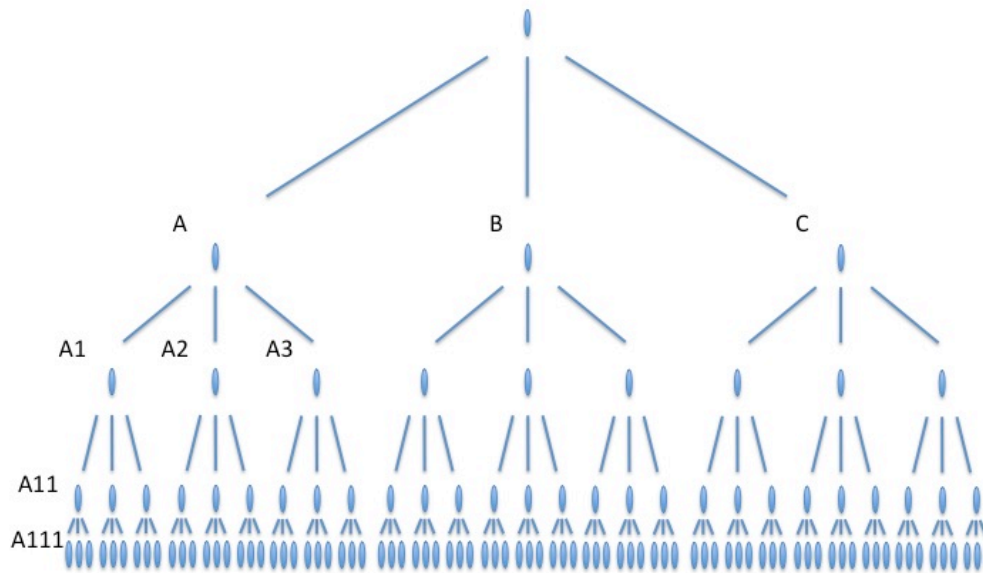


Fig. 3. The Structure of *Pattern Mining Patterns*.

4.3 Six Essential Patterns from the *Pattern Mining Patterns*

Here introduce six most essential patterns for people who create patterns, which describe the tips for element clustering phase discussed in category B. They are: *Starting from Chaos*, *One to One Comparison*, *Talking while Moving*, *Hidden Meanings*, *Doubting Clusters*, and *Discovering the Islands* (Figure 4).

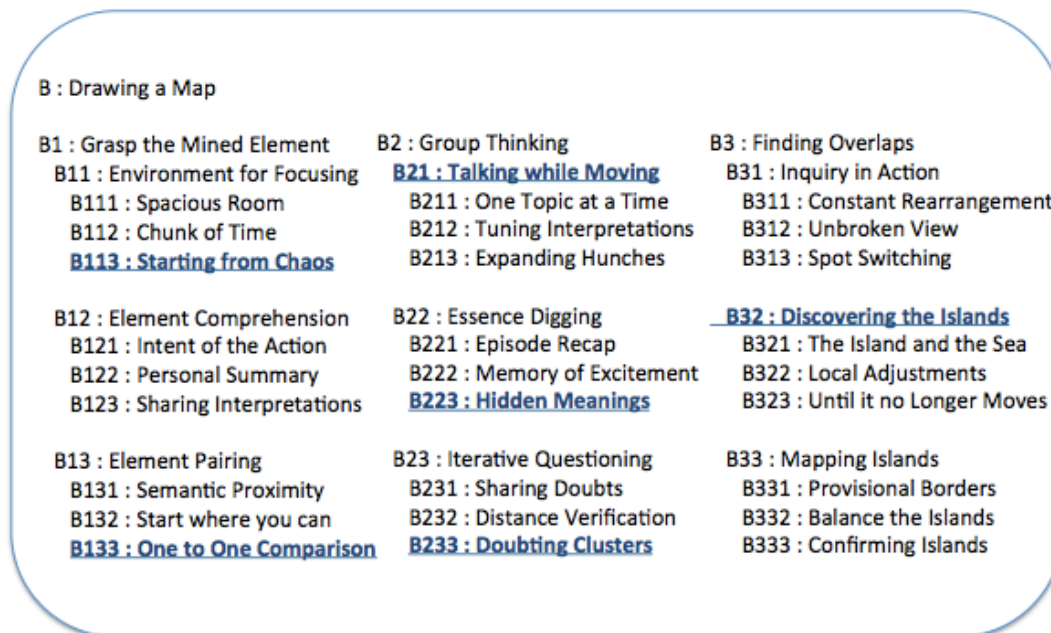
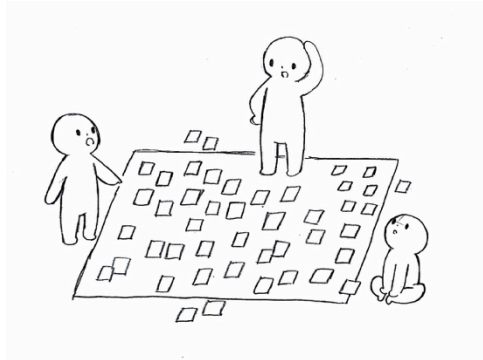


Fig. 4. Structure of Category B: Drawing a Map.

Starting from Chaos

Chaos stimulates thinking.



After gathering the elements, you are preparing to start clustering.

▼ In this context

Starting with notes in unchanged condition makes you preoccupied with the existing disposition. The phase of clustering could easily end when notes are neatly placed and the fear of breaking up the groups prevent you from moving around the notes to create a new value. When a group of notes are viewed, it could unconsciously be seen as a perfect group that already contains a meaning. Also, lining up the notes in order makes you feel it is holding a value already, and may stop the quest for a better meaning.

▼ Therefore

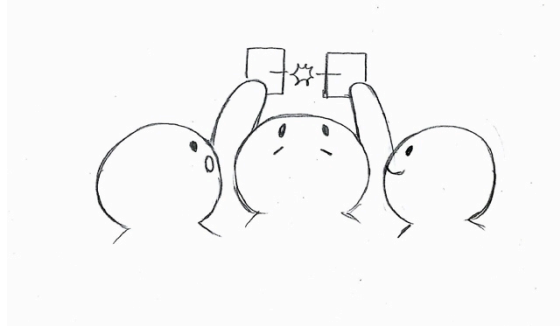
Put all the sticky notes in random order and switch directions to start with a paper with chaotically placed notes. Sprinkle and put the notes regardless of the recorded date and interviewees. Otherwise, it is difficult to find common point among various experiences. A disordered state of chaos is uncomfortable, yet leashes the power of creativity where people try to create an order. So, always dare to start with a random and disorganized state. The process of clustering creates a new meaning by boldly moving around the sticky notes and overseeing the entire picture of the arrangement. Even if you are experienced, this chaotic state will always make you depressed. However, you will overcome the long hours for a newborn meaning, so believe that you will reach an end.

▼ Consequently

When you start with the chaos state, it is easier to move the notes boldly. When this happens, you will soon experience a drive to organize them more neatly, reaching the momentum of clustering. Also, it requires you to know which note is where, helping you to grasp the big picture of the arranged notes and to do a better phase of clustering.

One to One Comparison

Compare carefully one by one.



You are trying to understand the two notes with similar meanings in clustering.

▼ In this context

There are too many notes to compare, so you tend to be overwhelmed by the quantity of notes. Thinking it might be better to compare in small subsets of notes instead you tend to approximate those notes while you do not grasp the meaning one by one. When the group appears, you might create a cluster by comparing a single note with a group, thinking about whether it belongs to the group or not. The words on the note may mislead you and prevent you to understand the notes individually. When you find a single note that is left alone, you become insecure and easily place it into a group without thoughts.

▼ Therefore

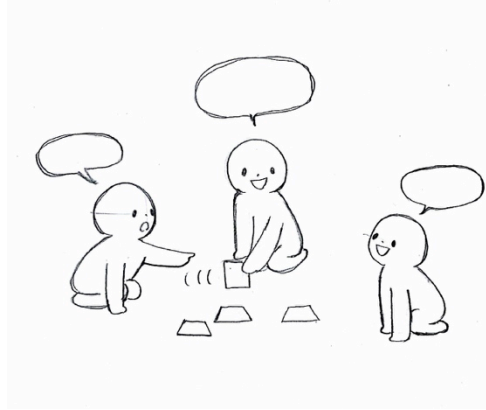
When you think about the relationship between the notes, evaluate between each note rather as a whole group and think about similarities one by one. We tend to group similar notes easily with "-atic" or "-ical" but do not forget to take a step further to really interpret the meanings one by one. Especially, as you progress towards the end, you may see some unity among notes, but always make sure to see the relationship one by one and decide on whether to put them closer or not.

▼ Consequently

Comparing every single note carefully enables you to understand the note more than the words or find unexpected connections between them. Additionally, the group will entail a defining message, thus clarifying the essence of a pattern. As you check each note, you will develop a deeper understanding of the overall notes.

Talking while Moving

Move around the notes while having discussion.



In the clustering phase, you are moving around the sticky notes.

▼ In this context

Clustering may proceed without the meaning being shared with other people. Most people have different interpretations on notes so it is difficult to allow everyone to understand the meaning of moving a particular note. Whenever there are many sticky notes, each person may start to cluster nearby notes and assume that they only need to share the end-result of the arrangement. But participants can have different understandings of what clusters mean.

▼ Therefore

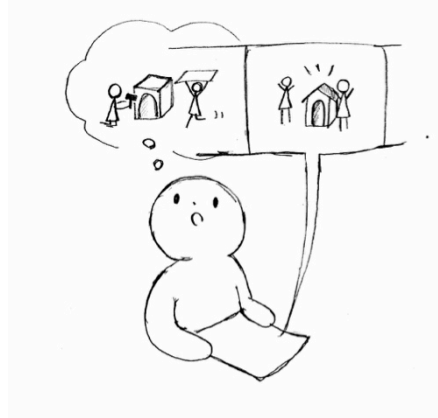
Always discuss with members while moving sticky notes. Do not move them your own way; be sure to talk about *One Topic at a Time* with all members to perform the *Tuning Interpretation*. In this case, share your thoughts with the group even if it is not organized or are not yet in right words.

▼ Consequently

Even if you cannot think about an idea alone, discussing it with other members will help find the meaning. As you share your idea with another person, he or she may turn it into a discovery that you would not come up with and help you organize your thoughts. While sharing your ideas with the members, it may lead to *Group Thinking*, and can continue creating clusters. By discussing how notes are clustered with other participants, it enables *Essence Digging*, recalling whom idea it was, what kind of episode it came from, and in what way it seemed important.

Hidden Meanings

Find the hidden meaning behind ideas.



In the clustering phase, you are exploring the meaning of sticky notes through discussion.

▼ In this context

The written and spoken words during mining are insufficient to create a pattern. If you just record what experts of the domain say, you will not be able to capture the complete reasoning behind the patterns. Thus, whenever the information is applied to creating a pattern, the pattern becomes shallow. However, it is difficult to redo interviews again for confirmation. Since interviewees are not with you, it is also dangerous to patch up the missing information with your assumptions.

▼ Therefore

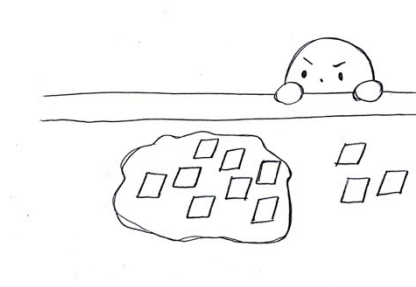
Predict the background of the person you interviewed and think about the hidden meanings under their words and actions. Even without the person's words, you can do *Essence Digging* about possible elements from their demographics like age, mindset, and status. Referring to their experiences, you can predict their true voice that was left unspoken during the interview by reading their mind. Share your insights with other members to obtain approval and empathy to make sure your prediction is valid.

▼ Consequently

You are able to elaborate the hidden meaning of what was not been described or articulated in the interview. You may get closer to the essence of the pattern once you think not only from written words, but also from your predictions.

Doubting Clusters

Check groups of notes again.



The phase of clustering is progressing, and there are some groups of notes.

▼ In this context

When there are too many notes in one group, it gets considered as a single meaning with disproportionate weight on one view or wrapped up into general beliefs. People are easily navigated to the wrong direction when there are similar words and judge that they contain the same meaning. As a result, there are misplaced notes in some groups. However, when too many notes are gathered into one group to create a pattern, individual notes lose their meanings and final expression could be too generic.

▼ Therefore

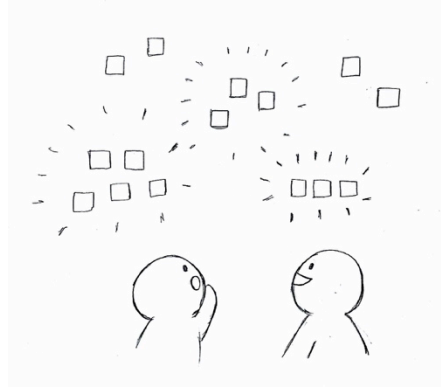
Always doubt whether the arrangement of the group is accurate or not and check if each note's meaning are similar to each other. Even after a group of notes is formed, evaluate the meaning of each note and replace those that do not fit to the group by *Iterative Questioning*. As you see a big group compared to other groups, check if you can rearrange the notes in it. When you are almost done with clustering, review the groups that you have created at the beginning of the phase.

▼ Consequently

By doubting the group of notes, you can repeat deconstructing and gathering the notes until the group contains an accurate and genuine meaning. To know convergence, persist the clustering process *Until it no longer moves*.

Discovering the Islands

Find the island from the sea of sticky notes.



Some notes are gathered and you feel like they are organized in groups.

▼ In this context

There are several groups of two to three notes that you become confused on which group to start with. When some notes are dispersed all over a sheet of paper, you cannot process all the information mentally and visually. After you feel like you have finished moving notes between groups, you want to move on to the next phase. However, the groups cannot bare a meaning without clarifying the borders.

▼ Therefore

Discover an island of notes. Think of the group of notes as an island, and the other area as the ocean. Differentiate the borders between the island and the ocean. In order to make sure the distance between the islands, do *Local Adjustments*. Make adjustments *Until it no Longer Moves*.

▼ Consequently

As you realize an organized group, you can truly understand the point for discussion. In each island, you can see the relationships between the notes and also compare the sizes among other islands. As a result of making an adjustment, some islands may contain only one note.

5. CONCLUSION

In this paper, we proposed the *Pattern Mining Patterns*, which describes Iba Laboratory's empirical knowledge, and introduced the 6 patterns out of 121 patterns in detail. *Pattern Mining Patterns* describe tips to mine *the Seeds of Patterns*, which is one of the phases to create a Pattern Language. Each pattern explains the comprehensive structure and content of Pattern Mining, including important mindsets and specific tips that encourage implementation. Therefore, it is considered that it is possible to meet the respective situations and stages of people attempting to create a Pattern Language. Some applications would be sharing and mining experiences, acting as cognitive glasses for past cases, or planning for a project to create a Pattern Language. In practice, the patterns are applied to worksheets (Iba and Isaku, 2016) that students in Iba Laboratory and those who take the Pattern Language class use at Keio University, Japan.

There are two points for future considerations and discussion. First, through the practice in Iba Laboratory and in classes at the university, we discovered the need to update and improve the current version of *Pattern Mining Patterns*. Next, we want to spread the *Pattern Mining Patterns* among people who are trying to create and use pattern language, and increase the number of people who want to make pattern language and support them. Not only does Iba Laboratory hopes to make these efforts, but also wish that *Pattern Mining Patterns* are used in the pattern community (such as PLoP and PURPLSOC) and referred to by those who want to create pattern languages.

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APPENDIX

1. List of All 121 Pattern Mining Patterns

1st Layer

Pattern Mining

2nd Layer

A : Experience Mining

B : Drawing a Map

C : Digging for the Seeds of Patterns

3rd Layer

A : Experience Mining

A1 : Strategy for Discoveries

A2 : Searching through Conversing

A3 : Collecting Clues

B : Drawing a Map

B1 : Grasping the Mined Elements

B2 : Group Thinking

B3 : Finding Overlaps

C : Digging for the Seeds of Patterns

C1 : Label Making

C2 : Structure Building

C3 : The C-P-S

5th Layer

A : Experience Mining

A1 : Strategy for Discoveries

A11 : Grasping the Process

A111 : Experienced Person

A112 : Well-Balanced Selection

A113 : Mid-Sized Interviewee Group

A12 : Own Gut Feeling

A121 : Excitement of Discoveries

A122 : Legitimate Content

A123 : Strong Feelings

A13 : Mining Atmosphere

A131 : Plenty of Time

A132 : Widespread Blanks

A133 : Visualizing the Process

A2 : Searching through Conversing

A21 : One Section at a Time

A211 : Important Matter

A212 : Prevented Problem

A213 : Grasping the Context

A22 : Chain Conversations

A221 : Flat Atmosphere

A222 : Talk before you Think

A223 : Honest Reactions

A23 : Inducing Talks

A231 : Overlapping Experiences

A232 : Uncovered Topics

A233 : Assistive Words

A3 : Collecting Clues

A31 : Quantity over Quality

A311 : Bite-Size Ideas

A312 : Multiple Viewpoints

A313 : Welcoming Duplicates

A32 : Qualitative Memory

A321 : Feeling the Speech

A322 : Raw Words

A323 : Recorded Voice

A33 : Idea Deposit

A331 : Recallable Summary

A332 : Notation of Examples

A333 : Emphasizing Mark

B : Drawing a Map

B1 : Grasp the Mined Element

B11 : Environment for Focusing

B111 : Spacious Room

B112 : Chunk of Time

B113 : Starting from Chaos

B12 : Element Comprehension

B121 : Intent of the Action

B122 : Personal Summary

B123 : Sharing Interpretations

B13 : Element Pairing

B131 : Semantic Proximity

B132 : Start where you can

B133 : One to One Comparison

B2 : Group Thinking

B21 : Talking while Moving

B211 : One Topic at a Time

B212 : Tuning Interpretations

B213 : Expanding Hunches

B22 : Essence Digging

B221 : Episode Recap

B222 : Memory of Excitement

B223 : Hidden Meanings

B23 : Iterative Questioning

B231 : Sharing Doubts

B232 : Distance Verification

B233 : Doubting Clusters

B3 : Finding Overlaps

B31 : Inquiry in Action

B311 : Constant Rearrangement

B312 : Unbroken View

B313 : Spot Switching

B32 : Discovering the Islands

B321 : The Island and the Sea

B322 : Local Adjustments

B323 : Until it no Longer Moves

B33 : Mapping Islands

B331 : Provisional Borders

B332 : Balance the Islands

B333 : Confirming Islands

C : Digging for the Seeds of Patterns

C1 : Label Making

C11 : Island Decoding

- C111 : Characteristic Grasping
- C112 : Abridge the Elements
- C113 : Essence of the Island

- C12 : Recallable Labels
 - C121 : What to do and Why
 - C122 : Long Sentence
 - C123 : Footnotes in Parenthesis

- C13 : Finishing the Labels
 - C131 : Abstractness Alignment
 - C132 : Memory of the Discovery
 - C133 : Collaborative Check

C2 : Structure Building

- C21 : The Whole and the Parts
 - C211 : Group of 3
 - C212 : 3 Categories
 - C213 : Optimal Structure

- C22 : Pincer Structuring
 - C221 : Group Label
 - C222 : Connecting Gaps
 - C223 : Checking Out Loud

- C23 : Position Confirmation
 - C231 : Position Adaptation
 - C232 : Adding the Missing Element
 - C233 : Resolving Surplus

C3 : The C-P-S

- C31 : Writer Assignment
 - C311 : Expert in Charge
 - C312 : Assignment in Bundles
 - C313 : Pre-Writing Check

- C32 : CPS Writing
 - C321 : Aim of the Act
 - C322 : Unwanted Results
 - C323 : Timing of the Action

- C33 : Finishing the CPS
 - C331 : Consistency with the Label
 - C332 : Logical Connections
 - C333 : Structure Posting

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