Pattern Mining Patterns
A Search for the Seeds of Patterns

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This paper present *Pattern Mining Patterns*. These 121 patterns were shaped based on Iba Laboratory's empirical knowledge on mining, with 10 years of creating many Pattern Languages. In this paper, we describe its objective and creation process, along with 6 patterns as an example: *Starting from Chaos*, *One to One Comparison*, *Talking while Moving*, *Hidden Meanings*, *Doubting Clusters* and *Discovering the Islands*, which belong to "Quest Map to Treasure", the phase of identifying overlapping meanings or relationships among ideas. The remaining patterns are presented in the list of pattern names.

1. INTRODUCTION

After "A Pattern Language" was published by Christopher Alexander in 1997 [1], it was also applied to various fields other than architecture. While "Design Patterns"(Gamma, et al., 1995)[2], "Fearless Change" (Manns and Rising, 2005)[3] and other types of Pattern Languages were subsequently published, Iba Laboratory created more than 1000 patterns in the field of human actions, for over a decade.

For creating Pattern Languages, the process of "Mining" is an essential component. Mining is the phase of extracting valuable seeds of the patterns from good experiences. The first step to create a Pattern Language is to mine knowledge and that the knowledge which is captured in the patterns. This phase is very important because we cannot create good patterns without mining good experiences.

There are various approaches to pattern mining. Iba and Isaku defined "Holistic Pattern-Mining Patterns" (Iba and Isaku, 2012)[4], a method in which group members write down rules or tips that are important about the subject onto sticky notes. In "Mining by Interview" (Rising, 1999)[5] or "Mining Interview Patterns" (Iba and Yoder, 2014)[6], they mentioned to mine by obtaining tips from the interviewee. Another approach mentioned by Akado et al is "Pattern Mining Workshop" (Akado et al., 2015)[7], a workshop style which enables mining for those who do not know a Pattern Language. Although tips for sharing experiences through interviews and brainstorming have been articulated, tips for clustering and drafting remain unrevealed.

Therefore, the authors decided to form the approach for pattern mining from our experiences in all 121 patterns. In this paper, we present its creation process, objective or implementation of *Pattern Mining Patterns*, and then introduce all 121 patterns.

2. THE BACKGROUND FOR REORGANIZNG MINING PATTERNS

A pattern is written from the element that is extracted from pattern mining. In this process, 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 idea then becomes the seed of a pattern. The

information obtained through the process of mining is important since it directly affects the pattern content.

In *Collaborative Introspection* and *Mining Interview* phase, taking note on subtle yet vital impressions is necessary for creating relatable and personal patterns. For example, during interviews, observe the overall atmosphere and your feelings for the conversations.

Gathering enough seeds (information) to write the knack of mining enables the pattern content to be comprehensive. A productive and satisfying mining is important to make a satisfying pattern. For this reason, the author felt the need to comprehensively lay out and organize the tips for mining.

However, since our past work partially captured the process of mining, the authors decided to structure the vital points for mining, by extracting and adding hidden tips to past work. As a result, 121 comprehensive patterns were created consisting of new patterns and revised patterns.

3. MAKING PROCESS

Pattern Mining Patterns describe the practical knowledge of Iba Laboratory, which have created more than 1000 patterns in total in the past 10 years including a Pattern Language for creative learning; "Learning Patterns" (Iba et al., 2009)[8]; "Presentation Patterns" (Iba et al., 2012)[9], for creative presentation; "Collaboration Patterns" (Iba and Isaku, 2013)[10], for creative collaboration; "Generative Beauty Patterns" (Arao et al., 2012)[11], for women to live beautifully and lively; "Words for a Journey" (Iba et al., 2015)[12], for living well with dementia. This section explains the process of creating the *Pattern Mining Patterns* (Fig.1).

3.1 Element Mining

The first stage is to discover "Element" which is key information of pattern, "Context," "Problem" and "Solution." To discover these "Element," the authors held *Mining Interviews* with Takashi Iba who has created many patterns in his laboratory, and his student, one of the members of "Collaboration Patterns" and *Future Language*; a design method to visualize the future (Honda T et al., 2015)[13]. He had abundant knowledge and experience on pattern mining under Iba professor for 3 years. During Mining Interview, it is important to ask key questions that relate to the Solution, Problem, and Context. For example, we first ask what interviewees really want to share with friends or newcomers to find out the *Important Matter*. After that, to understand *Prevented Problems,* ask what would happen if they didn't do the *Important Matter*, Furthermore ask the situation or the condition in which the *Important Matter* becomes necessary or the *Prevented Problem* is likely to occur to *Grasp the Context*. Consequently, we discover the "Element." Also it is important to take sticky notes when listening to their stories.

In addition to our experiences with the creation of "Words for a Journey", we wrote down our own tips for creating other Pattern Languages; "Global Life Patterns" (Matsuzuka et al., 2013)[14], a Pattern Language for people to maintain individuality and design their own actions in respect to the "globalizing" society; "Parenting Patterns" (Sasabe et al., 2016)[15], a Pattern Language for Growing with your Child, to sticky notes as *Collaborative Introspection*. Thus, we thoroughly wrote down the Iba Laboratory's empirical knowledge and ideas of pattern mining obtained through previous experiences in to sticky notes.

3.2 Element Clustering

After *Element Mining*, we organize sticky notes by compiling similar ideas, dividing into cluster of ideas, giving names to the cluster, and connecting them according to their meanings by using *KJ Method* (Kawakita, 1967)[16], which is well known in Japan. In 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. The cluster, made by *KJ method*, includes "Element" of "Context," "Problem" and "Solution." In this occasion, we added "Mining Interview Patterns" and "Holistic Pattern-Mining Patterns," which were written in sticky notes.

Then we divided them into 3 categories in bottom-up. We named each category A, B, and C. A is *Element Mining*: collecting key information 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 divided into 3 categories, we place them in the highest conceptual level of overall structure of all clusters. From this structure, we viewed each clusters from top-down, consider missing "Element" and conducted additional *Element Mining*. In this way, we were able to comprehensively represent practical knowledge by observing the entire structure in top-down, which was organized in bottom-up.

3.3 Seed Making

The third stage is to extract essentials from each cluster into a single note. We wrote down the cluster's essential meaning as a 'label' in each note. In the rest of the note are sentences of Context, Problem and Solution. We call this note *The C-P-S* (Context, Problem, and Solution).

In this stage, we also reviewed the entire structures from top-down to consider the missing "Element." We tried to understand relationships among each *C-P-S*. In the completed pattern language, each pattern has relationships with other patterns. So, we pay attention to the whole structures and relationships, thus leading to reflection and reconsideration of each pattern's meaning. As described above, the seeds of patterns while imagining the whole structure of the Pattern Language.

Fig. 1 Making Process

4. PATTERN MINING PATTERNS

Pattern Mining Patterns consists of 121 patterns for extracting valuable seeds to create good patterns. This set of patterns composes of 3 categories, human can only hold around 3-4 concepts in working memory, and use hierarchical structures to manager larger collecting of concepts. A lower (at least two) and an upper bound (at most seven) based on what psychological research tells us about human information processing. This is why, we need to have groups of three. A: *Mining for Experiences*, B: *Pattern Mapping*, C: *Digging for the Seeds of Patterns*, each containing 40 patterns. Combining the symbol of mining, the total is 121 patterns. In this section, we introduce *Pattern Mining Patterns*.

4.1   What is pattern mining

Pattern mining is the first phase of three (Mining, Writing, Symbolizing) in creating Pattern Language. *Mining Interview* was conducted by picking out necessary information that the pattern maker wants to collect for the pattern. In the *Pattern Mining Patterns*, we define pattern mining as a quest for unearthed treasure; the seeds of the patterns.

   In A: *Mining for Experiences* to collect the points in making a roadmap for treasure hunting, we listen to what one is saying 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: *Pattern Mapping* we write a map on paper that expresses the Pattern Language you are trying to create by combining the clues you collected. When you realized 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 writing.

4.2   The structure of mining

In *Pattern Mining Patterns*, we divide to 3 categories; A, B, and C. Then divide to 3 group A1, A2, A3. Finally, A111, A112, A113 which are *Group of 3* were constructed by *Optimal Structure* (Fig.2).

   In A: *Mining for Experiences* we summarize the points at the blain storming and interview phase. Before the interview, we plan *Strategy for Discoveries* and start the interviews with people by *Searching through Conversing*. Then, we recorded the hints until we do *Collecting Clues* in B: *Pattern Mapping*, we summarized the point for the *KJ Method* and *Clustering* phase. First, we *Grasp the Mined Elements* and *Group Thinking* to prevent procrastination and conducted *Finding Overlaps*. Finally, the phase of C: *Digging for the Seeds of Patterns*. To ascertain what *the Seeds of Patterns* are, and grasp it, then we grow seeds into plants. At the time of the collected almost all CPS cards, pattern maker thinks that patterns encompass the knack of mining, we assess that patterns complete a pattern language. It is *Mining Pattern's* role to help grow the seeds of the patterns for the writing phase.
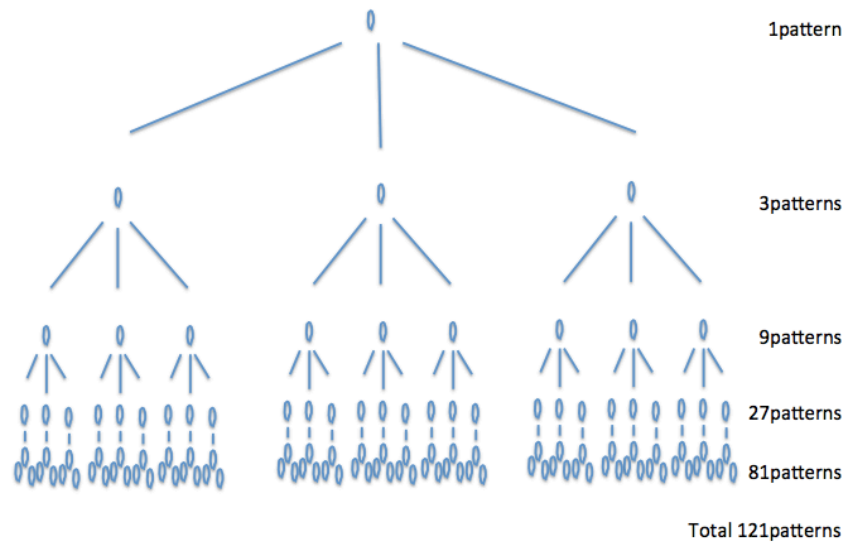
Fig.2 Structure of Pattern Mining Patterns

4.3 The pattern which we introduce in this prepare paper

In this paper, we introduce six patterns that describe the tips for the *KJ method* and *Clustering* stage, which Iba Laboratory utilizes. These are *Starting from Chaos*, *One to One Comparison*, *Talking while Moving*, *Hidden Meanings*, *Doubting Clusters* and *Discovering the Islands* (Fig.3). We chose these patterns because we thought that this six especially heuristic for people who create patterns.
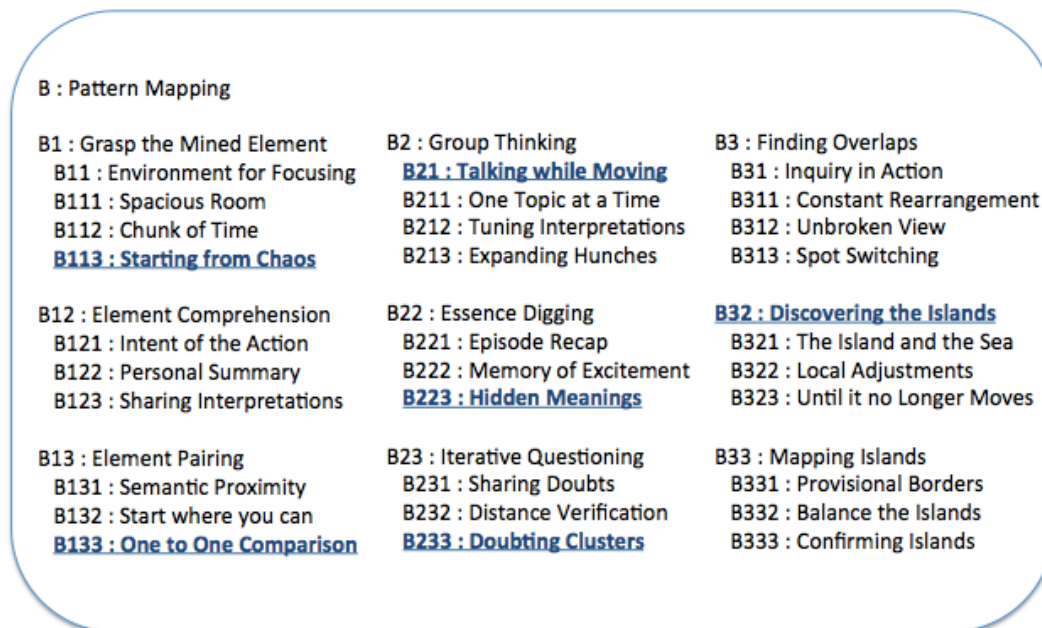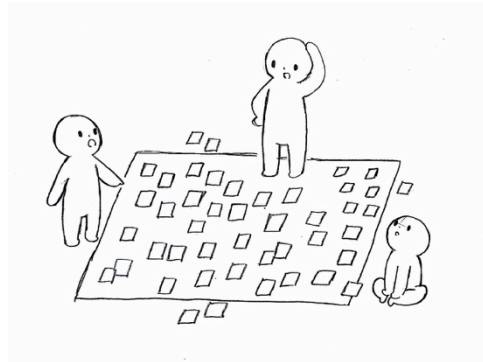

B : Pattern Mapping

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

Fig.3 Structure of B "Pattern Mapping"

Starting from Chaos

Thinking stimulate by chaos.

You are preparing to start clustering.

▼   In this context

As you start all the notes in an unchanged condition, you become preoccupied with the existing disposition. The phase of clustering could easily end when notes are neatly placed and fear to break up the group prevents 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 orderly, you feel it is holding together already, and may stop the quest for a better meaning.

▼   Therefore
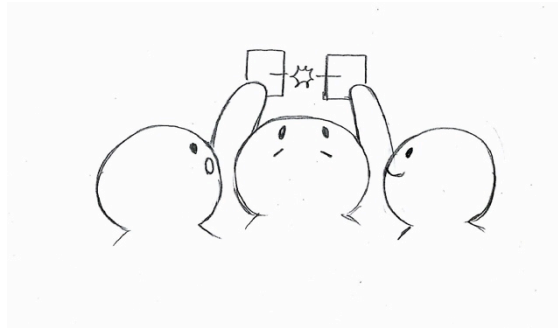
First, put all the sticky notes in a random order, switching the directions, and start with a paper of chaotically placed notes. Sprinkle and put the notes regardless of the recorded date and interviewee during mining. Otherwise, it is difficult to find common point among various experiences. A disordered 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 desperate. However, you will overcome the long hours for a new-born 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. Thus reaching the momentum of clustering. Also, it is required to know which note is where, which helps you to grasp the big picture of the arranged notes and to do a better phase of clustering.

One to One Comparison

Compare one by one carefully.

Trying to approximate the two between 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. It might be better to compare it to a small subset of the notes instead, so you approximate those notes while you do not grasp the meaning one by one. When the group appears, you tend to create a cluster by comparing the single note with one group, thinking about whether it belongs to the group. 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 thought.

▼   Therefore

When you think about the distance of the notes, evaluate the relationship between each note rather as a whole group and think about their similarities. We tend to easily group similar notes with"-atic" or "-ical" but do not forget to take another 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, 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

Gather the idea while talking.
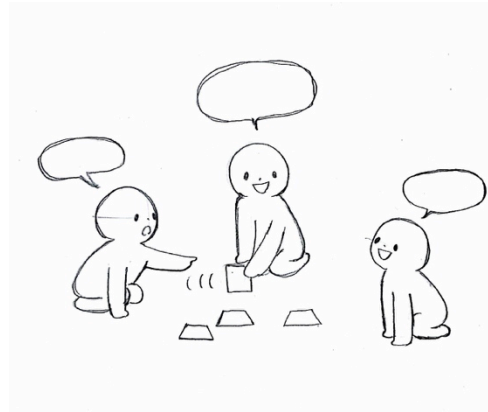
In the clustering phase, you are moving around the sticky notes.

▼   In this context

Clustering may proceed without the meaning being shared with other people. Most people have different interpretations, and it is difficult to allow everyone to understand the meaning of moving around a particular note when reach a common understanding of the notes is difficult. 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 interpretations of what clusters mean.

▼   Therefore

Always discuss with members while 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 put into the right words yet.

▼   Consequently

Even if you cannot think about an idea alone, discuss it with other members and they will make up the meaning for you. 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 leads to *Group Thinking*, and can continue creating clusters. By discussing how notes are clustered with other participants, recall together who's idea it was, what kind of an episode it came from, and in what way it seemed important, as *Essence Digging*.

Hidden Meanings

Make up hiding meaning behind the ideas.
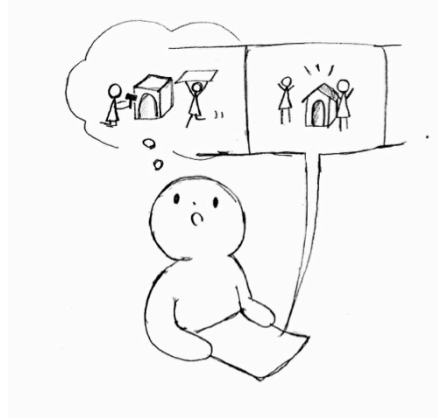
In the clustering phase, you are exploring the meaning of the sticky notes while talking.

▼   In this context

The written and spoken words during mining are insufficient to create a pattern. If you just record what domain experts say, you will not capture the full reasoning behind the pattern. Thus whenever these information are applied to creating a pattern, the pattern becomes shallow. However, it is also misleading to patch up the missing information with your assumptions.

▼   Therefore

Predict the background of the person you interviewed and think about hidden meanings below their words and actions. Even without the person's words, you can *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 on the hidden meanings of what has 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.
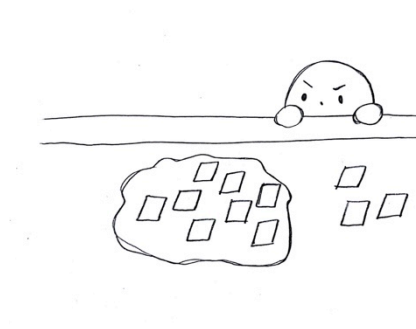
The phase of clustering is progressing, and there are some groups of notes.

▼   In this context

When there are too many notes in one group, it is usually considered as a single meaning, thus does not produce a new value. People are easily navigated to the wrong direction when the there are similar words and judge that they contain the same meaning. As a result, there are misplaces notes in some groups. However, when all the notes are gathered into one group to create a pattern, individual notes lose their meanings, thus the final expression could be to generic.

▼   Therefore

Always doubt if the arrangement of the group is accurate and check if each note's meanings 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 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.
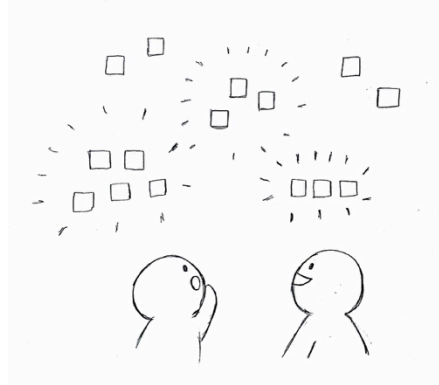
Some notes are gathered and you feel like they are organized in groups.

▼   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 boarders.

▼   Therefore

Discover an island of notes. Think as 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*. And make an adjustment some notes through *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.

5. CONCLUSION

In this paper, we proposed a *Pattern Mining Patterns*, which describes Iba Laboratory's empirical knowledge for creating more than 1000 patterns in total in the past 10 years, and introduced the 6 patterns out of 121 patterns. *Pattern Mining Patterns* describes tips to mine *the Seeds of Patterns*, which is one of the processes to create a Pattern Language. Each patterns explains the comprehensive structure and content of pattern mining, including important mindsets and specific tips that encourages implementation. Therefore, it is considered that it is possible to help 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, planning for a project to create a Pattern Language. In practice, the patterns are applied to worksheets that students in Iba Laboratory and those who take the Pattern Language class 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 Language.

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APPENDIX

A list of all 121 patterns name

1st Layer
Pattern Mining

2nd Layer
A : Mining for Experiences
B : Pattern Mapping
C : Digging for the Seeds of Patterns

3rd Layer
A : Mining for Experiences
  A1 : Strategy for Discoveries
  A2 : Searching through Conversing
  A3 : Collecting Clues

B : Pattern Mapping
  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 : Mining for Experiences
  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 : Pattern Mapping
    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 Intentions

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