Holistic Pattern-Mining Patterns

A Pattern Language for Pattern Mining on a Holistic Approach

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Abstract

In this paper we present the Holistic Pattern Mining Patterns, a pattern language for mining patterns based on a holistic approach. The act refers to the process of extracting the whole image of the practical knowledge of a certain area of expertise through the experiences of people in the domain. This language consists of 10 patterns describing ways of finding and solving problems for pattern mining. In this paper, we will refer to the following pattern language projects as cases of holistic pattern mining: Learning Patterns Project, Presentation Patterns Project, Generative Beauty Project, and Collaboration Patterns Project.

1. Introduction

Pattern languages have now been applied to the field of software design to effectively scribe out practical knowledge for a while. In recent years, its possibility to be applied to many other fields has been considered (Iba, 2011). Despite its potential, it is still difficult to actually apply the method and create a pattern language about a new subject. Little has been discussed about how to create patterns, and its methodology is yet to be coined.

The basic procedure for writing a pattern language consists of the following three phases: Pattern Mining, Pattern Writing, and Pattern Polishing. As for Pattern Mining and Pattern Writing, papers have been written, and pattern languages exist for them (Meszaros and Doble, 1997; Rising, 1998; Harrison, 2004; Wellhausen, and Fießer, 2011). Still, there is rather less written about the mining process of patterns (DeLano, 1998). In the following, we will share the

rules, methods, tips, and customs for Pattern Mining based on our experiences in the form of a pattern language.

2. Approaches of Pattern Mining

Pattern Mining refers to the discovery of patterns embodied in our minds or in the activities associated with the target. When mining patterns, writers must first explore their experiences, observations, episodes, or documented past works that they have about the subject. Through the exploration, they must identify the rules, methods, tips, and customs used for the target. The writer must then find connections among these, so the prospective patterns form a meaningful whole to be understood.

2.1 Well-Known Approaches

There are known to be a couple of types of Pattern Mining. The following are three well-known types: (1) mining based on individual contributions, (2) mining based on secondhand contributions, and (3) mining through collaborative pattern mining.

First, under the individual contributions category, two specific types of contributions exist: contributions based on expertise, and contributions based on experiences. Since each person has a variety of skills, patterns can be easily found based on them. As far as the contributions based on experiences go, mining for patterns based on them would only be limited by the time available to mine, since each of our life experiences are so substantial.

Second, patterns can also be produced from the experience of others. A pattern miner would be triggered by the words of the speaker and recognize a pattern. The best way to mine for patterns based on secondhand contributions is through interviews. It is effective if the interviewee can commit not only the time for the actual interview, but also the time to review the patterns created from it for their validation. Secondhand contributions can also occur when a person with an idea seeks for help of a facilitator to brush up or write it down as a pattern.

Third, collaborative pattern mining allow individuals with common knowledge about a subject to have a discussion so patterns can be mined out (DeLano, 1998). The workshop includes the target group with knowledge about the subject, a moderator who keeps the talks on track, and a few pattern miners. The target group would talk about their expertise and experiences under the facilitation of the moderator, and the pattern miners would document down any patterns that arise.

These approaches are, however, only effective for identifying patterns as *parts of the whole*. Former styles of mining force the writer to write patterns without grasping the whole image, namely without understanding the pattern's position within it. Based on this backdrop, we will propose an alternative approach to pattern mining.
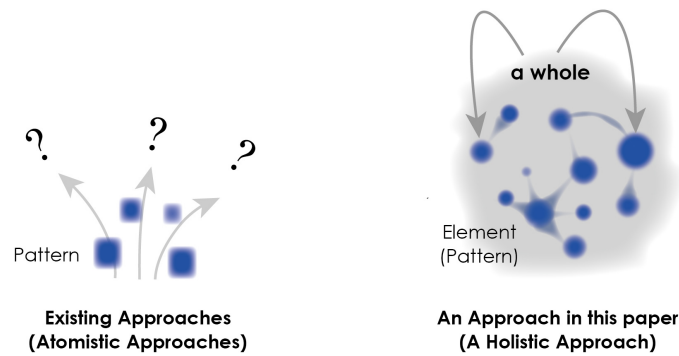
Figure 1. Approaches of Pattern Mining

2.2 A Holistic Approach

Christopher Alexander, in his newest book *The Nature of Order*, emphasized the importance of the `whole' when writing out patterns (Alexander, 2002a; 2002b). As he remarks, the conception is quite different from the conventional one, which claims that a whole consists of parts. He emphasizes the direction that a *whole makes its parts* rather than the direction that a whole consists of parts[1]. He wrote as follows:

> "[…] these parts and entities are rarely pre-existing. They are more often themselves *created* by the wholeness. This apparent paradox (seeming paradoxical only because of the simple-minded way in which it is expressed) is a fundamental issue in the nature of wholeness: the wholeness is made of parts; the parts are created by the wholeness. To understand wholeness we must have a conception in which `parts' and wholes work in this holistic way"(Alexander, 2002a: p.84)

Similarly, the *holistic approach* we present here works to reveal the whole image of the patterns before writing them individually out. In the process, all of the potential ideas for patterns are put out first so writers can understand how its system is laid out. Working out the details for the individual patterns comes after.

The process is usually done by two or more people so multiple points of view are brought in to avoid the patterns becoming weighted on the values of a single person. For this reason, collaboration is an important part of mining patterns in this way. To get the best results out of this

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[1] In order to tell the difference clearer, he call the parts made by the whole `centers.' Thus, a whole consists of the centers made by the whole. Not like a part, the boundary of a center is fuzzy. Note that the concept of center does not mean the particular location in the space, for example the central point of the circle nor the middle point in the line. Instead, it means a source of the living power and an essence of the phenomena. About the relation between centers and patterns, he wrote "A pattern language is essentially a way of defining generic centers, and then using them, sequentially, in design projects. The entities we called *patterns* were --- albeit in an early formulation --- somewhat similar to the entities I now call *centers*." (Alexander, 2002b: p.344).

holistic mining process, the patterns are written for pattern writers who are working in a group. Most of the patterns can be also applied to solo pattern miners, but it is strongly recommended that writers go through the mining process as a group.

As you see, this holistic approach is a different method from the existing approaches in software patterns, which can be called *atomistic approaches*. In the atomistic approaches, pattern writers would come up with the patterns without grasping the whole image. In contrast, pattern writers on the holistic approach first grasps the *whole*, and then work on the contents and the details of the patterns.

In the process, group members first go through an *element mining* session together. A member would write down rules, methods, tips, or customs that they think are important about the subject onto a sticky note, talk about it briefly to the group, and then place the note on a large sheet of craft paper (Figure 2). Participants would take turns in no specified order talking about their notes until no one has any more ideas to be put out. Here, the extracted notes are potential ideas for patterns. Temptations may arise to start writing the patterns form here, but that would be taking the bottom-up approach we've discussed above. Instead, the process continues on to finding the whole image of these ideas.

After collecting the ideas, they go on to organizing them by compiling similar ideas and dividing them into groups (Figure 3). The important thing to keep in mind here is that the notes must not be organized based on superficial similarities. To gain full advantage of the emergence that occurs in this step, a note must be brought close to another based on a one-to-one relationship, and not by the guidance of existing categories. This process is well known as the KJ Method (Kawakita, 1967)[2] and it requires abductive reasoning, proposed and emphasized by C. S. Peirce (Peirce, 1992; Peirce 1998). The process continues onto giving names to the emerged groups, and then moving the groups around in a similar matter as the KJ Method, so groups with similar meanings become close. Thus, the writers obtain the seeds of the patterns. Keep note, that this mining process can also be done alone in a similar matter, taking in account of the disadvantages of mining patterns alone discussed above.

Figure 2. Element Mining in the Pattern Mining on Holistic Approach

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[2] There are few literatures about KJ Method in English, but the book "Universal Methods of Design" (Martin and Hanington 2012).
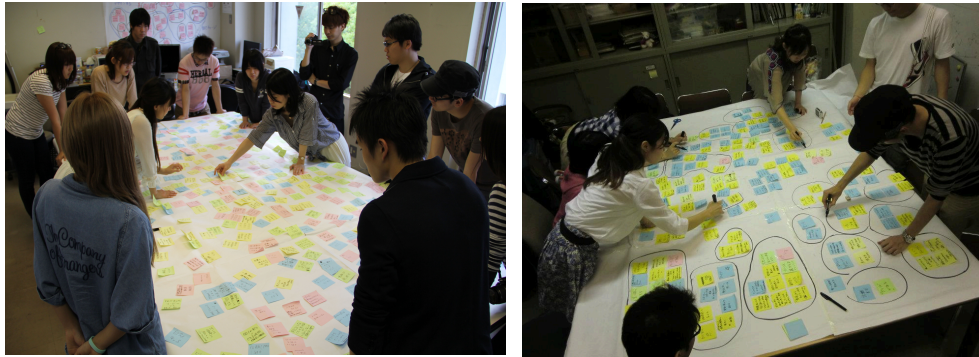
Figure 3. Visual Clustering in the Pattern Mining on Holistic Approach

3. Patterns

Holistic Pattern-Mining Patterns we propose here consists of 10 patterns: **Holistic Pattern Mining**, **Element Mining, My Own Experience, Posting Notes**, **Describe it Thoroughly**, **Re-Mining**, **Visual Clustering**, **Deep Connections**, **Dyadic Comparison**, **Balance the Islands**, and **Plain Labels.** Its Overview is shown in Figure 4.

Deciding the theme

No.0 Holistic Pattern Mining

No.1 Element Mining

No.2 My Own Experience

No.3 Posting Notes

No.4 Describe it Thoroughly

No.5 Re-Mining

No.6 Visual Clustering

No.7 Deep Connections

No.8 Dyadic Comparison

No.9 Balance the Islands
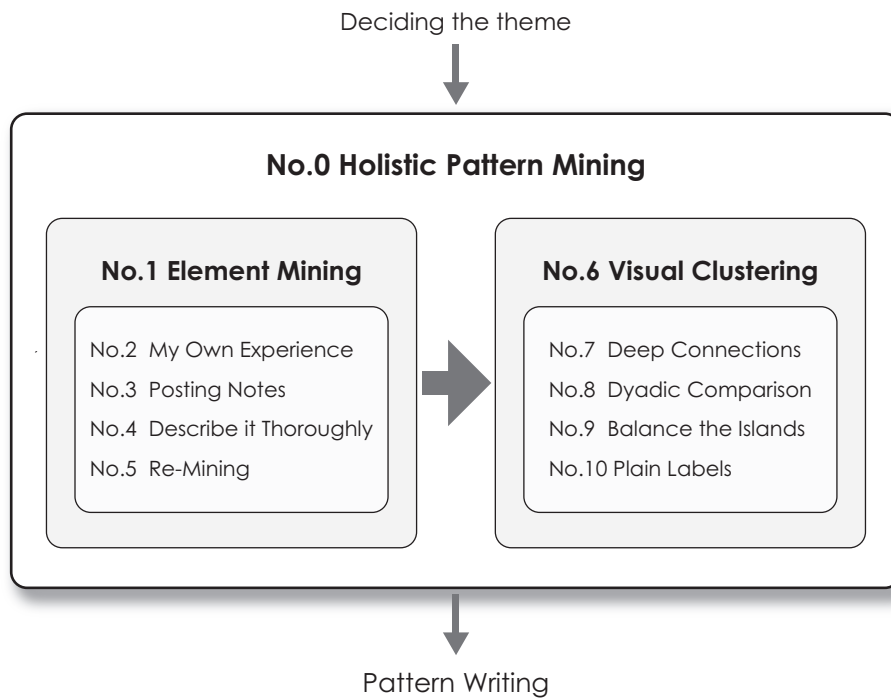
No.10 Plain Labels

Pattern Writing

Figure 4. The Structure of the Holistic Pattern-Mining Patterns

The Pattern Language guides readers through the process of pattern mining, the step coming after deciding the theme, and before writing the patterns in the process of creating a pattern language. In the base of it, **Holistic Pattern Mining** *(*No.0) falls. The patterns following this can be categorized into two large groups: **Element Mining** (No.1), and **Visual Clustering** (No.6). The two categories each contain four patterns that further explain the process. The **Element Mining** group contains patterns on how to extract the element of the whole to grasp, and **Visual Clustering** patterns on how to group the ideas to create a visual map of the whole. After this visual clustering is finished, the process can be continued onto writing the patterns.

In this paper, we will use the following pattern language projects as cases of holistic pattern mining: the Learning Patterns Project (Iba, *et. al.*, 2009; Iba and Miyake, 2010; Iba, *et. al.*, 2010; Iba and Learning Patterns Project, 2011), the Presentation Patterns Project (Iba, *et. al.*, 2012), the Generative Beauty Project (Arao, *et. al.*, 2012), and the Collaboration Patterns Project.

No.0

Holistic Pattern Mining

You are about to start on making a new pattern language.

▼ In this context
You can't get the whole picture of the theme just by writing the patterns out based on your own experiences because you don't know how much of a conceptual area your ideas cover. Since patterns are mined out of the experiences of individuals, its level of abstractness or its relationships with other patterns cannot be determined without having a grasp of the whole.

▼ Therefore
Take a holistic approach to mine out all rules, methods, tips, and customs of the area. Organize the mined out ideas and grasp the whole before you try to write out the patterns. It may take from 5 to 10 hours.

CASE: Many of the pattern languages that have been created in the Iba lab at Keio University, namely the *Learning Patterns*, the *Presentation Patterns*, and the *Generative Beauty Patterns* have all taken the holistic approach. The production process of the *Learning Patterns* is described in our past paper (Iba and Sakamoto, 2010). The *Collaboration Patterns* project, also taking the holistic approach, is now still in the production stage, but its progress can be viewed at our website[3].

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[3] Creative Systems Lab., http://creativesystemslab.blogspot.jp

Element Mining

You are holistically mining out the rules, methods, tips, and customs of the target domain.

▼ In this context

You can't get the whole picture of the theme just by writing the patterns out based on your own experiences. Since patterns are mined out of the your own experiences, they tend to lean towards one direction, making it hard to understand the whole.

▼ Therefore

Collect members who have expertise in different parts of the target domain, and mine out all rules, methods, tips, and customs of the area as a team. In this stage of creating a pattern language, quantity is valued over quality. By having team members give positive feedback, a warm environment that encourages more ideas is made. You can give and receive add-ons and constructive criticism to ideas, triggering more ideas to be produced, since some members have more knowledge than others on specific areas within the theme. At the end, by combining each member's expertise on various parts of the field, the whole can be easily constructed.

CASE: The *Learning Patterns*, *Presentation Patterns*, *Collaboration Patterns*, and the *Generative Beauty Patterns* projects were all made by teams of lab members with expertise about each of the subjects. In these projects, members gave positive feedback when other members shared their ideas during the brainstorming stage. Words of agreement, understanding, add-ons, and approval were given among members. Parts of this positive atmosphere of the *Collaboration Patterns* can be viewed in our video[4].

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[4] "Element Mining for Writing a New Pattern Language for Creative Collaborations (Collaboration Patterns Project #1)," https://vimeo.com/41613781

My Own Experience

You are trying to think of a rule, method, tip, or custom about the theme.

▼ In this context

You are apt to think of common or general statements rather than attributes coming from your actual experiences, resulting in patterns which lack reality. Stories you've read in books or heard from someone else come up in your mind, and you are tempted to talk about these even though you personally haven't understood its importance yet.

▼ Therefore

When presenting your idea, give examples from your experiences as well. If the original idea was from someone else, speak of how you've applied it to yourself and tell examples of it. Write out the examples onto the sticky note so the meanings can be easily recalled.

CASE: During the Brainstorming stage of the *Learning Patterns*, the *Presentation Patterns*, and the *Collaboration Patterns* projects, members only gave rules, methods, tips and customs based on their personal experiences.

For example in the *Presentation Patterns* project, the pattern *Success Imaging* says to imagine yourself successfully giving the presentation when preparing for it. The member who wrote the original note that later became this pattern also gave specific examples of personal experiences of presenting at conferences and giving dance performances. Though what was written on the note was somewhat abstract, the reality that his episodes had allowed members to clearly remember what the pattern meant, making it easier to write the pattern.

Posting Notes

Your team wants to mine out as much ideas about the theme as possible.

▼ In this context

You don't get much progress from just plain talks. Little is left after long talks, and the conversations tend to go off topic.

▼ Therefore

Spread out a large sheet of craft paper, and stick notes on it with your ideas written on them. When you have an idea, write it down on a sticky note, talk about it briefly, and post the note on the paper. For visual aid, use notes of a variety of color, and write with a thick black marker. By writing the ideas onto notes, records of the topics discussed can be kept. Topics of conversations will be centered on the idea on the current note go less off track. Transitions between ideas can be marked with a new note so the process goes on smoothly.

CASE: Brainstorming sessions using sticky notes were held in the *Learning Patterns*, the *Presentation Patterns*, and the *Collaboration Patterns* projects. Various colors of 3x3 sticky notes and the same thick, black marker was used for all projects. In the *Collaboration Patterns* project, members went through 2 sessions of brainstorming, for a total of seven hours, resulting in over 360 notes each filled with ideas about creative collaborations. A video of the process can be viewed online.

In the *Generative Beauty Project*, we took a similar but different approach. In the 30 hours of brainstorming, project members not only wrote their ideas on how to live beautifully as a woman onto the sticky notes, but also attached photos of items they use to represent the idea.

No.4

Describe it Thoroughly

You are trying to write out your rule, method, tip, or custom onto a note.

▼ In this context

The notes become too abstract and you cannot remember what the notes mean when you look at them later. At the time of writing the note you have a concrete image of your idea and you feel the note can be understood even if it's written shortly. Later on when you or some other member looks at the note, it is not easily understood as when the note was written.

▼ Therefore

Write out the notes in proper sentences, usually in an imperative form. Write them in the verb form telling the reader what should be done, rather than a noun that expresses the idea. Add on any examples that came up in the conversation that would help remember.

CASE: During the brainstorming process of the *Presentation Patterns*, and the *Generative Beauty Patterns*, the members did not place ant restrictions on how the notes should be written. As a result, confinements and arguments arose over what the notes really meant, especially when the notes had only single nouns on it. Members had to rewrite the same pattern over many times due to this. To avoid such a situation, members of the *Collaboration Patterns Project* agreed to write all notes in the verb form telling concrete actions to do so no misunderstanding happens.

Re-Mining

Your team feels they are done giving the rules, methods, tips, and customs out about the theme.

▼ In this context

Looking at the whole image of the subject, you have a feeling that some pieces of it are missing. The chain of thoughts up until then causes ideas to be biased towards certain subjects. The goal for pattern languages is to get an image of the entire subject, so having pieces missing here and there would be a problem.

▼ Therefore

Hold another brainstorming session considering the missing part as the theme this time. This would make ideas centered in the missing parts more likely to be produced, and the whole would be reinforced. Having shepherds or adding more members may be effective since they could give their opinions and ideas about the topic from a different point of view.

CASE: During the production of the *Generative Beauty Patterns*, members shared their rules, methods, tips, and customs on "being beautiful and lively." After the first brainstorming session, they realized their ideas were far weighted on the "being lively" side of the topic. Taking this into account, the topic for the next brainstorming session was focused on the "live beautifully" side, namely "fashion models," "clothes," "cosmetics," and "hair styles," and went through a process of re-mining.

No.6

Visual Clustering

Your team has finished brainstorming and all of the ideas are now posted on the paper.

▼ In this context
With the number of notes on the paper, it is impossible to sort out their relations in your head. Yet straight up categorizing the notes would defeat the purpose since it may cover up the true relationships and similarities between notes that would fall in different categories.

▼ Therefore
When talking about the relationships between the notes, visually express the distance between the meanings of each note on the large piece of craft paper by moving notes with similar attributes close together. This makes it possible to talk about the notes by considering the visual relationships between them.

CASE: The *Learning Patterns*, *Presentation Patterns*, *Collaboration Patterns*, and the *Generative Beauty Patterns* projects all went through a process of visual clustering. Specifically in the *Collaboration Patterns* project, members went through 4 sessions of clustering for a total of 20 hours. Members spread the notes produced in the brainstorming stage on the floor to gain enough space to cluster the 360 notes. This process can be viewed in our video[5].

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[5] "Visual Clustering for Writing a New Pattern Language for Creative Collaborations (Collaboration Patterns Project #2)," https://vimeo.com/42780071

Deep Connections

You are considering the distance between the meanings of two notes.

▼ In this context

You are tempted to pair up notes that contain similar words and phrases, and be blinded from their true meanings. You would then be combining what potentially needs to be two separate patterns into one.

▼ Therefore

Always think of the notes in terms of why it is important, and less about the actual actions being taken. Think of the distance between the notes in terms of similarity in its Problem or Context, and less about its Solution and Actions taken.
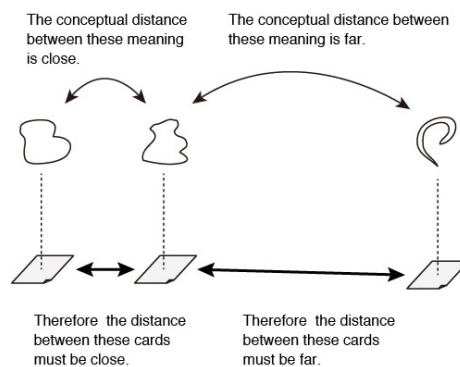
CASE: For example in the *Collaboration Patterns* project, a note about responding to emails quickly should not be grouped with a note that states the importance of exchanging email addresses so everyone can be reached when needed, just because they both are talking about emails. It is better paired with a note saying that feedbacks should be given constantly and immediately, since the point here is about giving responses and not so much about the email.

Dyadic Comparison

Notes are moved around and you start to see small groups of notes forming.

▼ In this context

You are tempted to move a note close to a group of notes rather than another single note. The uneasiness from having notes not yet associated with another rushes you to group the notes more quickly, but associating a note to a group of notes can easily blind you from the actual connection between the notes.

▼ Therefore

Always keep in mind that it is the relation between two specific notes that must be talked about. Prohibit members from talking about the general area that a note should go, or using words like "~ish" ("pattern-ish") or "~y" ("collaborationy") that talk about the vague meaning of the notes.
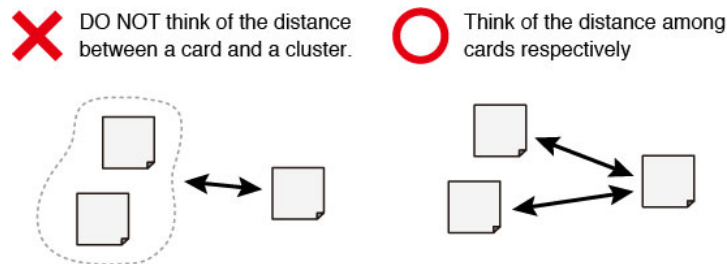
CASE: When going through visual clustering in *Learning Patterns, Presentation Patterns, Collaboration Patterns*, and *Generative Beauty Patterns* Project, members were always tempted to bring a note close to a group of notes that had already formed. Members emphasized the importance of thinking of the dyadic relationships between notes before each session, and pointed out when other members had forgot about it.

Balance the Islands

Your group has finished moving the notes around, and you are about to circle around the semantic groups (islands: these each become a pattern) of notes that have formed, to name them.

▼ In this context
You become too focused on the groupings that the levels of meaning of the islands become inconsistent. Islands have different levels of abstractness, or the areas of ideas they cover have large variances. Having scattered islands would result in the product patterns to be un-uniform in abstractness.

▼ Therefore
Consider that these islands become individual patterns, and make the level of abstractness even at the appropriate level. For islands that only contain notes that are too specific, think of a more general label that represents the group.

CASE: The level of abstractness of the islands have been important in all of the *Learning Patterns*, *Presentation Patterns*, *Collaboration Patterns*, and the *Generative Beauty Patterns*. When clustering the notes, it is how specific of an idea the notes state that is important, and not much the number of notes in it. As a result of the effort to equalize the abstractness, the sizes of islands had large variances where some islands had multiple notes in them, while other islands were composed of only one note.

Plain Labels

You are thinking of a label for an island of notes.

▼ In this context

If you use straightforward nouns as labels, it is hard to remember what the label means when writing the patterns later on. If you have named patterns in the past, you tend to give pattern name-ish nouns as labels for the islands. Giving such names would distract the writer away from the pattern's real contents during the pattern writing process later on.

▼ Therefore

Label each island as a thorough verb. Keep in mind that these are just temporary labels used at the stage of writing the patterns so the writer can understand and distinguish patterns at a glance. There is no problem even if it gets a little long or ordinary. The pattern name (which does not have to be a verb) will be later given after the pattern is written.

CASE: When labeling for the *Presentation Patterns*, members decided to give the clusters a candidate for its future pattern name, instead of a label that describes what the cluster means. The creative names (usually a noun) that were given to the clusters ended up generating confusion to the members. Since an attractive pattern name takes time to think up of, members gave temporary names to the clusters that necessary didn't represent its meaning well. Confusion and misunderstanding occurred among members as a result, negatively affecting the actual contents of the patterns.

With this failure in the past the *Collaboration Patterns* project members worked on giving a label that describes the clusters thoroughly. Thinking of the creative pattern names will be put off until later in the process, so members can concentrate on writing out solid patterns.

4. Conclusion

Concerning the relation between pattern languages and the *whole*, Alexander claims, "A well-constructed, deeply constructed pattern language has the power, within it, to help people visualize geometric configurations that are whole." (Alexander, 2002b: p.366). We wish to support readers generate this *whole*, by using the presented Holistic Pattern Mining Patterns: a pattern language for mining patterns based on a holistic approach. We anticipate that this language will help groups create a new pattern language with the wholeness that Alexander had held.

Acknowledgements

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