

A Pattern Language for Personal Authoring in E-Learning

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Abstract: The proposed pattern language is a collection of authoring patterns that individual authors can use in creating e-learning courses. The pattern language reflects our experience in the e-learning industry. Some of the patterns are basic and fundamental and most tool-related patterns are folklores among the IT-savvy authors. Other patterns emerged from our observation of users' authoring behaviors, environments, and outcomes. We believe that there are subtle relations among these patterns, and putting them together in a pattern language provides helpful insights. We expect that people can use this pattern language to create quality e-learning contents at low costs.

1. Introduction

Can quality e-learning courses be created at low costs, and can authoring be made a sustained activity that supports incremental and iterative course development? This paper takes the pattern approach to look at these issues from the perspective of *personal authoring*. Specifically, personal authoring is the practice in which the author is responsible for all aspects of course development, which includes tasks ranging from the preparation of course components to the composition of final presentation. Personal authoring is further characterized with authors completing the tasks on commonly accessible and usually inexpensive PC equipment.

The pattern language proposed here reflects our working experience in the e-learning industry. Some of the patterns presented here may be basic; nevertheless they address recurring questions of our clients. Other patterns address technically intensive problems that our less IT-savvy clients found themselves needing outside help. Finally, there are patterns which address problems that are subtle and easily ignored during authoring but may have adverse effects on the produced courses. The point of putting them together in a pattern language is to present a comprehensive picture of personal authoring. By following these patterns, an author should be able to create good quality e-learning courses for anything she/he cares to share or teach.

Table 1 lists the patterns by categories. Many types of courses can be constructed using these patterns. In this paper, we consider the construction of a type of e-learning courses called *presentation sequence with audio/video* (PSWAV), which is an extension of presentation sequence (Horton, 2000). Figure 1 shows an example, which includes an audio/video stream to explain the slides. If learners use the navigation bar to browse another slide, the playback position of the audio/video stream will be synchronized with the selected slide, and vice versa. Animation, if used, is also synchronized with the audio/video stream. In this point of view, the audio/video stream provides a time line which guides the presentation sequences. While this is only one type, it has many interesting subtypes that cover the most frequently used e-learning course styles. Furthermore, although a PSWAV type of course primarily supports *learning by seeing* and *learning by hearing*, some of the patterns are relevant in the context of *learning by doing* as well. The eleven patterns that are most relevant in constructing a PSWAV course are illustrated in Figure 2. However, to keep the document focused, the reader's attention is directed to three of the most important and heavily shepherded patterns, including

SEPARATE MATERIAL PREPARATION FROM INTEGRATION, *PERSONAL AUTHORIZING STATION*, and *TYPE-SPECIFIC MEDIA PRODUCTION*. The three patterns are presented in the full format in Section 2. The remaining eight un-shepherded patterns are included as supporting materials and are briefly presented as problem-solution pairs in Section 3. The paper concludes in Section 4 with an example of the use of the pattern language.

Table 1. Pattern categories

Category	Patterns
Content Production Concepts	SEPARATE MATERIAL PREPARATION FROM INTEGRATION, TYPE-SPECIFIC MEDIA PRODUCTION, MATERIAL INTEGRATION
Configuration of Computer	PERSONAL AUTHORIZING STATION, HIGH-END PC FOR MULTIMEDIA AUTHORIZING, AMATEUR STUDIO
Content Consistency	COHERENT AUTHORIZING
Material Production	SCREEN CAPTURE, SLIDE EDITING AND PRESENTATION, MONO DIRECTIONAL MICROPHONE, 16-BIT SOUND RECORDING, LIVE RECORDING, PC CAMERA, DIGITAL CAMERA, AUDIO/VIDEO CAPTURE, SCANNER, HTML EDITING, IMAGE PROCESSING, POST-PRODUCTION, NON-LINEAR AUDIO/VIDEO EDITING
Working Environments	DISTRACTION-FREE WORKPLACE, ATTITUDE TRANSITION, WALK-AROUND AREA, GOOD VIEW, QUIET CORNER, SUFFICIENT LIGHTING, SUBDUED BACKDROP, LARGE TABLE, COMFORTABLE SEAT, FAVORITE DRINK, EQUIPMENT IN FIXED POSITION, 1024X768 SCREEN RESOLUTION OR BETTER

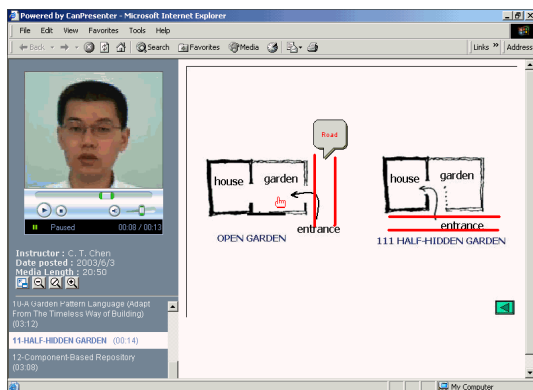


Figure 1. Presentation sequence with audio/video

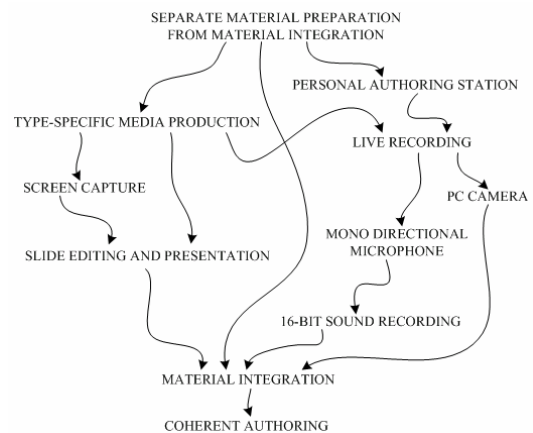
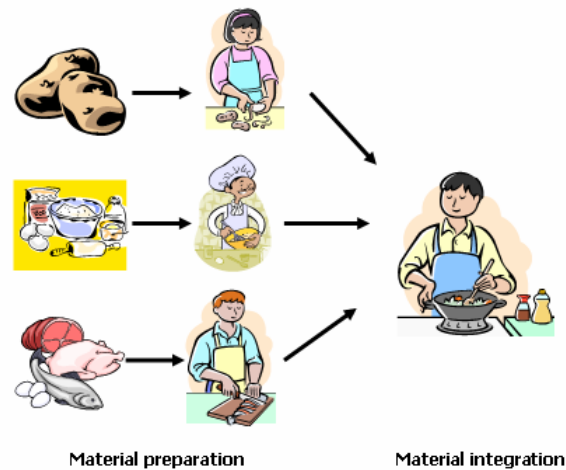


Figure 2. The personal authoring pattern language

2. The Patterns

SEPARATE MATERIAL PREPARATION FROM INTEGRATION



Context: You are developing a multimedia course that may contain simulation, presentation slides, audio/video, and so on. You not only prepare these materials but also organize them carefully to meet certain goals, including learning and pedagogical ones. Each of these is a complex activity.

Problem: How do you organize the work to efficiently create an e-learning course?

Forces:

- When creating course contents, you focus on the details of the construction, such as media types and tools, the implementation work, and the quality of the contents created.
- When integrating course contents, you focus on the structure and sequencing of the course elements to provide a teaching-learning process that meets the learning and pedagogical objectives.
- You want to speed up the course construction and to allocate resources better.

Solution: Divide the course construction into two activities: material preparation and material integration. Use a different authoring strategy in each activity. Specifically, use *TYPE-SPECIFIC MEDIA PRODUCTION* to prepare materials and *MATERIAL INTEGRATION* to compose materials. The first activity focuses on creating and refining a diversity of materials, which requires skills for multimedia processing as well as computer programming. For example, a particular course component makes use of animation to explain a complex process. The animation can be implemented by animated GIFs, Java applets, Flash programs, Javascript programs, and so on. The author must be knowledgeable both in selecting the appropriate methods and in actually producing the animation. Furthermore, a course usually contains different types of components, making the material preparation more complicated. Once the material preparation activity is separated from integration, authors can concentrate on the material production activities by using tools that implement *TYPE-SPECIFIC MEDIA PRODUCTION*.

In the second activity, authors use *MATERIAL INTEGRATION* to structure the materials according to the learning and pedagogical objectives. That is, the structure enforces a teaching-learning process. In this activity, authors do not really concern about the construction of materials. Instead, authors focus

on issues such as how to organize courses so as to keep the learners focused and so that learners can spend less time but still learn what they need, and so forth. Instructional methods can be adopted to achieve this objective. However, many instructional methods are too theoretical to be implemented in personal authoring, since the author may not have an adequate education background. Fortunately, easy and commonly used course structure templates exist. For example, the six common kinds of lessons by Horton (2003) is a good starting point.

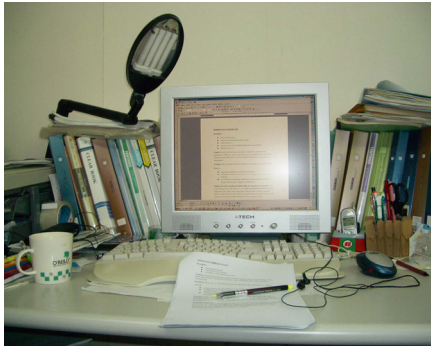
Many international learning standards separate content annotation from course structure annotation. For example, in ADL SCORM (2003) Content Aggregation Model, a component called Content Model is used to define two types of contents: assets and sharable content objects (SCOs). Another component, Content Packaging, defines how to represent the static content structure and how to package resources for delivering. IMS (2003) has a more sophisticated model called Learning Design (LD) that allows learners to change learning sequencing at runtime. Authors use LD to first design a teaching-learning process (a tree structure of activities) and later assign resources (usually contents and services such as homepage and videoconferencing) to each activity. This pattern fits well with the e-learning standards.

Resulting Context: When creating courses, authors tend to get very attached to the production of course components and forget to think about the learning and pedagogical objectives. By practicing *SEPARATE MATERIAL PREPARATION FROM INTEGRATION*, the authors can better balance the production of course components with the structuring of learning and pedagogical goals. Furthermore, explicitly distinguishing these two activities enables you to better allocate resources. In personal authoring, you may be the only one performing both activities. Nevertheless, this pattern helps you plan tasks, manage perspectives, and dispatch jobs if necessary.

SEPARATE MATERIAL PREPARATION FROM INTEGRATION does not advocate the component-based approach of course development. Although material preparation and material integration are separated, they are not isolated but closely related. A successful e-learning course must have clearly defined goals. It is from the common goals that the detailed tasks of material preparation as well as integration are derived. If these two activities are isolated, it should be possible to create courses from so called *learning objects*, which are reusable learning units readily gathered from digital learning repositories. The idea of reusable learning objects is adapted from component-based software and is becoming a hot research topic in the e-learning technology community. However, as the software community has learned, the development of domain-independent reusable software components is very hard (Glass, 2003), and so is the development of reusable learning objects (Feldstein, 2002).

Related Patterns: To avoid inconsistency in the separately prepared materials, use *COHERENT AUTHORING*.

PERSONAL AUTHORIZING STATION



Context: E-Learning authors use computers to produce and publish learning contents. Moreover, contents are usually built incrementally.

Problem: What type of computer should be used for personal authoring?

Forces:

- The computer should be easy to access and ready for personal authoring. An easily accessed computer reinforces incremental and iterative content construction.
- E-Learning contents are created with software packages that consume a large amount of memory space, computing power as well as screen estate. Moreover, extra hardware and equipment are usually needed.
- You are budgeting for establishing an authoring station. Thus, instead of buying a new computer, you want to use an existing one with upgrades within a reasonable budget limit.
- Workplace noises, interruptions, and traveling needs may prevent you from always authoring at a fixed location.

Solution: Configure a standard computer to serve as an authoring station rather than investing in a special-purpose one. Today's commodity-grade personal computers have adequate computing power to process multimedia data. With proper configuration and perhaps a little extra investment, your normal workstation can become a personal authoring station. You may have both a desktop and a laptop, and you have to decide which one to be used for authoring. Use the desktop if you spend most of your time at a fix location that is a *DISTRACTION-FREE WORKPLACE*, and you do not need to create courses when traveling. Otherwise, the laptop makes a better choice.

Multimedia authoring applications tend to require a large amount of memory. To produce contents smoothly, you should have at least 256 MB RAM, but 512 MB is recommended. Another suggestion is to double the minimal memory requirement recommended by software (Horton and Horton, 2003). In order to have enough screen estate to manipulate applications, you need *1024X768 SCREEN RESOLUTION OR BETTER*. If you want to record audio, you need *MONO DIRECTIONAL MICROPHONE* and *16-BIT SOUND RECORDING* configuration. To record video, *PC CAMERA* provides an inexpensive solution. Sometimes you may have to translate audio/video tapes into computers and *AUDIO/VIDEO CAPTURE* provides what you need. If you want to digitalize printed pictures, use *SCANNER*.

The total cost of hardware upgrade (excluding a monitor) should be less than 50% of buying a new

computer; otherwise you may consider purchasing a new one or setting up *AMATEUR STUDIO* to be shared among authors.

Finally, choices of software to be installed in the personal authoring station are addressed in the related patterns *TYPE-SPECIFIC MEDIA PRODUCTION* and *MATERIAL INTEGRATION*.

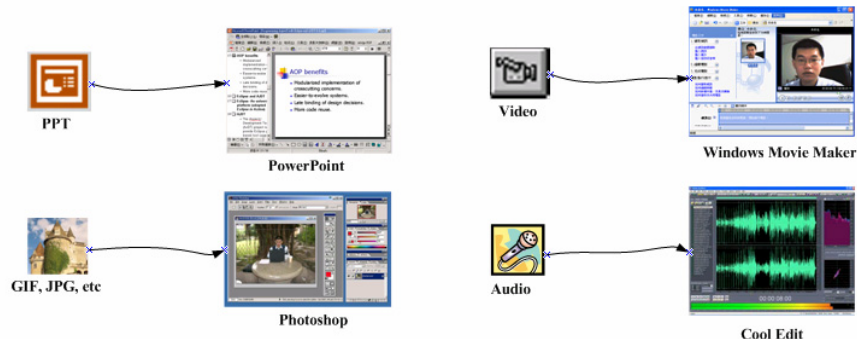
Resulting Context: *PERSONAL AUTHORIZING STATION* realized on a computer for everyday use allows authors to conveniently access their authoring equipment. Using this pattern, people can rapidly switch their contexts among work, authoring, learning, entertaining, and so on. They do not need to go to a media studio to produce learning contents. Authoring with a computer for everyday use supports incremental content construction.

There is a tradeoff between performance and mobility. Generally, a desktop has larger memory and higher-speed hard disk than a laptop. Equipment, e.g. RAM or hard disk, for a desktop is also cheaper than that of a laptop. On the other hand, a laptop provides better mobility. In our experiences, the primary concern of using a laptop is the ability to choose a workplace for authoring. Authoring is a thinking-intensive task, and finding an appropriate environment is as important as configuring a computer for authoring.

Sometimes the contents you are creating require expensive equipment or software to produce. For example, a high-end video capture card with software such as Adobe Premiere Pro may cost more than 5,000 USD. It is not realistic to install such equipment and software on every *PERSONAL AUTHORIZING STATION*. In this case an *AMATEUR STUDIO* to be shared among authors should be preferred. Notice also that some organizations make it as a policy to separate e-learning authoring from regular work. This is more easily enforced through a shared *AMATEUR STUDIO* instead of a *PERSONAL AUTHORIZING STATION*.

Related Patterns: To create e-learning contents, you install tools on *PERSONAL AUTHORIZING STATION* that supports *TYPE-SPECIFIC MEDIA PRODUCTION* and *MATERIAL INTEGRATION*, respectively. In addition, physical environment related patterns assist people in preparing or looking for an appropriate workplace for authoring; these patterns include *DISTRACTION-FREE WORKPLACE*, *ATTITUDE TRANSITION*, *GOOD VIEW*, *QUIET CORNER*, *LARGE TABLE*, and *COMFORTABLE SEAT*.

TYPE-SPECIFIC MEDIA PRODUCTION



Context: The preparation of course components is separated from the integration of course components into a concrete course. You plan to use a variety of course components.

Problem: What tools should you select to manipulate various types of course components?

Forces:

- Course components vary in types from plain text to multimedia data such as audio, video, animation, and so on.
- Not every tool is suitable for manipulating every material.
- A “cool tool” that produces fancy contents may be expensive and may require specific skills to use it.
- You need an overall strategy of developing your tool ensemble.

Solution: Use **purpose-made tools to manipulate course components of different types. Acquire tools incrementally to save cost as well as time.** Although using an all-purpose tool to process materials of different types sounds intuitive, currently this is impractical. A tool is usually designed to master a particular domain and all-purpose tools are rare in the market, if any. For example, while an image-processing tool is good for manipulating pictures and images, it is certainly not suitable for video editing. In practice, an ensemble of tools is required for e-learning course production.

Shrink-wrapped products for multimedia applications and content production are abundant in the market. They could cost a lot of money and take a lot of time to master. As a rule of thumb, always start with lightweight tools such as those come with an operating system. Note that the most powerful and feature-rich tool may not be the best choice for all circumstances. For instance, sometimes a simple tool such as the Microsoft Painter is good enough for processing images in comparison to Adobe Photoshop. Only after you are sure of the inadequacy of the lightweight tools should you make further investments on special-purpose tools.

This pattern is more conceptual in nature and can be implemented by the following patterns. *IMAGE PROCESSING* is employed to manipulate pictures, icons, and graphics. *SLIDE EDITING AND PRESENTATION* is used to build PowerPoint-like slides. *HTML EDITING* facilitates effective web page editing by hiding the primary HTML tags. To capture screen image, use *SCREEN CAPTURE*. Finally, *NON-LINEAR AUDIO/VIDEO EDITING* is used to refine audio/video outcomes.

Resulting Context: At the beginning stage of applying e-learning, authors may be eagerly running after a do-it-all tool for creating courses, especially if budget allows. By applying this pattern, authors now prepare course components of different types by using special purpose tools and then integrate them by applying *MATERIAL INTEGRATION*. However, since the production of course components is separated from the integration of the courses, authors may have to repeatedly modify the course components due to consistency problems. To avoid this inconsistency, apply *COHERENT AUTHORIZING* as early as possible.

Some integration tools support streamlined workflows for creating specific types of course components. In this case, it is easier to create the specific course components using *MATERIAL INTEGRATION* instead of *TYPE-SPECIFIC MEDIA PRODUCTION*.

Related Patterns: Some hardware devices are used to digitize materials. For instance, *DIGITAL VIDEO CAMERA*, *PC CAMERA*, and *DIGITAL CAMERA* generate digital image into PC through input ports. *SCANNER* captures and digitizes printed documents. To convert analog audio/video signal, use *AUDIO/VIDEO CAPTURE* and *16-BIT SOUND RECORDING*.

3. The Supporting Patterns

SCREEN CAPTURE

Problem: How can we gather images displayed on a computer's screen?

Solution: Use properly configured screen capture tools to gather images displayed on a computer screen. Screen capture tools usually provide rich options for gathering objects, including the full screen, arbitrary windows, the active window, regions, buttons, and so on. With an appropriate configuration, the captured images can be directly used without further processing. For example, some people always use the "Print Screen" function provided by the OS to capture the entire screen, even if what they need is just a particular area of the screen. Then, they use an image processing tool to cut out the needed region. The latter operation is superfluous if they capture the desired region rather than the entire screen.

The capture can be manually triggered or time triggered. By capturing at a high frame rate, such as 15 to 25 images per second, some capture tools can further encode these captured images into a particular video format, such as AVI or WMV. In this way, video clips are created without using a video camera.

In a software demonstration, people tend to move the target around. Consequently, the capture can be invalid if a fix-region setting is chosen. You avoid this problem by identifying the targets through their internal handlers rather than their initial positions. For example, Microsoft Windows Media Encoder allows you to choose a capture target by the text displayed in the title bar. In this way, capture tools can continuously track and gather images of the moving objects.

SLIDE EDITING AND PRESENTATION

Problem: How should a presentation sequence be created?

Solution: Use a slide editing and presentation tool, and follow guidelines to prepare slides. While presentation tools are very easy to learn and rich built-in templates are widely used in practice, creating a good presentation sequence requires more. For example, Alley (2002) suggests useful guidelines for technical presentation, including 1.5 to 2 minutes per slide in average, one primary message per slide, having a strong headline, and so on. In implementing a guideline, you may have to create your own templates for sequencing and layout rather than reusing a built-in template. For example, one of Alley's guidelines suggests using a more informative phrase or sentence for the slide title. However, in most built-in templates, the title text is at least 40 points, which is too large. The bottom line is that your presentation should not be limited by the tools' built-in templates.

Animation, if any, should be used judiciously. Designing a meaningful animation can be time-consuming. Although proper use of animation can sometimes help, (for example, in illustrating a complex phenomenon,) its use should be weighted in balance with the distraction it introduces. Moreover, printed hand-outs for heavily animated slides can be unreadable. As a result, you may have to prepare two kinds of slides, one for presentation and the other for print.

LIVE RECORDING

Problem: What is an easy and intuitive way to create multimedia courses for e-learning?

Solution: Provide easy-to-use tools to function alongside regular presentation for recording with minimum intrusion. Creating multimedia e-learning courses is time-consuming as well as skill-intensive and is generally regarded as a difficult task. With special hardware and software support, *LIVE RECORDING* provides an easy way to produce multimedia courses. For example, the demonstration of a software use can be recorded live with *SCREEN CAPTURE. DIGITAL VIDEO CAMERA* operated by specialists to record a classroom proceeding also falls under this pattern. *PC CAMERA* is suitable to capture video clips in computers. For recording audio, use *MONO DIRECTIONAL MICROPHONE* and *16-BIT SOUND RECORDING*.

PC CAMERA

Problem: How can video materials be created?

Solution: Use PC cameras for video recording. When purchasing PC cameras, pay attention to technical specifications that affect usability and image quality. These technical specifications include video-capture resolutions, frame rates, video-capture formats, interfaces, and system requirements. For personal authoring, a PC camera capable of capturing videos at a resolution of 640×480 pixels and at a frame rate of 30 frames per second (fps) is usually sufficient. When building a presentation-like course with a small talking head, even a 300 x 240/20 fps camera is acceptable. Moreover, your authoring station must satisfy a PC camera's system requirements, including supported operating systems, recommended CPU types, minimum required memory, and so on. Finally, current computers and PC cameras all support USB interfaces and do not require a power cable and an adapter.

MONO DIRECTIONAL MICROPHONE

Problem: What kind of microphones should be used?

Solution: Prepare a mono directional microphone for recording audio so that a speaker's voices are the main pickup signals. Establishing a noise free studio for multimedia course authoring can be costly and impractical. A mono directional microphone has limited pickup angles so that other voices around the environment are mostly cut off (Rose, 1999). This pattern makes voice recording possible even if the authoring environment is not noise free.

A *MONO DIRECTIONAL MICROPHONE* can also be useful if a quiet workplace is available but noises may arise haphazardly.

16-BIT SOUND RECORDING

Problem: What audio hardware and software configuration should be used for recording sounds or dubbing tapes?

Solution: Use a configuration for both hardware and software to enable a 16-bit or better audio signal processing and prepare a high capacity hard drive for storage. The minimum requirement for professional digital audio recording is 16 bits (Rose, 1999). If the source quality is poor, the processed soundtracks will be even worse. Thus, you should record sounds under a 16-bit or better configuration even if the soundtracks will be used in a lower bit rate environment, e.g., a 56 Kbps network connection. For example, your authoring station is equipped with a 24-bit soundcard and Adobe Audition, which allows you to configure the hardware for recording human voices under a 44.1 KHz and 16-bit stereo configuration.

MATERIAL INTEGRATION

Problem: What kind of tool should be used for course components integration?

Solution: Use tools to create courses by incrementally integrating course components of multiple types. Course integration is a time-consuming activity and it is rarely possible to create a course in a single sitting. You can incrementally build a course if integration tools supports fine-grained modifications. For example, the CanThink CanPresenter (CanThink, 2000) treats each slide as a unit of integration, which allows you to modify the course on a slide-by-slide basis. This makes it possible to freely replace any slide by redoing materials for the particular slide rather than the whole set. In contrast, other integration tools store audio/video streams in a single file, which makes partial modification difficult.

Most integration tools provide further assistance for streamlining the integration workflow. For example, Microsoft Producer adopts a wizard approach to help users construct a new course by importing a PowerPoint file and then integrating with an audio/video stream. The audio/video stream can be already in existence, in which case the author controls the playback of slides according to the progression of the audio/video stream. Alternatively, the audio/video stream is produced by recording the instructor's voices while the slides are being narrated. In the latter case, the instructor is usually unaware of this integration process since it is embedded within a normal presentation.

Course metadata that complies with international learning standards promote reusability, interchangeability and traceability. In practice, however, most tag fields are left empty because authors rarely explicitly fill in all the metadata. Integration tools can alleviate this problem by automatically generating metadata by collecting information of the authoring activity in the background.

COHERENT AUTHORIZING

Problem: How to avoid producing a course that may confuse and distract learning?

Solution: Keep the produced content coherent by establishing production rules and authoring environment guidelines. In teamwork, production rules such as writing styles, GUI design principles, course structure templates and instructional-design guidelines, are designed upfront so that a team can effectively collaborate to create a quality course. Production rules are also useful even in a one-person team. These rules serve as checklists and prevent a course developer from producing inconsistent contents.

Authoring environment guidelines address issues of selecting, configuring, and using hardware and software in the course development process. In a particular course, for example, you consistently use *16-BIT SOUND RECORDING* and *DIGITAL CAMERA* to capture sound and video, respectively. You also maintain the same voice volumes and video positions. Moreover, within the same instruction unit, you should wear the same dresses and use the same backdrop if the unit takes several days to complete.

Solutions should be contextualized. Rules and guidelines formulated without regarding to a particular context are difficult to follow because users may not be able to discern the appropriate situations for applying a particular rule. In general, past projects provide concrete contexts to see how the rules and guidelines work. Reasons of both success and failure should be recorded to assist users in applying these rules in new projects.

4. Patterns in Action

Consider the following scenario. I am developing a multimedia e-learning course for my company. To do so, I have to produce contents and organize them into a course to fulfill the learning goals. *SEPARATE MATERIAL PREPARATION FROM INTEGRATION* helps me to structure the workload and manage perspective since I rapidly switch between these two activities.

I am assigned to attend a 5-day conference in the UK in a few days. After that, I have to deliver the course. The only possibility to finish preparing the course on time would be building this course during the conference period. To do this, I have to have a multimedia authoring station that I can carry to the conference. This rules out heavyweight solutions. Since I work with my laptop on a daily basis, *PERSONAL AUTHORIZING STATION* realized on my laptop makes a good choice.

Next, I need to decide the presentation style. To save time, a PowerPoint file, which I prepared last year for a classroom course, will be reused with minor modifications by perhaps inserting a few screenshots into the slides. Therefore, *TYPES-SPECIFIC MEDIA PRODUCTION*, which is realized through *SCREEN CAPTURE* and *SLIDE EDITING AND PRESENTATION*, seems good for this purpose.

Also, since I am not to deliver the course in person, audio and video streams will be the necessary enhancements to the slides. This calls for *LIVE RECORDING*, which includes a *PC CAMERA* for video capture and a *MONO DIRECTIONAL MICROPHONE* for audio input. Note that since a *PC CAMERA* captures video in digital format, it can be hooked directly to a PC through a common input port. On the other hand, a *MONO DIRECTIONAL MICROPHONE* transmits analog audio signal to a

16-BIT SOUND RECORDING for sampling and encoding into digital format. A *16-BIT SOUND RECORDING* ensures that the quality of audio signal is maintained when it is digitized. Another reason for using a *MONO DIRECTIONAL MICROPHONE* is to ensure that audio is captured with background noise suppressed.

With the tools to produce course components in place, I must then find a way to assemble these course components into an integrated course. The pattern *MATERIAL INTEGRATION* pops up. Finally, since it will not be likely for me to complete the presentation in one sitting, I put in *COHERENT AUTHORIZING* as a reminder for the consistency of presentation, including the voice volume, the video position, the author's dress, and the style of slides. Fig. 2 is a constructed pattern language based on the above scenario.

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