A STRUCTURED METHODOLOGY FOR MULTIMEDIA PRODUCT AND SYSTEMS DEVELOPMENT

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ABSTRACT

While most developers/producers of multimedia are able to describe in detail the stages of development a project may go through, few are able to nominate, and incorporate into the development process, the support activities such as quality assurance, risk management, validation and verification and configuration management which are necessary to ensure that the final product is a quality product.

Until recently, the multimedia environment had few guidelines, as production processes were usually adapted from the film or software industries. The Excellent in Content report (Commonwealth of Australia, 1995) emphasised the need for multimedia developers to provide evidence of quality assurance in all aspects of the developers' business, particularly in production methodologies and that all developers be 'accredited' potentially in accordance with ISO 9001.

The methodology outlined in this paper is, in effect, a benchmark that endeavours to facilitate quality improvement and increased efficiency in organisations engaged in, or intending to engage, in the specification, design, production, evaluation and implementation of interactive resource-based education and training. The approach combines a product life cycle based on iterative prototyping and creative refinement, with supporting activities drawn from sources of best practice in software and multimedia development. The clear and detailed models of new/best practice, the integrated set of templates and the supporting tools provide developers with a model with which they can approach more systematically the design and development of multimedia products and systems.

The structured methodology can be applied to both dynamic (for example, Internet based) and static (for example, CD-ROM based) products. It is suggested that the methodology provides a baseline for better management and control of costs, schedule and quality in multimedia development.

KEY WORDS

Methodology, multimedia, product development, standards.

1. INTRODUCTION

While most developers or producers of multimedia understand their discipline extremely well and are able to describe in detail the stages of development a project may go through, few are able to nominate, and incorporate into the development process, the support activities such as quality assurance, risk management, validation and verification and configuration management which are necessary to ensure that the final product is a quality product. In Australia particularly, multimedia development is still largely a 'cottage industry' where developers work with small teams of 5-15 people. A majority of these developers either lack knowledge about the support activities or consider that they are irrelevant, time consuming and bureaucratic. A number of reports and government sponsored surveys such as *The Global Information Economy*

(Commonwealth of Australia, 1997), *Creative Nation* (Commonwealth of Australia, 1994), *Excellence in Content* (Commonwealth of Australia, 1995) and *National Multimedia Educational and Training Strategy* (Arts Training Australia, 1995) have found that many multimedia development teams are young and creative but that they have limited project and business management skills which can cause development teams to run at a loss, not deliver on time or produce a low quality product.

1.1 THE NEED FOR A METHODOLOGY

Methodologies for the development of multimedia products have, in most instances, focused on *what* is being developed with less attention to *how* the product is developed. Until recently, the multimedia environment had few guidelines so that development activities and methods varied according to the background of the producer, for example, publishing, computing or video production. However, while varied, these models for design and production have in common activities which are team based and complex, they are all producing a particular end product as a result of the team effort and each of these products has unique properties.

The *Excellent in Content* report (Commonwealth of Australia, 1995) emphasised the need for multimedia developers to provide evidence of quality assurance in all aspects of the developers' business, particularly in production methodologies and that all developers be 'accredited' potentially in accordance with ISO 9001 *Quality Systems – Model for quality assurance in design, development, production, installation and servicing*. However, the industrial convergence brought by multimedia raises a number of issues, which are not being systematically addressed by developers or policy makers. These issues include:

- the 'clash' of traditions and standards and views which are either industry centred and hardware based or capability centred and focused on function; and
- the proliferation of information now being distributed in an online environment which requires significantly different validation and verification processes to offline systems development.

Government and semi-government bodies as well as corporations are now focusing on multimedia solutions for their training needs, documentation requirements and online activities. Increasingly, these organisations provide much of the work for multimedia developers. A fundamental concern of large organisations acquiring complex systems is the management of risk in the acquisition of these products and systems.

One approach to the management of risk is to include, as a requirement of the tendering process, that suppliers demonstrate compliance with ISO 9001 thus reducing the risk and increasing the likelihood of a quality outcome. For example, the Queensland state government, since 1990, requires that suppliers of goods and services to government bodies implement software quality assurance systems. The Australian experience is no different to that of the United Kingdom and the European Community where suppliers and inhouse developers must "adopt definite policies and practices which are carried through from requirements capture to maintenance and user operations" (TickIT, 1992). Mandating compliance to an international standard for quality assurance will not necessarily guarantee that the final product is satisfactory to clients, end users and the production team, however, improvements in process should have a positive impact on the product. While the fundamental importance of conceptual quality and integrity of content to end user satisfaction can often be underestimated, for most developers these areas receive the maximum planning attention. The problems associated with the processes of communication, organisation and technology are not usually afforded the same degree of importance and, when neglected, can have a major negative impact on product.

It was seen as essential, therefore, that multimedia producers be provided with a rigorous and well-defined approach to the development of multimedia products and systems. Having access to other resources and information they might require to both guide them and support them, for example, templates or exemplars, would increase productivity and encourage team members to acknowledge significant changes in a formal manner. In addition, because each multimedia

product is unique even if standard tools are used and multimedia assets are reused in subsequent products, the content is different. Such a methodology would provide a way for team members with different production backgrounds (for example, video and computing) to have an agreed and shared understanding of the development process and the relevant documentation required. In such a rapidly changing technological environment as interactive multimedia, it is also essential that any methodology used is flexible enough to be tailored to suit small, medium and large scale projects. The methodology needs to be appropriate for the type of product being created and the type of environment in which it is being produced.

2. DESCRIPTION OF THE METHODOLOGY

The methodology (Sherwood et al, 1998) outlined in this paper, therefore is, in effect, a benchmark that will facilitate quality improvement and increased efficiency in organisations engaged, or intending to engage, in the specification, design, production, evaluation and implementation of interactive resource-based education and training. The clear and detailed models of new/best practice, the integrated set of templates and the supporting tools provide developers with a model with which they can approach more systematically the design and development of multimedia products and systems.

Interactive multimedia products lend themselves to a development process based on collaborative analysis and design, iterative and rapid prototyping, small development teams comprised of specialists with advanced tool sets, and project management based on prioritisation. The methodology outlined in this document follows this process and focuses on six phases of multimedia development:

- Initiation
- Specifications
- Design
- Production
- Review and Evaluation
- Delivery and Implementation.

Each phase is divided into three categories of activity, with each category further subdivided:

1) Development
    - Generic
    - Online
2) Management
    - Legal
    - Project
    - Risk
3) Support
    - Change control
    - Quality assurance
    - Validation and verification.

2.1 PHASES AND ACTIVITIES

Initiation

The Initiation phase focuses on the planning required for the development of the product. Tasks include the determination of the overall strategy, the costs associated with copyright and rights negotiations are incorporated into the budget and the scope of the risk management (business, technical and project risks) to be performed is identified. Change control policies are established, the client's acceptance criteria are outlined and a preliminary project plan is prepared.

Specifications

In this phase, the feasibility of the project is reassessed. Detailed specifications of functional and, where appropriate, performance requirements, content and objectives of learning outcomes are developed. Testing and useability criteria are established.

Design

A major product of this phase is the Design Document which identifies the human activity that the proposed interactive multimedia system will support. It also identifies the people or users who will perform the activity and outlines the solution to the design problem.

Production

Within this phase, control of change is critical, as is attention to detail. Adherence to the specified technical aspects and formats are monitored and reviewed. Media acquisition is finalised and all rights and/or licence negotiations should be complete.

Review and Evaluation

This phase occurs throughout the iterative development process. At the end of each cycle of conceptualise, specify, design and produce, the product is critically examined before starting the next iteration. For online products and systems, maintenance evaluation is conducted to examine their viability over time.

Delivery and Implementation

The level of client support, performance support and ongoing maintenance is finalised with the client. The delivery of the product is formalised with the client's signing of an acceptance agreement. The overall conduct of the project is reviewed with corrective actions recommended.

The following diagram, Figure 1, outlines some of the tasks in each phase. Reviews by the client and formative evaluation and testing are undertaken in most phases.

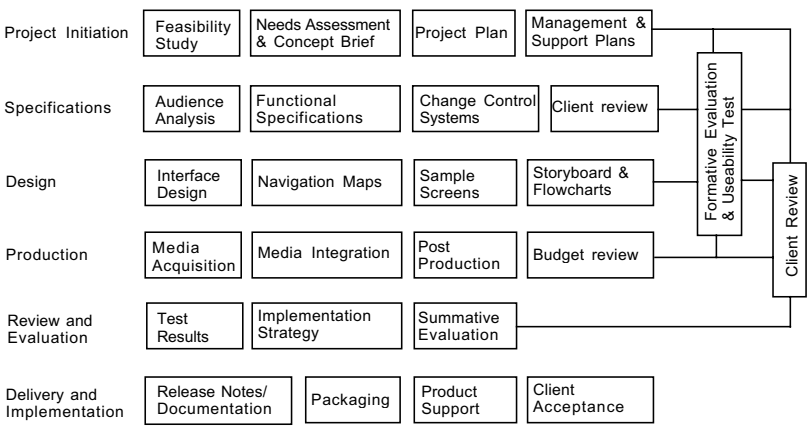

Figure 1: Overview of the Methodology and Sample Tasks

The key categories of activity in each of the six phases of interactive multimedia development forms the core of the methodology, supported by examples, structural diagrams and templates. The overview of each phase of development is followed by a one page outline of the particular activity. The activity is described and associated tasks are outlined. Each phase section concludes with a list of work products and a checklist of questions to confirm that tasks for the phase have been completed as required.

Table 1 below shows the Design phase of the complete methodology with the descriptor for the type of activity performed in each category.

Table 1

Design Phase

Category	Activity	Overview of Activity
DEVELOPMENT	Generic Online	The design solution identifies the key components, and the relationships between the technical, interface and educational requirements reflecting the primary purpose of communicating effectively with the end user.
MANAGEMENT	Legal	It is desirable to incorporate a significant proportion of original material in online resources, and ensure that linked materials are attributed to the respective authors.
	Project	A global overview of the project is derived once revisions of cost estimates, schedules, team members and other matters are conducted in accordance with the concept brief and the detailed design document.
	Risk	Identified risks are quantified and qualified and corrective strategies are validated.
SUPPORT	Change Control	The design solution is traceable to the requirements baseline, and agreed changes are reflected in both.
	Quality Assurance	Confidence is established in that the design solution accurately reflects the user's requirements, and that the agreed standards are followed.
	Validation and Verification	The correctness and appropriateness of the design solution are demonstrated through a process of design review.

Table 2 shows another cross section from the overview matrix, which provides a synopsis of the methodology. Change Control activities are outlined across each of the first four phases.

Table 2

Change Control

Category	Initiation & Activity	Specifications	Design	Production
SUPPORT *Change Control*	The project deliverables and their associated supporting documents, are identified, presentation standards are defined and change procedures established.	A baseline for the user's requirements for the system is established and defined, and changes to the baseline are agreed through a formal process.	The design solution is traceable to the requirements baseline, and agreed changes are reflected in both.	The integrity and consistency of the developed system are ensured through the enforcement of agreed standards and control of change.

The development blueprint is not a prescriptive step-by-step methodology, but a resource of processes and strategies of which all, or part, can be accessed depending upon the needs and the nature of the interactive multimedia initiative.

Activities within the methodology acknowledge the difference in approach between video and audio production, graphic design, instructional design and software development for multimedia products.

3. INFLUENCES ON THE METHODOLOGY

In defining the activities for the product life cycle, the authors reviewed existing resources related to models and practices in interactive multimedia product and systems specifications, design, development, evaluation and implementation. These resources were obtained from a number of locations, including online sites and current journals and books. What became evident on reviewing these resources, is that few methodologies incorporate quality assurance, validation and verification and change control or change management (see for example, Koper, 1995) as a matter of course. One exception is the methodology outlined by England and Finney (1996) which is both comprehensive and practical. However, it does not provide the exemplars and templates required by developers who lack experience in including support strategies and processes into the life cycle of the project. The methodology outlined in this paper, therefore, represents an attempt to provide not only a structured framework for effective management of multimedia development but also the appropriate support for all stakeholders in the project, including those who may have a limited understanding of the process (for example, the client).

The selection of an appropriate life cycle model was critical as the division of a project into several project phases provides "better management control and appropriate links to the ongoing operations of the performing organisation" (PMBOK, 1996). While software elements are only one component of any multimedia system, there are significant similarities – at the high level – between multimedia and software that indicate that life cycles similar to those employed for software will be a sound basis for multimedia development. These include the 'intellectual' nature of the product; the irrelevance of concepts such as 'wear and tear'; and the difficulty of arriving at a firmly agreed and detailed set of requirements for the product. From these considerations, a life cycle model was adopted that is based upon both current thinking in the multimedia arena, and state of the art concepts for software life cycle processes.

The overall philosophy embraced in the methodology was strongly influenced by the international standard, ISO/IEC 12207 – *Software Life Cycle Processes*. In the framework defined in this standard, a basic product life cycle – defined in terms of a series of "primary life cycle processes" – is supported and controlled by a variety of other project or organisation-based processes, covering such functions as project management, configuration management, quality control and assurance and problem resolution. These functions are explicitly visible in

the 'second dimension' of the methodology, implemented through a series of activities derived from a variety of sources of 'best practice'. A number of international and other standards in the software engineering field were major sources of influence on the support activities of the methodology.

The detailed listing of activities and practices seen as desirable for multimedia development was drawn in part, from ISO/IEC 15504 — *Software Process Assessment*. These primary influences were supplemented by sources such as the IEEE Software Engineering Standards and the United States of America Military Standard, Mil Std 498.

The choice of ISO/IEC 15504 as a source of material was also influenced by our desire to establish, through the methodology, defined processes, the capability of which could be assessed in a manner conformant with this standard (El Emam, Drouin & Melo (Eds), 1997). The methodology thereby provides an in-built mechanism for its own improvement, and more importantly, for the improvement of practice in adopting organisations.

4. VALIDATION AND VERIFICATION OF THE METHODOLOGY

In order to confirm the value of this approach to multimedia development, a detailed program of verification and validation is being undertaken. This falls into three stages.

In the first stage, the methodology has been subjected to peer review by experienced developers from within the industry, and also by academic experts on multimedia development. This peer review process has highlighted a number of changes that need to be made to the structure of the methodology. For example, each phase needs to clearly identify the task or activity which commences in that phase but may be continued or repeated with variations in subsequent phases. A tailoring guide will be included in the next iteration so that developers are able to incorporate processes and procedures compatible with the size and complexity of the required product or system.

The second stage involved piloting of the methodology as a basis for conduct of projects by student groups within the Bachelor of Multimedia degree programme at Griffith University. These projects are semester or year long and are delivered on CD-ROM, World Wide Web or a hybrid of the two. The year long projects are for external clients. Students work in teams of five or six to develop substantial projects which have included national training programs for new company staff, interactive kiosks or web sites for national organisations. Staff have had extensive experience in employing structured management approaches in student software projects (Rout, 1997), and this provided a firm basis for evaluating the success of the methodology in this context.

The first two stages of the evaluation process have highlighted areas of omission within the methodology or aspects which need strengthening. A number of the templates, for example, require changes to ensure that they are appropriate for multimedia development and not software development, by taking account not only of software code but also changes which may need to be made to graphics, video, audio or text. In client/user centred projects, the client can initiate changes usually in consultation with the project manager or the team so that all stakeholders are aware of the impact such a change will have on the outcome of the project. For multimedia projects, this means that all aspects of development need to be reviewed so the impact of change is likely to be much greater, and, in many instances almost impossible to detail in any great depth. The project initiation phase could include the review of similar products in order to set some benchmark targets for development in user and successful usage terms. This would help to reduce risk in later stages of the project.

The final stage will see implementation of the methodology on large-scale industrial multimedia projects, through industrial partners in the cooperative multimedia centre programme. Evaluations of the cost effectiveness of the methodology-based projects will be possible, and comparisons to developments of similar scope undertaken without the benefits of the methodology will be drawn.

This comprehensive evaluation programme ensures that the final implementation of the methodology represents an approach to development that will have proven benefits and established effectiveness in terms of both productivity and product quality.

5. FURTHER ISSUES

While the methodology addresses the development of online multimedia, it will require adaptation in the near future to more specifically cater for advances in online technology, for example, expansions in bandwidth or video compression techniques. What is critical at this stage is to involve practitioners in trialing the methodology so that their feedback reflects the needs of the multimedia development industry. For the industry to move from cottage status to a mature and capable provider of reliable products, it must adopt a more disciplined and controlled approach to product development so those robust products, which more closely reflect the needs and requirements of the client/user, are delivered. This does not imply constraints upon the creativity of the developers; rather it ensures that this creativity is harnessed to best effect.

The methodology constitutes a set of clearly defined processes integrated to support the predictable outcomes in the development of multimedia products and systems. This provides the basis for future development of a process-centred environment (Fugetta & Ghezzi, 1993), which can be adapted to suit the expertise level of the team and allow changes during the execution of a process such as the composition of the development team. A process-centred environment would help to coordinate the efforts of different contributors to the project and would support effective project control while sustaining the creative effort of the contributors.

6. CONCLUSION

As multimedia products and systems move more rapidly into the interactive information mainstream, awareness of standards, quality practices and legal issues is now a prime consideration. The ever-increasing number of new, emerging and diverse technologies poses significant challenges for the multimedia industry, Firstly, are development strategies applicable to the new technologies? Is the management of industry assets appropriate for large-scale online systems? Finally, to what extent do configuration management procedures require updating or necessitate new and innovative practices? These challenges can be met, in part, by combining the rapid prototyping development cycles of emerging interactive multimedia initiatives and the creative talents of media designers and artists with the best attributes of traditional software development approaches (including extensive quality assurance considerations).

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