Preliminary Results from a Survey of Multimedia Development Practices in Australia

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Abstract. In this paper we present our preliminary findings from a survey conducted during 2005 of Australian Multimedia Application Developers. Our objective was to understand what development processes and techniques are used and how these relate to practices cited in the literature. We were also interested in what impact the presence of multimedia content has on the process, as well as the differing skill sets it requires in relation to "traditional" software development. In our findings we report on the process models used and detail the process tasks most often performed, as a first step to determining what is considered best practice in the industry. We found that developers appear to have a much keener sense of their processes than previous studies have suggested.

1 Introduction

The Australian Multimedia Industry is a major developer of "software-like" products, ranging from multimedia CDs and DVDs, to online applications. A fundamental characteristic which differentiates product creation from conventional software development is the inclusion of various combinations of visual media and audio, often providing an interactive experience for users. While these may include significant amounts of "traditional" software the presence of media content requires additional tasks and differing skills to those in conventional software development. Existing studies of multimedia development generally address only certain phases or aspects of the processes. In addition, with the advancements of technology, many are becoming dated in some areas. A survey of industrial multimedia practice was undertaken as a basis for our research into multimedia development processes and their relationship to "traditional" software areas. Our objective was to gain an understanding of the current state of practice and its relationship to those cited in the literature.

Earlier surveys into multimedia application development have described the approach to design, and as a result the development processes undertaken, as inconsistent [1]. They have also commented on the apparent use of design techniques based in software development being used to capture multimedia design, particularly by those who are crossing over into the industry from "non-multimedia" software development [2]. Further they show that techniques from film and video production,

such as the use of storyboards, scripts and mock-ups are also being used, even when these too can be ineffective in capturing critical aspects, such as interaction[2].

These have been attributed to factors such as the diversity of developer backgrounds, the newness of the discipline, and the limited industrial take-up of specifically designed techniques from academia [1, 2]. However, the impact of these factors on the actual development processes and outcomes has yet to be established.

The survey questionnaire was targeted at tying together the factors impacting multimedia processes, to allow us to establish which parameters influenced developers' decisions to follow certain processes, employ particular techniques, and use particular tools. By doing this we hope to identify "best practice", and guide our research in the direction of industry needs. Due to space limitations, we focus here on respondents' profiles, team skills, process models/methods and process tasks.

The following section describes our survey method and the profile of our resulting sample. In Section 3 we discuss the preliminary results of our data analysis, and in Section 4 we discuss our findings and their implications for further work.

2 Survey Instrument and Method

Based on our review of previous studies and processes described in the literature, we constructed a list of survey goals and questions. We applied a GQM [3] style approach to assess the fitness of our questions to the realisation of our goals. Once we had mapped the questions to our goals, we looked at the kind of statements we wished to make about the data collected, to check our questions would provide us with the appropriate data, i.e. technique *x* is being used to model *y*. The resulting survey instrument was organised into the following sections: Company Profile, Team Profile, Development Process, Treatment of Content, Design Techniques, Authoring Tools, and Project Management.

The pilot survey had a further section which asked for feedback on the survey instrument, to try and identify likely problems before the survey was distributed to a larger sample.

To facilitate responses and try and keep consistent terminology amongst respondents, closed questions were used where possible. However, where applicable the opportunity to give an alternate response by use of an "other" option was also provided. In addition, open-ended questions were used to help elicit reasons for particular responses.

2.1 Pilot Survey

During 2004 we conducted a pilot study to assess the suitability of our survey instrument. The study involved three companies obtained using convenience sampling [4]. To determine the applicability of our response options and terminology each company represented one of our target domains: educational systems, business communication systems, and games.

2.2 Survey Sample

Prospective participants for the survey were initially selected from company listings publicly available via the VicIT Web Directory[1], and the Australian Interactive Media Industry Association (AIMIA) member listing[2].

The VicIT directory is a self-serve web site established by Multimedia Victoria, a government body responsible for the maintenance and expansion of the information and communications technology industry in Victoria [5].

AIMIA is a national industry body which represents the Interactive Media and Digital Content sectors in Australia. It is focused on the commercial development of its members, and the industry as a whole, through the provision of promotional support, export services (with Austrade), the hosting of networking events, making representations to government and providing industry recognition via annual awards [6].

To determine the target population for the survey, suitable inclusion and exclusion criteria were established, as not all companies listed in these directories were involved in the development of multimedia applications. A detailed discussion is beyond the scope of this paper. Companies identified to be developing multimedia applications based on the information they provided were included, as were companies/individuals where it was unclear, to avoid biasing the sample.

Due to the well known difficulty of obtaining appropriate response rates (to be discussed in section 3) the survey was sent to all members of the target population. The main reason for this was while the AIMIA sample was derived from a membership listing where membership is renewed annually, the vicIT sample was derived from a database that has been in operation since 2001. It was therefore not known how many of the businesses listed had up-to-date profiles or were still in operation.

Four other individuals (two from the same team) working in the eLearning sector were included, and two others requested the survey after seeing the publicity on the AIMIA web site.

2.3 Survey Distribution

Table 1 shows details of the distribution of the survey to the two sample groups. In an effort to improve the response rate an advance notice was sent via email.

Members of the vicIT sample were sent the survey in both an electronic format (by email) and a paper-copy by regular mail. Members of the AIMIA sample were sent the survey by email only. This was done as there was concern about peoples preferred method of response.

Of the actual surveys sent 37 were returned “unknown at this address” from the vicIT mail-out, and a number of the emailed surveys “bounced”. Further to this, responses were also received indicating when the company was no longer in business, did not develop multimedia, or was no longer developing multimedia. Some people

[1] www.vicit.com.au

[2] www.aimia.com.au/i-cms?page=782

advised they were too busy to complete the survey, others simply declined participation.

Three reminders notices were sent, the first to all those who had not yet responded, the next two to those who had indicated a willingness to respond.

Table 1. Target Sample

	Sample Group	
	AIMIA	vicIT
Original target sample size	223	430
Badly formed or no email address	2	4
Number of advance notices sent	221	426
Number of advance notice undeliverables	8	80
Declined participation from advance notice	0	4
Actual surveys sent	213	342

3. Results and Analysis

We received responses from 40 companies. Of these, 5 have been excluded as they either did not fit the multimedia application developer profile, or did not provide enough information. The remaining 35 companies have their main operations based in 4 states: Queensland (5.7%), New South Wales (22.9%), Tasmania (2.9%) and Victoria (65.7%). One company's main operations are split between New South Wales and Queensland. 94.3% of these companies are 100% Australian owned, while one is 50% Australian owned, and the other had no Australian ownership.

Our disappointingly low response rate is consistent with the experiences of others [2, 7], however our number of respondents compares favourably to those used in other studies of the multimedia industry[1, 2, 8-10]. In addition, the experience base of the respondents is also encouraging with 90.6% of companies (n = 32) more than 5 years old.

3.1 Respondents' Development Profile

To obtain a picture of the impact application domain has on processes and techniques used by developers, we asked respondents to indicate the percentage of their total production in each domain. Five broad domains were given, the first four adapted from [11]: Multimedia Business Systems, Multimedia Education Systems, Multimedia Entertainment Systems, Multimedia Communication Systems and Multimedia Application Development Tools. An option of specifying additional categories through the use of *other* was also provided. Within the first four domains sub-domains were listed. These are shown in Table 2.

The majority of respondents were involved to varying degrees in developing applications within the multimedia business systems or multimedia education systems categories, with multimedia communication systems well represented. No respondents were primarily games producers. Given the detailed response received

from the games company included in our pilot this was unfortunate. Only three companies were not involved solely in multimedia development.

Table 2. Percentage of respondents' development within each domain/sub domain, $n = 35$

Application Development Domain			Percentage Level of Production in each Domain					
			0.5 - 20%		21 - 40%	41 - 60%	61 - 80%	81 - 100%
			0.5 - 10%	11 - 20%				
Multimedia Business Systems (MBS)	Sub-domain	Electronic Commerce	25.7%	2.9%	0.0%	0.0%	0.0%	2.9%
		Online Shopping	20.0%	5.7%	0.0%	2.9%	0.0%	0.0%
		Marketing/Advertising	5.7%	8.6%	8.6%	5.7%	5.7%	2.9%
		Intranet	17.1%	5.7%	0.0%	0.0%	0.0%	0.0%
		MBS Other	2.9%	0.0%	5.7%	0.0%	0.0%	0.0%
Multimedia Education Systems (MEduS)	Sub-domain	Corporate Training	8.6%	8.6%	0.0%	5.7%	5.7%	0.0%
		Automated Assessment	14.3%	0.0%	0.0%	0.0%	0.0%	0.0%
		Distance Learning	11.4%	0.0%	0.0%	0.0%	0.0%	0.0%
		Instruction Manuals	8.6%	0.0%	0.0%	0.0%	0.0%	0.0%
		Simulation Systems	8.6%	0.0%	2.9%	0.0%	0.0%	0.0%
		Training Manuals	11.4%	2.9%	2.9%	0.0%	0.0%	0.0%
		General Education Packages	14.3%	5.7%	2.9%	0.0%	2.9%	5.7%
		MEduS Other	2.9%	5.7%	5.7%	0.0%	2.9%	5.7%
Multimedia Entertainment Systems (MEntS)	Sub-domain	Infotainment	0.0%	5.7%	2.9%	0.0%	2.9%	0.0%
		Games	8.6%	5.7%	0.0%	0.0%	0.0%	0.0%
		MEntS Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Multimedia Communication Systems (MCS)	Sub-domain	Chat Systems	8.6%	0.0%	0.0%	0.0%	0.0%	0.0%
		Bulletin Boards	17.1%	0.0%	0.0%	0.0%	0.0%	0.0%
		Presentations	14.3%	2.9%	0.0%	0.0%	0.0%	0.0%
		Teleservices	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		Videoconferencing	2.9%	0.0%	0.0%	0.0%	2.9%	0.0%
		MCS Other	5.7%	2.9%	0.0%	0.0%	2.9%	2.9%
Multimedia Application Development Tools			2.9%	2.9%	0.0%	0.0%	0.0%	5.7%
Other			0.0%	0.0%	2.9%	5.7%	0.0%	2.9%

Within the multimedia business domain those who used the *other* option cited general "business applications" and "websites". One respondent specified "ecommerce" websites with "marketing/advertising" – a hybrid of options offered.

Multimedia education developers reported producing custom packages for specific sections of the market, interactive learning objects, mobile learning and online learning (which may be used for distance learning). In addition, utilities such as "document database repositories" and "learning management systems" were also developed. "New media art" was specified in *other* for multimedia communication systems, as was "instant messaging", "broadcast television", "public websites", "facilitating/managing weblogs", and "e-Newsletters and e-Calenders".

In addition multimedia application development tools being produced included: "professional development tools for accessibility and usability", and tools to assist

web site development, content management, and the authoring of online learning. Further areas included interactive documentaries, knowledge management systems, and web sites.

Very few developers specialised in one domain. This is not surprising as the domains are not mutually exclusive, especially with regard to Communication Systems, where applications such as Chat Systems and Bulletin Boards may also feature in education applications. Another reason may be the need to meet changing markets.

Mediums and Platforms. The most common delivery medium for application distribution was the internet (80.0%), followed by CD ROM (68.6%). The most common delivery platforms were PC (97.1%) and Macintosh (60.0%). Interestingly 22.9% of companies were building applications for hand-held devices.

For 68.6% of respondents, the development and delivery platforms were the same. However, the use of Macintoshes in development (due to their graphics capability) with final applications running on or accessed by PCs was also reported.

Project Output. Table 3 shows the number of projects that were completed by companies from 2002-2004 (n = 30)[3]. This historical data indicates a consistent growth in the volume of company output over the 3 years, as shown by decreases in the *Less than 5* category coupled with compensating increases across the remaining categories.

Table 3. Number of Projects completed by Companies in each of the past three years, n = 30

	Year		
no. of projects	2004	2003	2002
Less than 5	26.7%	33.3%	43.3%
6 – 10	26.7%	30.0%	20.0%
11 – 15	13.3%	10.0%	13.3%
16 – 20	6.7%	6.7%	3.3%
21 – 25	6.7%	3.3%	3.3%
More than 25	20.0%	16.7%	16.7%

86.7% of companies reported 90% or more of their projects were adopted in 2004, with 90% reporting in the same year that less than 10% were cancelled before completion (note that we neglected to include a 0% option). This paints the picture of a very successful sample. As one respondent put it “I don’t build shelf-ware”. However we could not determine whether this was an industry-wide characteristic given our sample size. Companies may have been reluctant to report their failures, as respondents who indicated projects had been cancelled were usually part of a larger company where projects were initiated internally.

[3] Two companies did not answer this question. One responded for only one year of business. The other two had not been in business for the full three years so were omitted to allow any trends to be observed.

3.2 Team Profile

All respondents reported average team sizes of ten or less members, with 68.6% having five or less. This is consistent with the findings of Britton [8].

Skills and Roles. We asked respondents about the skill background of their team members, the roles they filled and the roles filled by temporary staff. The number of skills of each staff member varied in the range of 1 – 20. Smaller project teams obviously requiring members to utilise more of their skills. Some respondents included temporary staff in describing the skills of their development team while others did not. Therefore in our preliminary analysis we looked at the number of companies who had at least one person with a particular skill. This is shown in Figure 1. For a company to include the skills of a temporary staff member in their response to this question we reasoned that this is a skill they require in most of their projects, and so hire someone to fill even though it may not necessarily always be the same person.

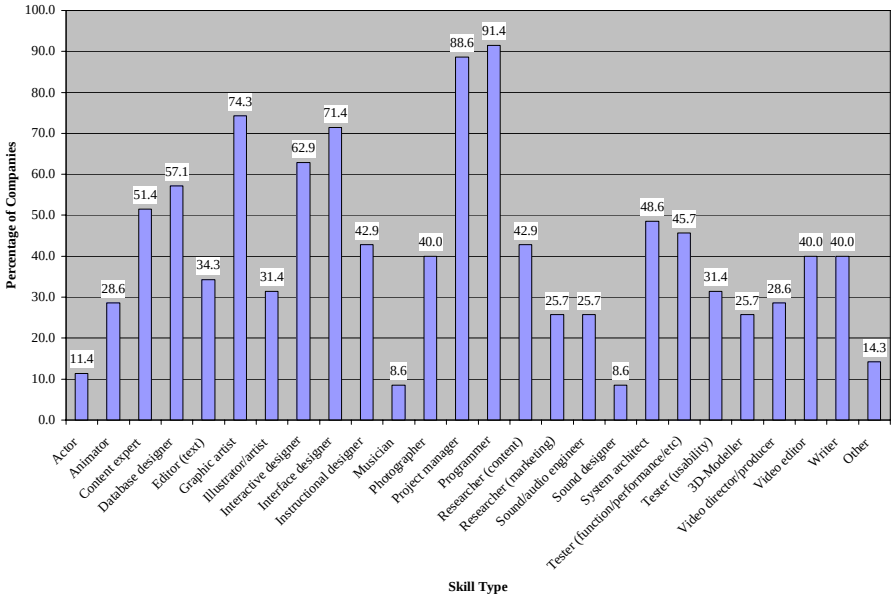

Fig. 1. Percentage of companies employing at least one person with a particular skill, $n = 35$

As can be seen from Figure 1 the five most common skills are those of programmer, project management, graphic artist, interface designer and interactive designer. This ranking mapped to those skills considered by respondents as essential to multimedia development teams with 68.6% of respondents considering programming skills essential followed by project management and graphic artist (62.9%), interface design (51.4%) and interactive design (37.1%). This shows an increase in recognition of interface and interactive design skills when compared to [8]. Instructional design was also listed by 37.1% reflecting the slightly higher portion

of respondents specialising in educational titles. Team composition may of course change depending on the requirements of each project.

Temporary-staff mainly filled the roles of Content Expert (25.7%), Usability Tester (25.7%), Actor (22.9%), Photographer (22.9%), Sound/Audio Engineer (22.9%) and Functional and Performance Tester (22.9%). The bringing in of testers from outside aligns with good practice recognised in "traditional" software development [12]. Content experts may be expected to change from project to project as the content changes. Actors, Photographers and Sound/Audio Engineers would also be expected to be used on an as-needed basis, especially within this sample as audio and video were reportedly less used (see section 3.3).

3.3 Development Process

Respondents were given a list of process models/methods and asked to select those that best described their organization's development approach on a typical project. Table 4 shows the percentage of respondents using the models listed either alone or in combination. There were 33 (94.3%) valid responses to this question and two invalid. One (2.9%) of these was not familiar with the concepts presented. This is to be expected given the differing backgrounds of multimedia developers. This outcome indicates a reasonable level of familiarity with these concepts. By way of contrast a survey of "traditional" software developers [13] found 9.5% were not familiar with the concept of software development methodologies. We may, however, have achieved a higher percentage since a list of options was provided.

Most companies include some kind of prototyping in their development process, with many classifying their process as in-house proprietary. This is consistent with the findings of Barry and Lang [2]. As commented by one respondent there is substantial cross-over in this area. While nearly 50% of respondents used only one model, the other 50% used from 2 (12.1%) up to 7 (6.1%). Combinations for two models included: prototyping and iterative, iterative and component-based, and prototyping and in-house. The first is fairly intuitive as prototyping by its nature may lead to iterative development. The combination of prototyping and in-house gives some insight into the nature of the proprietary method. Table 5 shows all the combinations cited.

The reports of combinations involving some form of Waterfall model and Agile process appear contradictory, particularly with regard to the level of documentation produced. This is less surprising considering Royce's original model included both prototyping and iteration [14]. As this is not the common interpretation it could also be due to the users' associating it with a clear delineation of phases, and therefore using it to assist project management [2]. Another view is that the responses may not all be for a typical project but instead represent the range of processes used for different kinds of projects. This may be resolved by examining the tasks performed.

Table 4. Process models/methods used in multimedia development, *n* = 33

Process Model/Method	Percentage of affirmative responses
Waterfall Model	12.1%
Waterfall Model (with prototyping)	9.1%
Prototyping Model	45.5%
Incremental Model	15.2%
Iterative Model	39.4%
Spiral Model	0.0%
RAD Model	6.1%
Unified Process Model	3.0%
Component Based Model	27.3%
Concurrent Development Model	18.2%
Extreme Programming (XP)	3.0%
Agile Process (other than XP)	12.1%
In-house Proprietary	39.4%
Other	9.1%

Table 5. Process model/method combinations reported where two or more model/methods used *n* = 17

Company	Waterfall	Waterfall (with prototyping)	Prototyping	Incremental	Iterative	RAD	Unufued Process Model	Componet Based	Concurrent	Extreme Programming (XP)	Agile Process (other than XP)	In-house Proprietary	Other
c1			■									■	
c2			■		■								
c3		■			■						■		■
c4	■	■	■		■		■				■		
c5			■		■								
c6				■					■			■	
c7	■	■	■		■				■				
c8	■			■				■	■				
c9	■			■	■								
c10			■		■	■							
c11			■					■				■	
c12			■		■			■	■	■	■	■	
c13				■				■				■	
c14			■	■	■	■		■	■			■	
c15			■		■			■					
c16					■			■					
c17			■					■	■			■	

Amongst single method/model users (*n* = 16) an In-house Proprietary method was most common (37.5%) followed by Prototyping (25.0%), Iterative (12.5%), Other (12.5%), Agile – Feature Driven Development (6.25%) and Component Based (6.25%). Examination of the tasks performed by those using an in-house method (*n* = 6) shows that on most or all of their projects 83% build a structural prototype and 67% create a prototype to achieve an early visualisation. Whether these prototypes are just throwaway (as may be expected in the case of the early visualisation) or evolve into the final system is unclear.

The client's process requirements are occasionally adopted (one respondent in the *other* category). Another noted that due to projects mainly being simple internet sites extensive project management was not required. Overall 93.9% of respondents tailored the method(s)/model(s) used to meet individual project needs, however only 53.1% of these stated that they kept a record of their tailored process.

Process Tasks. Responses were sought on actual tasks performed to provide more detail on processes used and inform our work on a multimedia process framework. In addition, developers varying backgrounds may have meant they were not familiar with the software engineering process models listed so this provided a way of still capturing process information. The list of tasks was derived from the multimedia and software development literature. We asked respondents to indicate whether they performed these tasks in the development of every, most, half, few, or none of their projects. The tasks were assigned to the following phases of development adapted from [15]:

1. *Concept and Planning* – determines the feasibility of the projects, outlining required product functionality and development resources
2. *Design and Prototype* – outlines the structural, behavioural and media design
3. *Production* – results in the production of all required media and their integration
4. *Application Testing* – tests the application works correctly
5. *Distribution* – sees the product delivered to the client or end-users
6. *Maintenance* – deals with correcting post-delivery errors, and assessing/ maintaining the product's performance/viability to provide feedback to new versions until the product is retired

Table 6 shows the tasks performed by 75% or more companies, in order of ranking, on at least half of their projects. As a comparison the far right column shows the percentage of companies who perform these tasks on every project.

Tasks related to scoping a project ranked highest as a group. This may be because these tasks are common across all projects regardless of domain or process model used, as establishing a project's purpose and delivery mechanisms are inherent in assessing its feasibility. It may also be due to the high task granularity with which the "Approach Exploration" activity was represented. The top two tasks performed on half or more of projects, *Determine software (functional) requirements* (97% of companies) and *Function Testing* (94%) compare to tasks considered best practice in Software Engineering. Interestingly, 86% created a requirement specification document and 80% had the client sign-off on this document. User interface screens were also as "sign-off" requirements. Over 90% of respondents reported that determining content and structuring content were tasks performed on half or more of their projects.

Graphics production appears highest of all media production as, aside from text, this is the most common media used by our sample. All companies (n = 31) use text in their applications to varying degrees. 93.5% of companies used graphics, with 41.9% using graphics in 21 – 30% of their applications. 83.9% of companies had animation in applications they produced, with 45.2% of companies using it in 6 – 10% of their products. Audio and video were included in applications developed by 74.2% and 77.4% of respondents respectively however the majority used these media in less than 10% of their total production. While in a creative sense the choice of

Table 6. Tasks performed on half or more projects by at least 75% of companies, $n = 35$. Also shown is the percentage of companies that peform these tasks on all projects.

Task	Phase	Percentage of companies performing task on half or more projects	Percentage of companies performing task on all projects
Determine software (functional) requirements	Concept and Planning	97	77
Function testing	Application Testing	94	66
Establish the project's intended audience	Concept and Planning	94	80
Determine delivery platform	Concept and Planning	94	77
Determine content	Concept and Planning	94	69
Function testing (Design and Prototype)	Design and Prototype	94	66
Establish the project's purpose in terms of its resulting benefits	Concept and Planning	91	71
Establish the project's themes and major points	Concept and Planning	91	71
Determine delivery medium	Concept and Planning	91	83
Determine level of interactivity	Concept and Planning	91	60
Structure content	Design and Prototype	91	60
Interface/Screen design	Design and Prototype	91	74
Determine hardware requirements	Concept and Planning	89	54
Determine content source	Concept and Planning	89	63
Interactivity design	Design and Prototype	89	63
Navigation design	Design and Prototype	89	69
Test the delivery medium	Design and Prototype	89	71
Determine development platform	Concept and Planning	86	66
Determine non-functional system requirements (security, accuracy, speed, reliability…)	Concept and Planning	86	51
Create proposal	Concept and Planning	86	54
Create requirement specification	Concept and Planning	86	43
Establish legal (content ownership) issues	Concept and Planning	83	57
Have client sign-off on proposal/requirement specification	Concept and Planning	83	60
Maintenance	Maintenance	83	29
Usability testing (interface and design)	Application Testing	80	57
Content testing	Application Testing	80	43
Graphics design	Design and Prototype	80	51
Establish content (asset) naming conventions	Design and Prototype	80	51
Have client sign-off on design document	Design and Prototype	80	51
Final Sign-off	Distribution	80	66
Support	Maintenance	80	40
Establish naming conventions (Production)	Production	80	51
Graphics production	Production	80	60
Performance testing	Application Testing	77	40
Create an early visualisation (prototype)	Concept and Planning	77	31
Integrate working content with structural design	Design and Prototype	77	46
Evaluate design with respect to objectives	Design and Prototype	77	51
Archive budget and planning information	Distribution	77	63

media used is based on its ability to convey or support the idea presented, distribution medium also plays a large part. Most reasons for the limited use of video related to bandwidth - as noted earlier the majority of distribution was online. Audio was

mainly used by those developing musical instrument instruction, or eLearning with full voice-over for the text.

We asked respondents if there were any tasks that they considered important to development, yet rarely undertook and the reasons for this. Responses included application testing due to limited resources, documentation and evaluation of the project due to being too busy seeking or undertaking the next project, archiving for reuse, and prototyping due to lack of time and budget. While the responses indicate prototyping is incorporated into most development processes, knowledge of the extent of its use and nature would be valuable. Fully rendering graphics etc. for an early visualisation would be a waste of time and money if the client changed their mind. This will be further investigated when we incorporate our findings on the use of design techniques (in this instance wire-frames), which is beyond the scope of this paper.

The necessity and yet difficulty of establishing a project's purpose and benefits was noted by one respondent, as clients are at times unable or unwilling to justify a business case.

In one case it was reported that the graphic design was signed-off as the design document. While the respondent noted it would be useful on occasion to write-up the design rationale, they find that the client rarely, if ever, reads the documentation – "particularly documentation that could be described as "optional"".

Respondents were also asked if they performed any tasks in phases other than the ones in which they were specified. Understandably, a few cited testing as occurring throughout the development phase rather than in a dedicated phase. One respondent reported a process similar to that described in [16] for computer assisted learning, where their instructional designers get the project first and specify the structure, content frame and assessment strategies which are then refined with graphic designers and programmers.

Comparing the highly ranked tasks performed on all projects for business and education showed little deviation from those in Table 6. Notable additions for education included content archiving and text production, while the only addition for business was the archiving of formal documents (requirements, design, test, code etc).

When asked what percentage of total development time was usually spent within each development phase the most common responses were: 11 – 20% of their time on *Concept and Planning* (55.9% of companies); 11 – 20% on *Design and Prototype* (38.2%); 41 – 50%on *Production* (32.4%); 6 – 10% on *Application Testing* (52.9%); 1 – 5% on *Maintenance* (41.1%) and 1 – 5% on *Distribution* (44.10%). It is not surprising that most time is spent in production given the fuzzy distinction between it and design due to the role content plays and the need for an early visualisation.

Impact of content on the development process. The importance of tasks relating to identifying and structuring content was shown in the previous discussion. As the presence of content makes it important to provide the client with an example of the "look and feel" of the application, especially when the client is new, we asked what was the earliest phase in which media design would begin. 40.6% (n = 32) indicated media design could start in the *Concept and Planning* phase, illustrating the overlap of tasks between the phases, while 34.4% indicated it may not start until the *Design and Prototype* phase. One respondent stated that while the media design didn't begin

until *Design and Prototype* the design concepts were still referred to in *Concept and Planning* as outlines or abstracts. Another stated that during planning they would draft ideas and sketches, and depending on the bid, prototype a sample. Other respondents stated a particular milestone as the trigger for media design, such as a complete specification that allows the basic site structure to be implemented; after the interface design concepts have been approved; and when the basic content (instructional and information architecture, and basic flowcharts) have been provided.

The majority of respondents indicated *Design and Prototype* as the earliest phase in which media production would begin (41.9%, $n = 31$), with *Production* (25.8%) and *Concept and Planning* (9.7%). Other responses included: "once everything (content particularly) has been locked down", "early in the project to give authors visual feedback on ideas developed, [to] better evaluate the methods", "after interface design concepts have been approved", and "after programming". The need to prototype before production to get clients "excited" about what can be done for them, as well as to assess technical risks (e.g. 3D animations running on minimum spec PCs) was reported. The comment was also made that while "routine media production will occur as required", "look and feel (i.e. interface design) will be the first step in the production phase, as all the rest must follow style and colour guides".

4. Discussion and Further Work

This paper presents the preliminary analysis of the profile, skill and process data collected. While the response was small, and perhaps unrepresentative of a national industry, the results do give useful insights into its nature and current practices. As noted earlier, small responses seem to be the norm in such studies [1, 2, 8-10].

Our responses suggest an industry comprised predominantly of small to medium size enterprises (SMEs), with relatively high success rates in terms of product adoption compared to traditional software development. While high quality data on adoption/cancellation of conventional software projects is scarce, the figures most often mentioned are substantially higher than those reported here, suggesting that there is a significant difference between these two domains.

A significant factor may be the relatively small size of MM projects. These averaged about 560 person hours (about 0.3 person years), with projects in the range 100 to 500 person hours predominating. Software projects are far larger, with projects from tens to hundreds of person years being common, and some even thousands.

Our analysis shows use of a variety of models that are predominantly iterative and incremental in nature. Prototyping (both of structure and visuals) plays a major role, as would be considered inherent in the visual and interactive nature of the work.

For 2004, 36.5% of companies reported delays due to changes in requirements on more than 50% of projects, with only 17.2% reporting delays on more than half of projects due to design changes. We conclude from this that MM projects are less sensitive to requirements changes than software projects are believed to be. This could be because the MM projects are small, emphasise prototyping, and may be examples of a class of system where a number of outcomes with appropriate properties may meet the user's needs. They may therefore be insensitive to small variations in requirements. (We note that Verner and Cerpa [13] report that

requirements volatility did not appear to be a factor in perceived software project success either).

Considering the majority of projects were delivered via the internet we compared the multimedia specific tasks in Table 6 to those defined in the Web OPEN framework[17], an extension of the OPEN framework [18]. Our findings are given in Table 7.

Table 7. MM specific tasks identified as common practice vs their Web OPEN counterparts.

Multimedia Tasks	Web OPEN Task/ [Fitness (0-3)]	Comments
Determine Content	- [0]	Requirements level. Web OPEN's *Create Content (on website)* is more design/production oriented.
Determine Level of Interactivity	- [0]	
Create an early visualisation (prototype)	Build White Site [2]	Task focus is more visual than structural, and may also be used in offline projects.
Structure Content	Create Content (on website) [2]	
Interface/Screen Design	Design User Interface [3]	OPEN Task
Interactivity Design	- [0]	
Navigation Design	Create Navigation Map for Website[3]	
Integrate working content with structural design	Prototype the Human Interface / Build White Site [2.5]	"Working" content refers to content that may not yet be complete and is being used to assist in a structural prototype
Graphics Design	Create Content (on website) [1]	The Web OPEN task is not granular enough to capture the design of specific media.
Graphic Production	as above	as above for "production"

Based on our findings, a framework to support multimedia development (online and offline) should also include: Determine Content, Determine Level of Interactivity, Interactivity Design, Graphic Design and Graphic Production (individual design and production tasks should exist for each media). This would provide an appropriate level of detail for project management and assist in propagating best practice through successful popular practice. This is particularly important in the case of media design and production as each media requires different roles and technical considerations.

The important Web OPEN task *Integrate Content with User Interface* was split between *Integrate Using Programming Language* and *Integrate Using Authoring Package*, hence these tasks did not appear in Table 6 which reports the top 25% most frequent tasks. Future work will ascertain which tasks can and are being performed at the expense of each other and explore possible common task combinations.

The relationship between skills, roles and specialisation is particularly interesting, since specialist activities from outside the "software" development domain, (what might be called "artistic" skills) are clearly required. This will provide a basis for exploring the design and project management techniques, and tools used, to determine how these influence the process. Coupled with the impact of multimedia domain this should identify common development practices leading to a tailorable multimedia process model.

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