Production of TV Multimedia Content: Modelling in Problem Space

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Abstract – **Model of problem space (MOPS) deals with creating an understanding of the problem that the potential user of the system is facing. While usually it is the business problem that is being described, even a technical problem can be described at the user level in MOPS. Aim of this paper is to investigate the functional as well as dynamical behaviour of the user in system of software-intensive television production using the methodology of modelling in problem space and set of tools provided by Unified Modelling Language (UML).**

***Keywords* – Modelling in problem space, Software-intensive television production, Multimedia content life cycle**

I. Introduction

The new technology induced some fundamental changes in the basic workflows and business models of the content creation in the television industry. The dividing line between offline and online editing is eroded and the linear workflows of tape-based production are fragmented. Producers can now perform multiple tasks in parallel including media creation, editing, and compositing. The sequence in which production and post-production tasks occur is less important than it used to be. Production processes are changed, each department is involved and processes are coming closer. These changes are placing unprecedented strain on traditional production workflows and many of them collapsed under the pressure.

The new model of production and post-production is based upon: digital formats, the centralized management of media and metadata, non-linear assembly of media elements, high-speed networks, format agnostic distribution and automated processes.

Program makers in search of a solution quickly discover that there is no existing model within the broadcast and production industry to which they can turn. Today's "off-the-shelf" digital production solutions rarely do everything needed by the typical media enterprise. Ultimately, what is needed is a complete re-thinking of the way technology can be applied to the art and business of program making.

The main goal of this paper is to analyze this area of interest in a systematic way and to discuss underlying organizational and technical issues.

II. The Method

A model, by its very nature, is an abstraction of the reality. The modeller, depending on his/her needs, keeps parts of the reality that are important to him/her in a particular situation and leaves out others which may be considered less important. Therefore, the model is not a complete representation of the reality.

Modelling raises abstraction to a level where only the core essentials matter. The resultant advantage is twofold: easier understanding of the reality that exists and efficient creation of a new reality [1].

Software projects use modelling throughout the entire life cycle. Subsequently, modelling is used not only to create the software solution but also to understand the problem. As a result, modelling occurs in the problem, solution and background (architectural) spaces.

Successful modelling needs to consider the areas in which modelling needs to take place. These modelling spaces have been formally considered and discussed by [1]. The three distinct yet related modelling spaces are defined: problem, solution and background.

In UML projects, model of problem space (MOPS) deals with creating an understanding of the problem, primarily the problem that the potential user of the system is facing. While usually it is the business problem that is being described, even a technical problem can be described at the user level in MOPS. In any case, the problem space deals with all the work that takes place in understanding the problem in the context of the software system before any solution or development is attempted.

Typical activities that take place in MOPS include documenting and understanding the requirements, analyzing requirements, investigating the problem in detail, and perhaps optional prototyping and understanding the flow of the process within the business. Thus the problem space would focus entirely on what is happening with the business or the user.

As a description of what is happening with the user or the business, the problem space will need the UML diagrams that help the modeller understand the problem without going into technological detail. The UML diagrams that help express what is expected of the system, rather than how the system will be implemented, are: use case diagrams, activity diagrams, class diagrams, sequence and state machine diagrams, interaction overview diagrams and package diagrams.

The UML diagrams in the problem space that are of interest here are:

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Use case diagrams—provide the overall view and scope of functionality. The use cases within these diagrams contain the behavioural (or functional) description of the system.

State machine diagrams—occasionally used to help us understand the dynamicity and behaviour of the problem better.

III. MODEL OF TV PRODUCTION WORKFLOW

Basic production stages are defined here as follows: development, planning, acquisition, processing, control, archiving and publication. These stages are shown on Fig. 1 as well as the production processes consisting of. At each step in the production workflow we can collect, and possibly re-use the metadata.

A programme's life traditionally begins with a need to fill a slot in a schedule. New skeleton schedule is produced from the analyses of the audience numbers and reactions. This schedule has to encompass details of the programme categories, possibilities for re-using (repeat) of the programmes as well as outline budgets of the programmes required to fit into slots.

During the development stage, programme ideas are investigated and a commission results when the producer persuades the TV company to finance the conversion of an idea into a real programme. The commission is very important for production as it gathers some key information like the 'working' title, producer's identity, possibly contributor's names, genre and possibly initial scripts. It could well have financial decisions which subsequently apply to the rest of the programme making process.

When a commission has been accepted research was doing and archives and other databases are examined for potential contributors, locations, facilities and material that can be re-used.

On the end of the planning stage a production order may be produced. The planning encompasses the staffing, resources and also the creation of the artistic description in the form of a storyboard and script.

During the acquisition stage, video shoots, audio clips and other programme items are created, pre-selected, ingested into production system and logged.

The obvious capture device is the camera, but equally, sound effects, graphics, stills, captions and music may all be added. At all points in capture there is an opportunity for metadata collection. Some of the metadata, like producer's comments and annotation, can only be captured by direct entry at the time of shooting. The metadata at this point in the chain should be viewed as 'portable', carried along with the essence as a link directly to a central.

The importance of the ingestion process is emphasized in [2] and noticed that *"crucial problem of Content Management Systems (CMS) is constituted by the ingestion of new content. As we cannot realistically expect that all the aspects of a production/archive environment are under the rules of a CMS, we need to set up gateways through which the content must pass when migrating from a non-managed environment to a CMS. The role of these gateways, that we call Ingestion Systems, is that of collecting and organizing as many relevant information (metadata) on the item as possible and that of generating all the content versions required by the CMS, including low resolution replicas of the essence, that can be exploited to economically implement browsing and offline editing functionalities, in such a way that time relations between the various versions are maintained."*

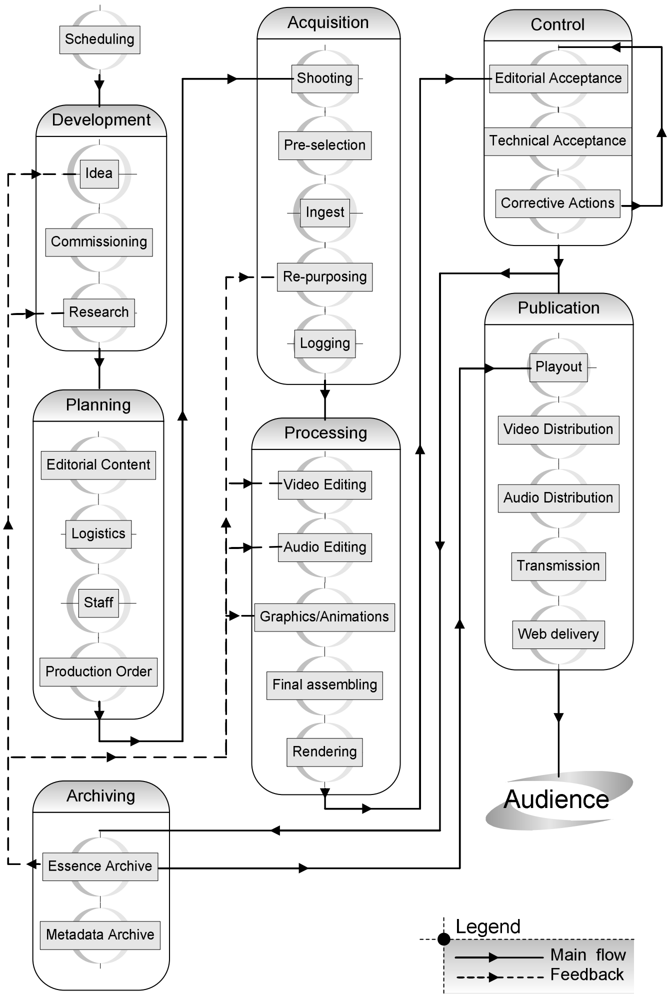


Fig. 1. Content Production Workflow

During the ingest we take all the content collected during a shoot, as well as new metadata, and transfer it into the production environment. We assume that the planning and commissioning metadata is already in the system. More metadata can be generated at ingest and this can either be directly entered, for example by an operator marking technically poor sections, or regions for special processing, or it can be extracted automatically.

Logging is where the producers review what they have, and mark down its possible use. It is expected that all the metadata capture that has taken place up until this stage will greatly reduce this overhead.

Processing stage represents a craftsman work where the shoots, clips, sounds and already assembled items are put into an order. Whole editing process, which is consisting of video and audio editing, has to be concentrated on capturing the composition metadata, so called Edit Decision List, in order to accurately represent the artistic composition of the programme from its constituents. Different graphics, subtitles as well as animations are produced and added to the essence.

Editorial and technical acceptances, which are the constituent parts of the recurrent control stage, approve the use of the produced programme material. If the corrections are needed, corrective action must be undertaken until editorial and/or technical approval is received.

Approved final product is catalogued and stored in archive. Archiving is one of the most important and most demanding organizational and technical processes in whole television production. Over time, media-rich organizations realized the value of their media assets. For instance, BBC Archive system has more than 750000 hours of television programmes in the archive, receives over 2000 enquires each weak and loans 45000 items per month [3]. Archival system is usually consisted of different servers such as workgroup media servers for short term storage and deep archive media servers for long term storage. Among the other things, archival systems can contain and manage metadata archives, low resolution archives as well as archives of still images, effects, sounds and other media related data. Archival in any form requires metadata to be captured and archiving is a prime candidate for metadata re-use, as the metadata is the basis for a comprehensive search. The capture of metadata not only enhances the search, but also removes some of the overhead and uncertainty that archivists can have in cataloguing the material.

Publication is the last but not least stage in the new production workflow. Playout process allows scheduled showing of the program produced at earlier stages. Programs, whether live or played from archive, are sent to the delivery point (transmitter chain, web etc.).

IV. Functional description: Use case diagram

The main objective of a use case diagram is to visualize how the user (represented by the actor) will interact with and use the system. This is done by showing the actor associating with one or more use cases and, additionally, by drawing many use case diagrams.

Use case diagrams can be used by the project manager to scope the requirements. A comprehensive list of use cases in a use case diagram helps the users, together with the business analyst and the project manager, to decide which use case(s) to include in the initial iteration of the development cycle.

One of the important strengths of a use case diagram is its ability to model the actor (role). The actor demonstrates to the user who is involved in specifying requirements and where he exists in the context of the software system. In addition, the actor helps users to express their requirements in greater detail.

Use cases and use case diagrams help to organize the requirements i.e. use cases document complete functional requirements.

Use case diagram of the TV production as well as the description of the use cases in TV production are shown on Figs. 2 and 3, respectively.

V. Dynamic-behavioural description: State machine diagram

In terms of modern communications, business models need to account for the vital resources of production and distribution technologies, content creation or acquisition, and recovery of costs for creating, assembling and presenting the content [4].

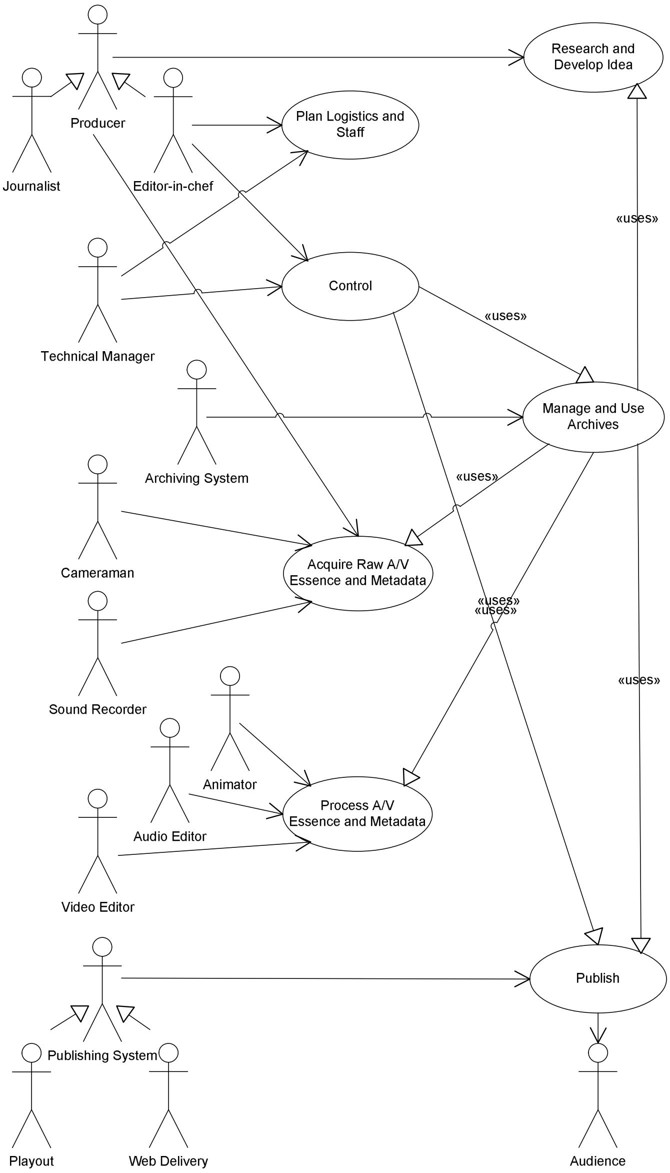
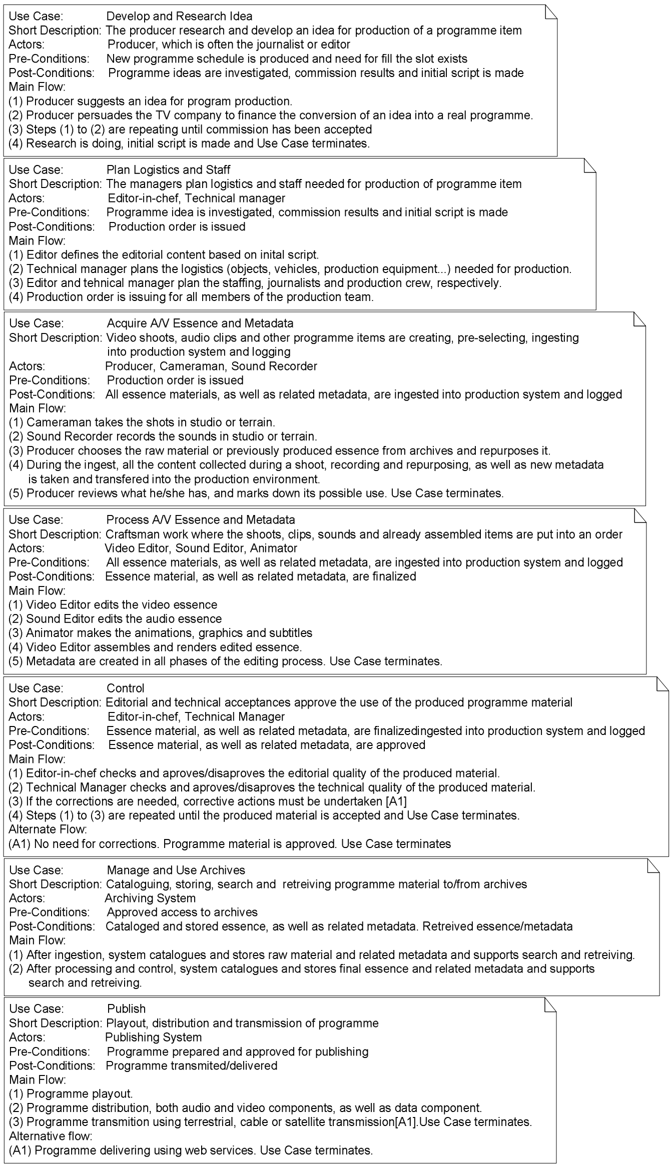


Fig. 2. Use Case Diagram of TV Program Production

The traditional emphasis of the media business has been the creation, bundling and distribution of content consisted of information and entertainment. In publishing and media, content is information and experiences created by individuals, institutions and technology to benefit audiences in venues that they value [5]. The creation of the content that is of interest to users is the basic issue in the broadcasting business model.

The nature of the state machine diagram is considered dynamic-behavioural. The state machine diagram of UML has the ability to represent time precisely and in a real-time fashion. “What happens at a certain point in time?” is a question that is answered by this diagram.



Use Case: Develop and Research Idea
Short Description: The producer research and develop an idea for production of a programme item
Actors: Producer, which is often the journalist or editor
Pre-Conditions: New programme schedule is produced and need for fill the slot exists
Post-Conditions: Programme ideas are investigated, commission results and initial script is made
Main Flow:
(1) Producer suggests an idea for program production.
(2) Producer persuades the TV company to finance the conversion of an idea into a real programme.
(3) Steps (1) to (2) are repeating until commission has been accepted
(4) Research is doing, initial script is made and Use Case terminates.

Use Case: Plan Logistics and Staff
Short Description: The managers plan logistics and staff needed for production of programme item
Actors: Editor-in-chef, Technical manager
Pre-Conditions: Programme idea is investigated, commission results and initial script is made
Post-Conditions: Production order is issued
Main Flow:
(1) Editor defines the editorial content based on inital script.
(2) Technical manager plans the logistics (objects, vehicles, production equipment...) needed for production.
(3) Editor and tehnical manager plan the staffing, journalists and production crew, respectively.
(4) Production order is issuing for all members of the production team.

Use Case: Acquire A/V Essence and Metadata
Short Description: Video shoots, audio clips and other programme items are creating, pre-selecting, ingesting into production system and logging
Actors: Producer, Cameraman, Sound Recorder
Pre-Conditions: Production order is issued
Post-Conditions: All essence materials, as well as related metadata, are ingested into production system and logged
Main Flow:
(1) Cameraman takes the shots in studio or terrain.
(2) Sound Recorder records the sounds in studio or terrain.
(3) Producer chooses the raw material or previously produced essence from archives and repurposes it.
(4) During the ingest, all the content collected during a shoot, recording and repurposing, as well as new metadata is taken and transfered into the production environment.
(5) Producer reviews what he/she has, and marks down its possible use. Use Case terminates.

Use Case: Process A/V Essence and Metadata
Short Description: Craftsman work where the shoots, clips, sounds and already assembled items are put into an order
Actors: Video Editor, Sound Editor, Animator
Pre-Conditions: All essence materials, as well as related metadata, are ingested into production system and logged
Post-Conditions: Essence material, as well as related metadata, are finalized
Main Flow:
(1) Video Editor edits the video essence
(2) Sound Editor edits the audio essence
(3) Animator makes the animations, graphics and subtitles
(4) Video Editor assembles and renders edited essence.
(5) Metadata are created in all phases of the editing process. Use Case terminates.

Use Case: Control
Short Description: Editorial and technical acceptances approve the use of the produced programme material
Actors: Editor-in-chef, Technical Manager
Pre-Conditions: Essence material, as well as related metadata, are finalizedingested into production system and logged
Post-Conditions: Essence material, as well as related metadata, are approved
Main Flow:
(1) Editor-in-chef checks and aproves/disaproves the editorial quality of the produced material.
(2) Technical Manager checks and aproves/disaproves the technical quality of the produced material.
(3) If the corrections are needed, corrective actions must be undertaken [A1]
(4) Steps (1) to (3) are repeated until the produced material is accepted and Use Case terminates.
Alternate Flow:
(A1) No need for corrections. Programme material is approved. Use Case terminates

Use Case: Manage and Use Archives
Short Description: Cataloguing, storing, search and retreiving programme material to/from archives
Actors: Archiving System
Pre-Conditions: Approved access to archives
Post-Conditions: Cataloged and stored essence, as well as related metadata. Retreived essence/metadata
Main Flow:
(1) After ingestion, system catalogues and stores raw material and related metadata and supports search and retreiving.
(2) After processing and control, system catalogues and stores final essence and related metadata and supports search and retreiving.

Use Case: Publish
Short Description: Playout, distribution and transmission of programme
Actors: Publishing System
Pre-Conditions: Programme prepared and approved for publishing
Post-Conditions: Programme transmited/delivered
Main Flow:
(1) Programme playout.
(2) Programme distribution, both audio and video components, as well as data component.
(3) Programme transmition using terrestrial, cable or satellite transmission[A1].Use Case terminates.
Alternative flow:
(A1) Programme delivering using web services. Use Case terminates.

Fig. 3. Description of the Use cases in TV Program Production

VI. CONCLUSION

As content is one of the most valuable assets for broadcasting companies, ingesting, archiving, accessing, managing, delivering and security of digital content assets become basic requirements in the everyday life of multimedia producers and providers; at the same time, it becomes ever important the way the company structures the processes involved and how it chooses the technologies that best adhere to the purpose related to content handling.

Model of problem space (MOPS) deals with creating an understanding of the problem, primarily the problem that the potential user of the system is facing.

Partial model of problem space related to the production of television content is suggested and analyzed in this paper.

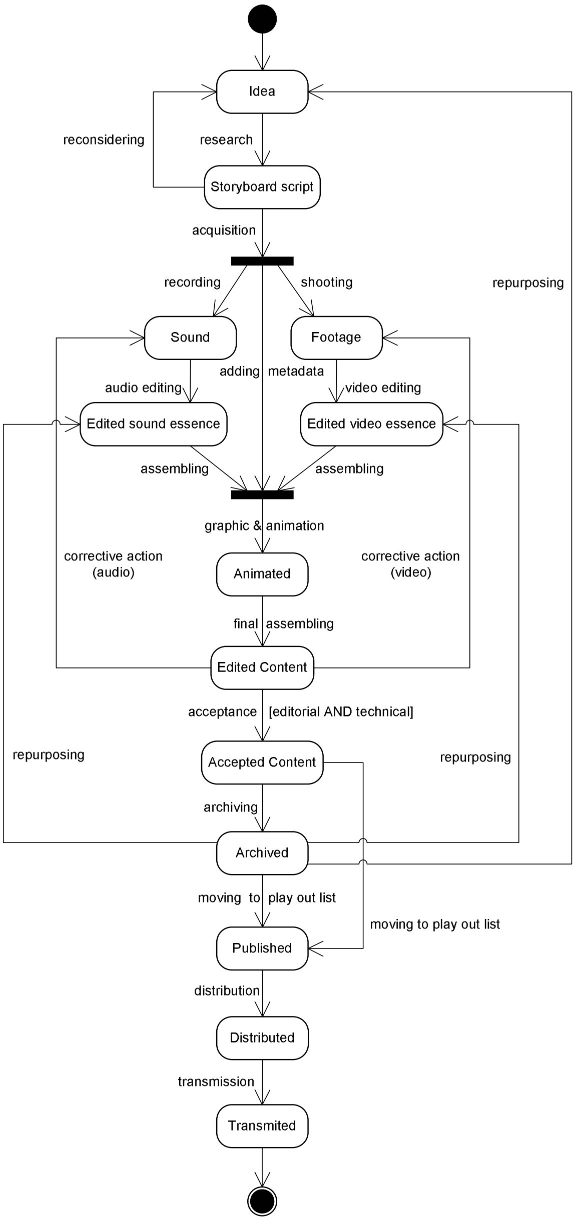


Fig. 4. Content State Machine Diagram

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