cultural science

Camera, Set, Action: Process Innovation for Film and TV Production[1]

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Abstract: Film and TV productions, a key area in production screen business, comprise of processes with high demand for creativity and flexibility. However, despite the era of fast developing technology, film production processes are carried out in an old fashioned way. This is reflected, for example, by the fact that document processing accompanied by daily shooting activities is still primarily paper-based and coordinating geographically distributed cast and crew is purely manual or at best through emails. There is an opportunity to bring process innovation into this industry, which can streamline and optimise film production processes and thus reduce production costs.

Business Process Management (BPM) is the mainstream contemporary technology-enabled business improvement method. It has proven to provide significant benefits to an organisation in terms of cost savings and responsiveness to changes. In this paper, we apply BPM technology to process innovation for film production. We also share experiences in how to deal with innovation barriers in the film industry. Over the course of the investigation, a prototype called YAWL4Film was developed on top of a state-of-the-art BPM system. YAWL4Film supports collection and entering of production related data and automatic generation of reports required during film production. The system was deployed in two student productions at the Australian Film Television and Radio School (AFTRS), as well as in a feature film production by Porchlight, an independent film production company.

Keywords: Business Process Management (BPM), YAWL, YAWL4Film, Screen Business, Film Production, Production Management, Production Office, Film and TV Scheduling.

1. Introduction

In recent years the field of *Business Process Management* (BPM) has risen to prominence in terms of its perceived importance by the IT industry. Successful BPM implementations may lead

[1] This paper is an adaptation and extension of (Ouyang, ter Hofstede, La Rosa, Rosemann, Shortland, and Court, 2008).

to significant efficiency gains, may help demonstrate compliance with standard practices and procedures, and may increase adaptiveness to changes in the environment in which a business operates. While there are several definitions of BPM sometimes emphasising different aspects, a core notion is the concept of *business process*. Examples of business processes include the processing of insurance claims, mortgage applications, and travel requests. BPM is concerned with the lifecycle of these processes, which not only involves their brief and execution, but also their post-execution analysis and subsequent improvement (van der Aalst, ter Hofstede, and Weske, 2003).

While BPM technology has reached a certain level of maturity in recent years and has great potential to deliver benefits in a wide range of application areas, it is typically applied by organisations with a high adoption level of information technology. As part of the ARC Centre of Excellence for Creative Industries and Innovation (CCI)[2], we move well beyond the typical use of BPM and investigate how the application of BPM technology can deliver benefits to the field of *screen business*.

The screen business comprises all creative and business related aspects and processes of film, television and new media content, from concept to production and finally distribution. A value chain model for the screen business consists of four major phases: *development*, *pre-production*, *production*, and *post-production* (Clevé, 2006). Whether it is a live action drama with actors, a documentary or animation, the production period is generally the most expensive in screen business. It is during production that the majority of cast and crew are contracted and the majority of the equipment and resources are utilised. A production can be as short as a day, or last several years. During each shooting day, a number of activities such as acting, visual effects, camera and sound recording can be performed in studio or on location. Whilst shooting is taking place, designated onset crew collect the information associated with each of these activities via corresponding production forms. For example, the Camera Assistant is responsible for filling in the camera sheet with details of each shot recorded while the Sound Recordist will complete a corresponding sound sheet of all dialogue or effects recorded on set. This information is later gathered and collated by the production offer to generate the daily progress report. The production office also monitors requirements for the subsequent shooting days and communicates this information prior to the start of the next shooting day. Traditionally the forms and reports are primarily paper-based and the production of these documents is a highly manual process. For the past few years, the film production crew has adopted software tools such as Microsoft Office (i.e. Words, Excel, etc) to facilitate their production needs. However, the usage of these tools remains heterogeneous and in a non-collaborative nature. Not surprisingly, such an approach is time-consuming and error-prone, and can easily increase the risk of delays in the schedule.

In this paper, we demonstrate how film production can benefit from the application of BPM technology and discuss how we overcame innovation barriers that exist in the industry. In particular, a prototypical environment was developed that assists with the production of various forms and reports during the shooting of a film and ensures that information is available to cast and/or crew at the right time. The prototype, namely *YAWL4Film*, aims at automating the daily document procedure as much as possible by reducing manual data entry, by avoiding data re-entry and by performing the required data calculation, aggregation and synchronisation. The benefits are twofold. Firstly, the process automation may ultimately reduce the production costs by minimising errors and delays. Secondly, by saving time otherwise spent in costly and tedious

[2] CCI's website is available at http://www.cci.edu.au/.

procedural tasks, the production team can focus more on creative activities, such as problem solving, thus increasing the quality of the final product. This paper discusses the functionalities offered by YAWL4Film and evaluates the system based on its trial application during two student productions at the Australian Film, Television and Radio School (AFTRS) in 2007 and its deployment in the production of a medium-budget feature film by Porchlight, an independent film production company, in 2008. It adds to our work reported in (Ouyang, ter Hofstede, La Rosa, Rosemann, Shortland, and Court, 2008) with significant system extensions for deployment in real film productions.

2. Research Methodology

As we were developing a new artifact in this research activity, we were faced with the fact that we had no access to empirical evidence. In order to deal with this challenge, there were extensive interactions with domain experts which formed the basis of the prototype deployed during the student film productions at the AFTRS. Hence, the research approach can be seen as in line with the Design Science methodology in information systems research. There are seven guidelines for this methodology as reported in (Hevner, March, Park, and Ram, 2004).

According to Guideline 1 (*Design as an Artifact*), the project starts with the design of a purposeful IT artifact – YAWL4Film. Moving to Guideline 2 (*Problem Relevance*), this artifact is innovative and purposeful to the domain of the screen business based on the fact that business process management in the screen business is widely regarded as important but not sufficiently addressed. Guideline 3 is concerned with *Design Evaluation*. Due to the interdisciplinary scope of our project, its evaluation can be approached from two different angles. Firstly, as researchers in the field of BPM (more broadly the domain of information systems), we apply the observational method where our artifact is evaluated through its deployment in two student productions at the AFTRS. Secondly, in the domain of screen business, YAWL4Film brings process innovation to the film industry. To this end, alternative evaluation strategies such as Design Experiments (Brown, 1992) or Design-based Research (Barab and Squire, 2004) can be applied to evaluate the significance of the innovation for the film industry. Next, with regard to Guideline 4 (*Research Contributions*), our research aims to contribute to the field of screen business. Due to its roots in established theory we regard our research outcome as addressing Guideline 5 (*Research Rigor*). The research process though is not finished and the resulting artifact requires continuous questioning, revision, and extension. This indicates that the design of our artifact is a *Search Process* as in Guideline 6. Finally, following Guideline 7 (*Communication of Research*), our research process aims to expose the research to both the IT community, among others through publications, and to the screen business community, which includes the AFTRS.

3. Dealing with Innovation Barriers

The barriers to innovation in the film industry are significant. They arise from the project orientation of the industry – the fact that production is organised as and when financing and other preconditions are satisfied. Cast and crew come together specifically to execute a production such as a feature film or TV series. They do not interact in a conventional corporate framework, with opportunities for training and experimentation. Innovation is therefore problematic for a production. Not only may it involve unplanned expenditure and risk in a context where risk and expenditures are tightly controlled, it is simply not part of the common, learned routines of the group. In designing process innovations such as those described in the

paper, we have sought to counter possible resistance through a combination of considerations described below:

- Firstly, identifying only selective functions to automate. We analyse each of the tasks in the process to see if a task is to collect user input (manual task) or can be operated by the system with no intervention from the user (automatic task). The analysis is also important in modelling the tasks that involve creative decision making.

- Secondly, the proposed system should blend seamlessly into the current workflow. This is to ensure that the users may start using the system with little or no prior training. To this end, we model system functions to closely replicate the actual paper-based process. This is particularly true for user interfaces requiring inputs and outputs. For example, call sheets were generated into MS Excel format so that prior familiarity on the format is preserved.

- Thirdly, segregation of system functions based on user roles instead of the tasks to be achieved. We consider how each of the crew members react to the resources and information that are given to them. For example, the production coordinator may generate the call sheet without the knowledge of the schedule or location notes.

In the next section, we discuss how we take the above considerations into the account during the development of the system YAWL4Film.

4. System: YAWL4Film

In the field of BPM, *workflow management systems* are a class of software that supports business processes by taking on their information logistics, i.e. they ensure that the right information reaches the right person at the right time (van der Aalst and van Hee, 2002). The word "workflow" here is used as a synonym for "business process". YAWL (Yet Another Workflow Language) (van der Aalst and ter Hofstede, 2005) is an open source workflow management system[3] with a well-established foundation partially derived from insights gained from the well-known Workflow Patterns Initiative[4]. The system offers comprehensive support for construction and enactment of process models with complex control flow, information handling and resource allocation, and is easily extensible.

YAWL4Film is developed over the general YAWL system to support the automation of film production processes. Hence, the order in which tasks need to be executed, the information they require and produce, and the roles that may perform them are formally captured. In addition, the user interfaces were designed to mimic paper-based forms currently in use. During the shooting of a film, the resulting system thus can present required information to the involved cast/crew members at the right time using a professional look-and-feel. In this paper we assume that the audience does not have an IT background and therefore we abstract from technical details. The interested readers may refer to (Ouyang, La Rosa, ter Hofstede, Dumas, and Shortland, 2008) for more information on design and implementation aspects.

[3] The YAWL system can be downloaded at http://sourceforge.net/projects/yawl.
[4] The website of Workflow Patterns Initiative is available at http://www.workflowpatterns.com/.

4.1 Modelling a Film Production Process

Figure 1 depicts the YAWL model capturing a film production process. Tasks are drawn as rectangles that may have an icon indicating whether they are *manual* or *automatic*. Intuitively, a manual task requires a user to enter information, while an automatic task is performed by the system (e.g. the generation of a specific report). A task without an icon represents a step in the process that exists purely for routing purposes. It is hoped that the subsequent informal explanation of the process together with the legend of Figure 1 provides a sufficient explanation to understand the process model shown.

The process begins with the collection of specific production data (e.g. cast, crew, location, and shooting schedule) generated during the pre-production phase. Next, the shooting process starts and is carried out on a daily basis. Each day, tasks are performed along two main parallel streams: one involving the production of a call sheet, the other involving the production of the Daily Progress report (DPR).

The stream involving the production of a call sheet starts with the task *Begin Call Sheet* and ends with the task *Finish Call Sheet*. A call sheet is a daily shooting schedule for a specific day. It is usually maintained by the production office and is sent out to all cast and crew the day prior. A draft call sheet can be created from the shooting schedule. It may go through any number of revisions before it is finalized, and most of the revisions result from the changes to the shooting schedule.

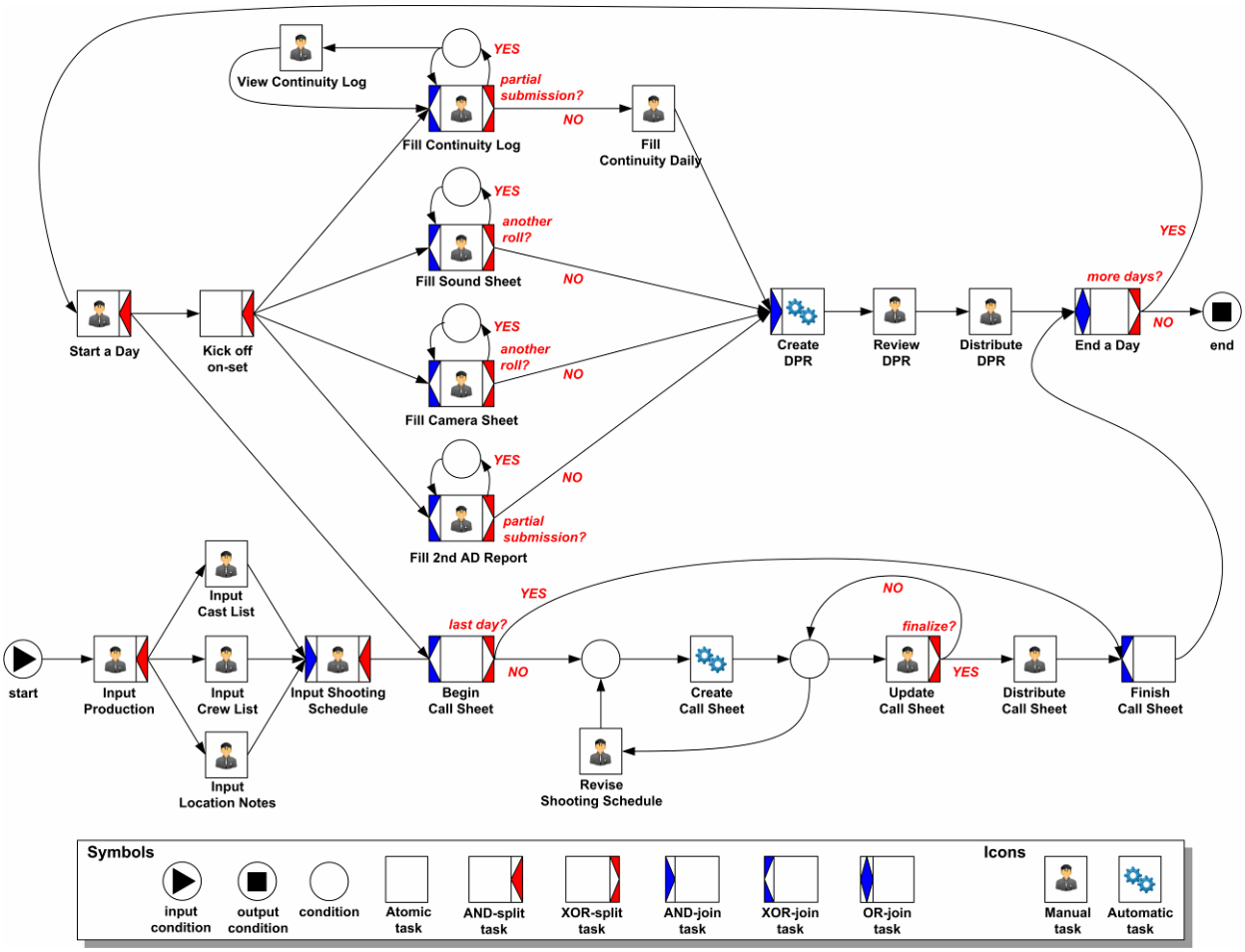


Figure 1. YAWL4Film – Film Production Process Model.

The stream involving the production of a DPR starts with the task *Kick Off on-set* and ends with the task *Distribute DPR*. As mentioned specific crew members on set collect data regarding on-set activity. The Continuity person fills in the continuity log and then the continuity daily report, the Sound Recorder produces the sound sheet, the Camera Assistant produces the camera sheet, and the second Assistant Director (AD) is responsible for the second AD report. It is possible to interrupt filling in the continuity log and the second AD report, for example for a meal break, and then to resume the work after the break. Also, there can be many camera and sound sheets to be filled in during a shooting day. Upon completion of these on-set documents, a DPR can be generated and passed onto the Production Manager for review. After the review is finished, the DPR is circulated to certain crew members such as Producer and Executive Producer.

4.2 Interacting with Users

The film production process model of Figure 1 can be executed via the system engine (i.e. YAWL engine) to support a running production. Performing a manual task requires users' inputs through customised user interfaces, which were designed to replicate actual templates used in professional film making and support the ways that the users are familiar with when filling in the forms.

An example of such a customised user interface can be seen in Figure 2. It depicts two Scheduler screens, which are both Web-based, for entering and updating shooting schedule information. Figure 2(a) shows a screen of Scheduler Stripboard which consists of a list of scenes with selected scene information for each of the shooting days during the entire production. Each scene is displayed as a strip which is highlighted with one of the four pre-defined colours (blue, green, yellow and orange) indicating whether the scene is for internal/external and day/night shooting. The Stripboard supports drag-and-drop so that users can move a scene (strip) between different shooting days. Next, by clicking the "pen-icon" located at the right end of a scene strip, it opens a screen of Scene Breakdown which comprises all the details about that specific scene, as shown in Figure 2(b). This is where one can perform scene-related operations including: entering and storing scene details ("Save"), adding a new scene ("New Sheet"), deleting an existing scene ("Delete Sheet"), etc.

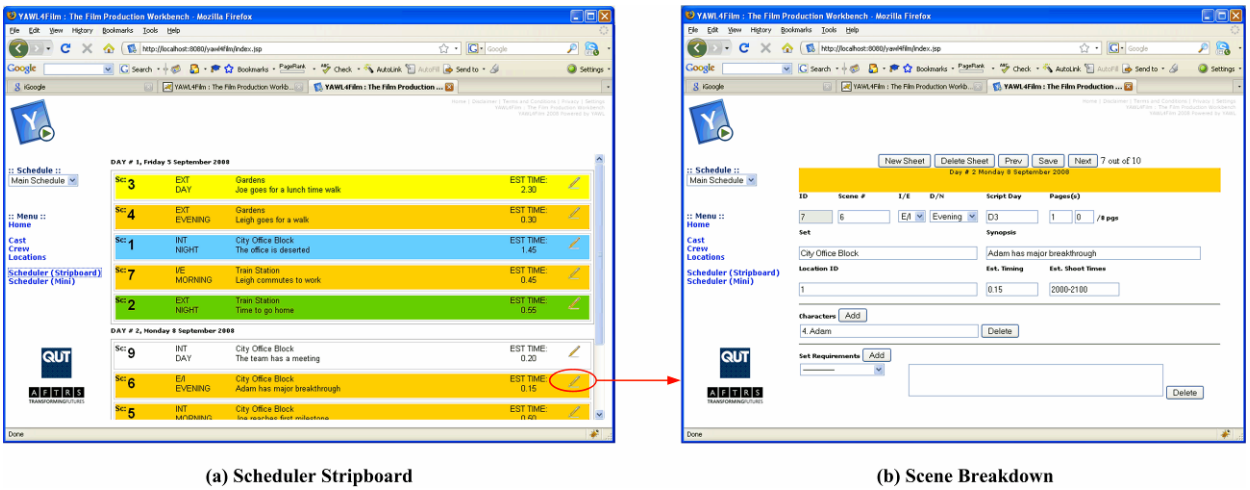


Figure 2. YAWL4Film – Scheduler: (a) Scheduler Stripboard and (b) Scene Breakdown.

As another example, Figure 3 depicts three user screens, as viewed in MS-Excel, for Call Sheet Production. The first screen (leftmost) takes the input of a shooting day number (e.g. 2nd shooting day) and sends it back to the system engine to create a call sheet template of the

corresponding day. Such a call sheet template is then generated into Excel format, as the second screen (middle) of Figure 3 shows. It replicates what users are familiar with before, and approximately 80% of the data fields are automatically filled in with up-to-date information which is taken from other documents such as the shooting schedule. For example, certain details of each scene (including scene number, script pages, set, synopsis, etc.) can be taken from the Scheduler shown in Figure 2. The user only needs to fill in the rest of the data fields such as individual cast call times for each scene. Generally, a call sheet template contains many blank data fields. The user, e.g. a Production Coordinator, either fills in the template from scratch, or works from a copy of the previous day's call sheet so that he/she only need to change the data fields that require updates. The former may cost more time, but the latter can easily introduce errors. Also, the call sheet production of YAWL4Film supports the generation of a call sheet of any shooting day in advance as well as a call sheet for any additional unit. These are very useful for advanced scheduling and for large productions but are not usual in the current production processes due to their manual and paper-based nature.

The above examples demonstrate that the system user interfaces are easy to use and in line with the paper-based forms currently in use. Hence, the learning process should be straightforward and no dramatic changes are required on the part of the production crew involved. The use of YAWL4Film does not lead to interference with best practices as they currently exist. Furthermore, the user screens are system-independent and can be applied on PCs, laptops, and even tablet PCs.

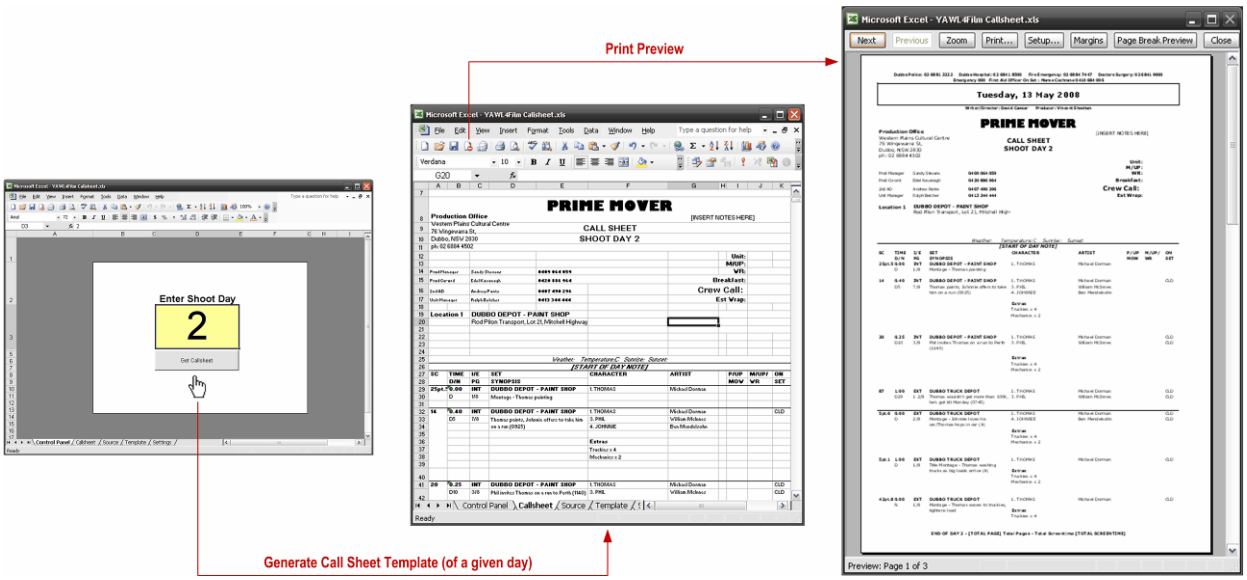
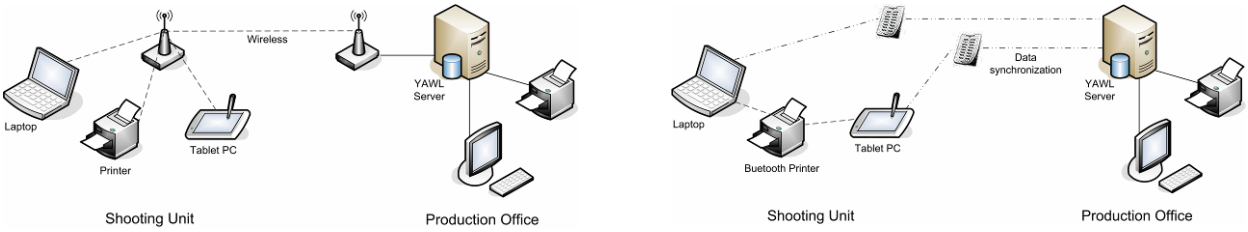


Figure 3. YAWL4Film – Call Sheet Production.

4.3 Deploying the System

A film production process usually involves a central production office and a shooting unit. In general, YAWL4Film can be deployed as Figure 4(a) illustrates. A server that runs the YAWL engine is set up in the production office. The connection for communication between the production office and the shooting unit is available all the time via wired/wireless networks. The onset crew members can access the YAWL server via laptops, tablet PCs, and etc.



(a) When network connection between production office and shooting unit is available all the time

(b) When there is no network connection between production office and shooting unit

Figure 4. Two deployment scenarios of YAWL4Film.

However, for film shooting, it is likely that the designated shooting location (e.g. shooting in a desert) may have no standard Internet or phone coverage to facilitate communication between the production office and the shooting unit. Although a dedicated wireless connection (e.g. a satellite connection) may be set up to cover the whole area between the production office and the unit, it is usually not feasible due to the budget constraints in many film production projects. This brings us to the deployment scenario shown in Figure 4(b) in which one runs stand-alone user forms for the unit crew to fill in onset and later synchronises the data from these forms to generate the DPR at the production office. The stand-alone forms include continuity log, continuity daily, sound sheet, camera sheet, and 2nd AD report, and each is installed in the designated crew's computer device. At the end of each shooting day, the saved files containing the data from each of the stand-alone onset forms will be physically brought to the production office (e.g. by a production runner) or uploaded once at a certain time in mobile range. They will then be loaded into the system engine to generate the DPR. Although this way the real-time synchronisation cannot be maintained between tasks modelling onset activities (due to the off-line executions of these tasks), it ensures the integrity of the user data throughout the production process, which so far seems to fulfil the end users' expectations.

5. AFTRS Deployment: "Rope Burn" and "Family Man"

The Australian Film Television and Radio School (AFTRS) is the national training and research facility for Graduate Diploma, Masters Certificate, courses and short courses in film, and TV production. A core component of coursework is the short film production slates that occur throughout the academic year. These slates range from 1 to 20 days of filming and aim to mirror professional industry standards. Student teams are provided with a budget, resources allocation and facilities from development, pre-production, production, through to post-production and distribution.

YAWL4Film was deployed on two film productions at the AFTRS in October 2007. The crew for each production consists of approximately ten students, ten full time or contract staff, and any number of volunteer crew. Project 1, "Rope Burn", was a three-day shoot in studio with 30 onset crew, 6 cast and 6 production office crew. The office was run by a professional Production Manager, and supervised by a student Producer. Project 2, "Family Man", was a three-day shoot on location and in studio with 35 crew, 5 cast and 4 production office crew. A semi-professional Production Manager was contracted and supervised by a student Producer. In both projects, laptops and tablet PCs (with stylus-enabled user input) were used by Continuity and 2nd AD, while Camera and Sound students were not part of the testing and the system supervisor and technical assistant entered their data manually into the system.

During the two productions, YAWL4Film shadowed the process of call sheet generation, DPR generation, and cast and crew database update. For "Rope Burn" the system was used on-set

alongside the traditional paper method of data capture for Continuity and second AD; and later for “Family Man” the system totally replaced the paper-based method for the two crew members. From the feedback from both projects, it was clear that the system would save time, and create more precise documentation:

“*I have managed over a dozen productions offices, and the amount of time this tool could save is incredible. Seeing the system up and running makes me realize how manual and laborious many of the activities are in any production office.*”

– Production Manager in “Rope Burn”

“I found the electronic form simple and easy to fill in. It was just the same as using a paper form, but much cleaner and neater, e.g., no messy handwriting, smudges or crumpled paper.”

– Second AD in “Family Man”

“I so often make errors when calculating DPR or even the Call Sheet, it is much easier to use the tool to double check figures and ratios.”

– Production Manager in “Family Man”

The feedback also indicated that, once users became familiar with the tablet PC, the data input was significantly streamlined:

“There is a bit of a knack to filling in the details using an electronic tablet and pen, but with a small amount of practice I found a way to do it that I was most comfortable with.”

– Second AD in “Rope Burn”

“Writing on the machine should as fast as handwriting. The system in itself is pretty easy to use.”

– Continuity in “Family Man”

6. Porchlight Deployment: “Prime Mover”

Porchlight Films is an independent film production company based in Sydney, Australia. Porchlight Films has produced award winning feature films, television dramas, documentaries and short films, including a number of highly acclaimed films such as ``Walking On Water'' and ``Little Fish''.

YAWL4Film was deployed on Porchlight’s feature film ``Prime Mover'' in May 2008. For the duration leading up to this deployment, the YAWL4Film system was enhanced to better support the information supply chain encompassing the creation of call sheets. The approach to support only call sheet creation allows YAWL4Film to better support and contain activities within the production office, and to minimise accessibility issues bounded by technical limitations (i.e. the network connectivity problem in rural areas on location).

YAWL4Film was used mainly by the production coordinator to generate call sheets. The inputs required for the call sheets were pre-entered into the system before production. Changes to the production schedule, cast, crew and location can easily be performed through YAWL4Film. The call sheets generated by the system automatically congregates data sources from the production schedule, cast, crew and location. The generated call sheet populates around 80% of the information, where the final 20% will be entered manually.

``Prime Mover'' was a twenty-seven days shoot on location at Dubbo and Bourke, NSW. During the deployment, YAWL4Film totally replaced the traditional method of call sheet generation.

Our study shows that using YAWL4film saved around 2 hours each day for the Production Coordinator alone, and also provided various other advantages (e.g. better planning, management of information, etc) to the crew in general. From the feedback from Prime Mover crew, it was evident that the automation of call sheets in the production environment is beneficial if not an essential step towards better film production management:

"We needed to have a system that could optimise the way that we scheduled and communicated with people … (YAWL4Film) will essentially replace the few key chains that are not up to speed with where technology is… I think that's exciting. And I think that every film could benefit from that."

– Vincent Sheehan, Producer "Prime Mover"

"The system (YAWL4Film) proved to be a really good way to process all the information for our production in an accurate and efficient way. Speed also proved to be its strength, with schedule changes it simplified the process of re-organising our information and producing a final document. If properly used it could really save time in the day to day running of productions large or small."

– Andy Pante, 2nd AD "Prime Mover"

"It (YAWL4Film) generates exactly what you want, when you want. …It is definitely very efficient, but it's the time it saved that make it efficient. It gives you some of your days back, because you days is taken up with general problems in production. …Without a doubt, I will definitely suggest using the tool to any production coordinator."

– Edel Kavanagh, Production Coordinator "Prime Mover"

7. Conclusions and Outlook

We have applied BPM technology to process innovation for film production. As a major outcome, we developed YAWL4Film for collection and entering of production related data and automatic generation of reports during film production, and deployed the system in both an educational setting and a real film production. YAWL4Film, as a representative of the implementation of BPM to the filming industry, resulted in the discovery of additional benefits:

- Firstly, using YAWL4Film, call sheets can be generated many days in advance (i.e. a week) as well as for each of the additional units. This allows the second assistant director to engage in discussions with the first assistant director, production manager and various department heads using consolidated materials. This is in contrast with the current method where many standalone documents (i.e. schedule, props, etc), spanning many versions, are discussed.

- Secondly, YAWL4Film reduces data redundancy and improves data accuracy. Information is updated in, and taken from, a centralised source, thus reducing the need of entering the same information many times (e.g. scene information on the scheduler and call sheet, etc).

- Thirdly, YAWL4Film facilitates a separation of concerns through modules created for specific crew members. This is unlike bundled software functions that provide a one-stop solution. For example, the first assistant director may concentrate on ensuring the correctness of the schedule, while the production coordinator focuses on the creation of call sheets, where bundled software provides scheduling and call sheet creation in the same software. The authors discourage such behaviour and claim that technical software

should be created for users and should keep user roles in mind. For example, the first assistant director should not be forced to create the initial call sheets on behalf of the production office because she/he is the only person with the software, or the production coordinator should not be required to obtain a copy of the scheduling software in order to create the call sheets.

The crew members from both AFTRS deployments and the Porchlight's deployment indicated that the more information one could store, such as scripts and schedule, the more useful the tool could become. Such feedback suggests that YAWL4Film should be used right from the pre-production phase, for example during script development and scheduling, so that information gathered during the pre-production phase can be exploited to better coordinate the production phase. Hence, work is ongoing on a light-weight pre-production tool that supports scripting, scheduling, cast, crew and location management and that can interface with the current YAWL4Film production tool. It is expected that the earlier the system is introduced in the filmmaking lifecycle, the more significant the impact and efficiency gains will be.

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