Production and Multi-Channel Distribution of News

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ABSTRACT

News production is characterized by a complex and dynamic workflow as it is important to produce and distribute news as soon as possible and in an audio-visual quality as good as possible. In this paper we present news production as it has been implemented at the Flemish Radio and Television (Vlaamse radio en televisie – VRT). Driven by the dynamic nature of news content, the VRT news department is optimized for short cycle times and characterized by a highly parallel production process, i.e. product engineering (news bulletin composition or "organize" and story editing or "construct message"), various material procurement ("create media asset") processes, mastering ("publish"), and the distribution processes largely run in parallel. The formal expression of news operations in terms of canonical processes has allowed us to disambiguate the overall process and it will help us developing meaningful and reusable interfaces.

Categories and Subject Descriptors

H.1 [**Models and Principles**]: General; H.4 [**Information Systems Applications**]: Miscellaneous; D.2.13 [**Software Engineering**]: Reusable Software – Domain engineering.

General Terms

Design, Standardization, Theory

Keywords

Archiving, file-based production, multimedia mastering, news production

1. INTRODUCTION

Similar to the description of generic video production [19], news operations can be described by the canonical processes of media production [8]. We consider the canonical processes as a reference framework and we will discuss how they relate with the actual production processes as implemented by the news production department of the VRT as part of the file-based *Digital Media Factory* (DMF) [11].

While news is a popular format on other distribution channels besides conventional radio and television, it is in general considered not scalable to create an individual news product per distribution channel [10].

The requirement to implement a scalable solution for multi-channel publishing that ensures the integrity and the quality of the product, has motivated the VRT to fundamentally re-engineer its production processes, based on the notion of a cross-functional and configurable format [21,25,26]. In fact, news bulletin composition ("organise"), story editing ("construct message"), and material procurement ("create media asset") are generic and make abstraction of the implementation details of the distribution channel. Since mastering ("publish") and distribution have been automated to a large extent and the remaining amount of human intervention does not depend directly on the number of distribution channel types, the overall architecture is considered scalable as function of the number of distribution channels.

This paper is organised as follows. Section 2 highlights the specific logical units of work applicable for news production and discusses the interfaces between the processes. Section 3 suggests how future systems supporting interactive applications may extend the actual system and which information will be required in addition to the actual canonical processes in order to correctly represent these processes. Finally, conclusions are drawn in section 4.

2. NEWS PRODUCTION

News differs from other genres or formats and an important differentiator is the perception of quality. Given an intrinsic editorial quality, which is not the subject of this paper, it is considered important to produce and distribute news as soon as possible to as many channels as possible, in an audio-visual quality as good as possible [9]. Therefore the news format is an excellent candidate for multi-channel distribution [1], including to internet terminals that need to cope with varying distribution capacities and mobile devices with limited rendering capabilities [18,24].

Items are brought on air or online as soon as possible and they will be continuously enhanced by additional material during their lifecycle [20]. Given an arbitrary lifecycle of an item being 24 hours and the requirement to issue a news bulletin at least once per hour, we conclude that news production is in fact a moving target. This poses complex architectural constraints on the production facility. Driven by the highly dynamic nature of the format, the phases of news bulletin composition ("organise"), story editing ("construct message"), production, publishing, and distribution overlap and interfere. The process artefacts exchanged between them are continuously in a draft state. The audiovisual product is never finished as such; it is in fact the mastering ("publish") process that de facto executes a final assembly. Modelling by UML has allowed us to make abstraction of this concurrency problem, to formally define each important input and output and eventually to define a scalable architecture.
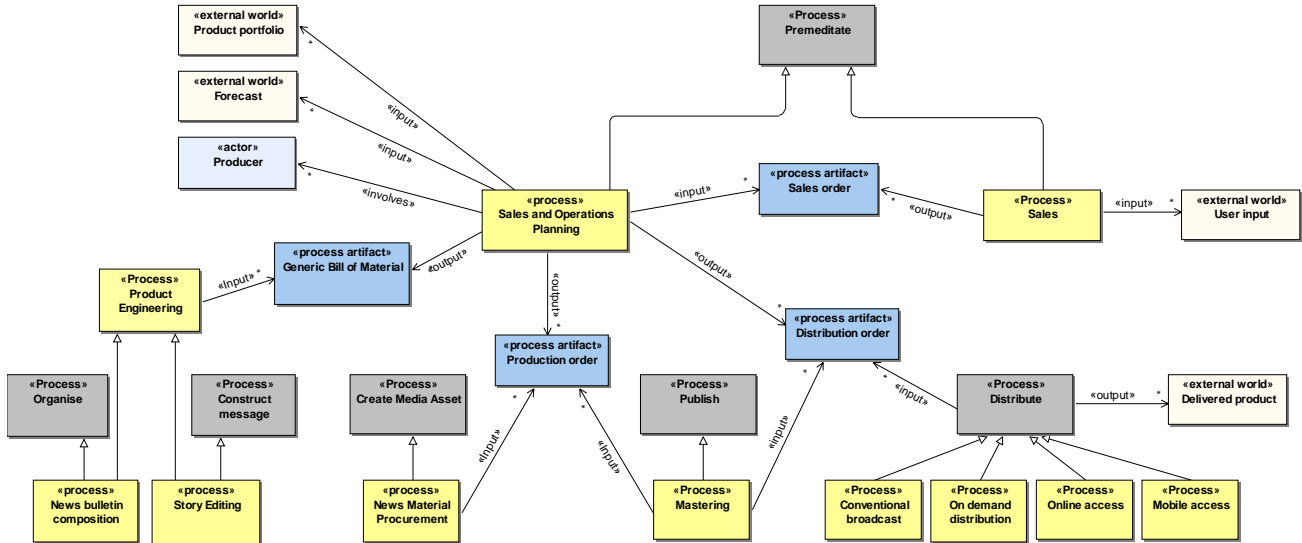
Figure 1: Sales and Operations Planning

In the remainder of this section, we examine per business process how news production is represented by the canonical processes. The logistic processes of sales and planning (depicted in Figure 1) is an implementation of *premeditate*, product engineering (depicted in Figure 2) includes *organise* and *construct message* representing respectively news bulletin composition and story editing. News material procurement (depicted in Figure 3) is a particular type of *media asset creation* and includes goods receipt, Electronic News Gathering (ENG) and material editing. Based on the assumption of scalability of the publishing process, we then deduct the requirements of the material warehouse (depicted in Figure 3), multi-channel publishing, and distribution systems (depicted in Figure 4).

2.1 Planning and Sales - Premeditate

The ***Sales and Operations Planning*** (SOP) process is the highest abstraction of the media assets and the processes that create and distribute them. It is the process that formally integrates the sales, production, and distribution logic by an overall planning implemented by an Enterprise Resources Planning (ERP) system. It is a reflection of the business strategy and therefore it involves the management, represented by the *producer*. Input is based on management decisions in general, in particular the product portfolio and the forecast, which is in fact a long term schedule of production and distribution. The SOP issues *production orders* and *distribution orders*, based on which the DMF operates. The SOP is a typical specialisation of *Premeditate*.

Before the actual production of news is started by the SOP through the release of a *production order*, the planning system expects a *sales order* from the **sales** process (see Figure 1). While the *sales* process is usually implicit in the context of broadcasting operations - there is no sell operation or financial settlement - the producer's commissioning decision is based on indirect user input and it is formally implemented by a *sales order*. In the context of video on demand, broadband internet, or mobile access, sales processes and orders are explicit, and different business models co-exist, including pay-per-view, subscription-based (online) channels, or services paid by advertisement. Therefore, it is plausible to generalize the concept of a *sales process*, which is a specialisation of the *premeditate* process as well.

In this context, interactivity can be easily understood as an extension of the sales process, which, as indicated on Figure 1, receives explicit or implicit input from the user. As opposed to the current situation where pay-per-view is considered the maximum level of interactivity, it is expected that the intelligence of future sales processes will drastically increase, allowing the user to express his interest and a desired level of quality.

The *product portfolio* implements a generic *Bill of Material* (BOM) per type of product that can be produced and distributed by the DMF, including non-news programmes [27]. The BOM is a formal definition of the product in terms of raw material and semi-finished components, based on which *product engineering* processes will specify the content of each audiovisual product.

In the context of news production, audiovisual products do usually not match the individual news bulletins. Given an arbitrary assumption that an item is usually newsworthy during 24 hours, the news product is arbitrarily defined as the entire news production during a period of 24 hours and referred to as a *news day*. During this period, the amount of original footage that can be produced for the *news day* is primarily constraint by the production capacity, while in principle an unlimited number of news bulletins can be *published* and *distributed*. In fact, news is considered mass production. The VRT news department issues 4 bulletins per day for television, 26 for radio and mobile and broadband internet support ad hoc mastering of a bulletin that contains the most up-to-date collection of news items.
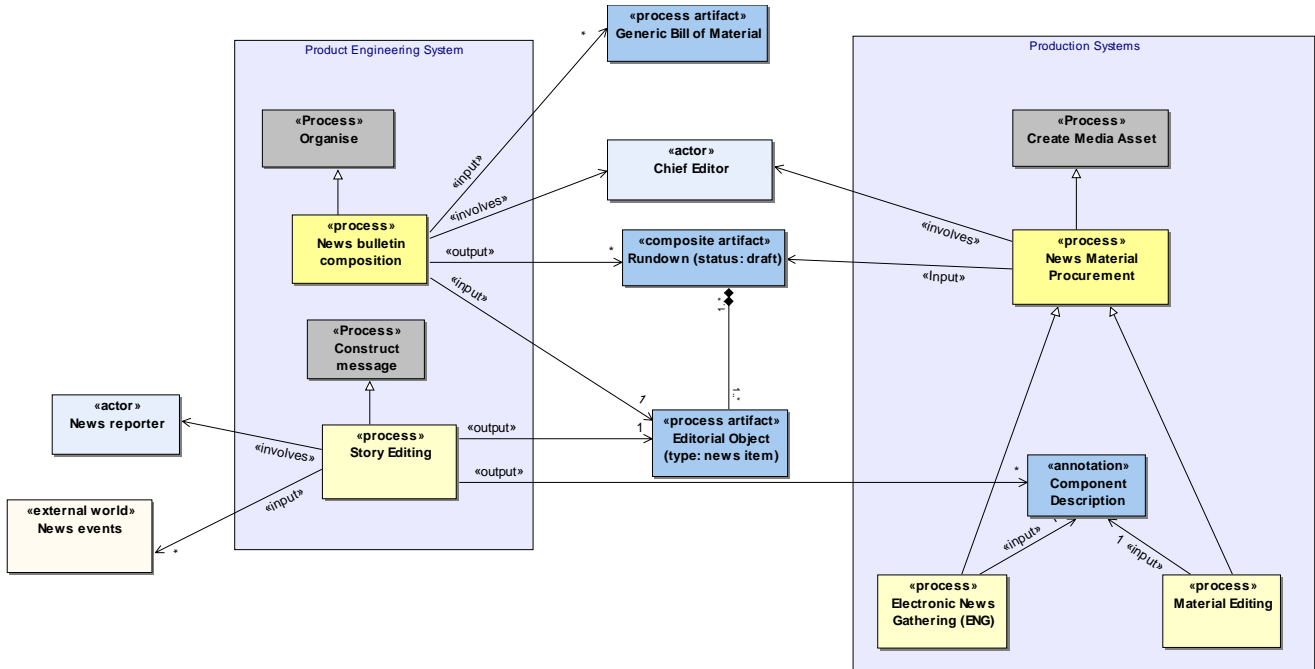
Figure 2: Product Engineering

2.2 Product Engineering - Construct Message and Organise

Media production is usually preceded by one or more ***product engineering*** processes and in ideal circumstances the product specifications are approved before the production starts. In case of news production, the product specification is in a continuous draft state and the *product engineering* processes will be executed in parallel with the material production, publishing and distribution processes.

Whereas the SOP issues a formal definition of the *news day* as a BOM, *Product Engineering* processes are rather concerned with the editorial specification of the *news day* and by extension of each individual news bulletin.

In the context of news operations, we have identified two product engineering processes, as depicted in Figure 2, based on different outputs and different actors that take editorial decisions.

- ***Story Editing*** is a specialization of construct message. It is an interpretation of a news event by a news reporter. Eventually the news item may also refer to the specifications of the material that will be captured, retrieved from the archive or edited in order to illustrate the item. These annotations are referred to as component descriptions on Figure 2. In particular cases, story editing can be partially outsourced to an external news agency. Then again, the news agency would issue a formal description of the news event that is then used as input of an internal re-interpretation.

- ***News bulletin composition*** is a specialization of organize. While the structure of a news bulletin is usually based on a fixed template, it is populated by news items delivered by the story editing (construct message) process. The output is a ***Rundown***; a document structure that includes individual news

items that contain pointers to the media assets that will be or have been created in the context of this news item. Each decision to include/exclude an item in/from the rundown is formally taken by the chief editor. In ideal circumstances, the rundown contains any decision that needs to be taken during production and mastering.

As of today, an important fraction of the necessary creative decisions are not documented and a fair amount of human interaction is required during production and mastering. Automatic mastering of live programmes, such as news, would require a virtual modelling environment capable of pre-visualising the news and delivering a precise model based on which the master control can be automated. Research is currently going on [13] in order to stretch the idea of virtual modelling and to estimate to what extent production and mastering can be automated.

2.3 Material Procurement - Create Media Asset

Production refers to any process that converts raw or semi-finished material to a state of further completion. *Procurement* is a generalisation of production that includes any other type of material acquisition, e.g., the intake of news agency material. In any case *news material procurement* is a typical specialisation of *create media asset*.

In the context of news production we have identified three types of material procurement, as indicated by Figure 3. Any of these require in principle a production order issued by the SOP, and an approval decision of the director is reflected as an approved update of the rundown.
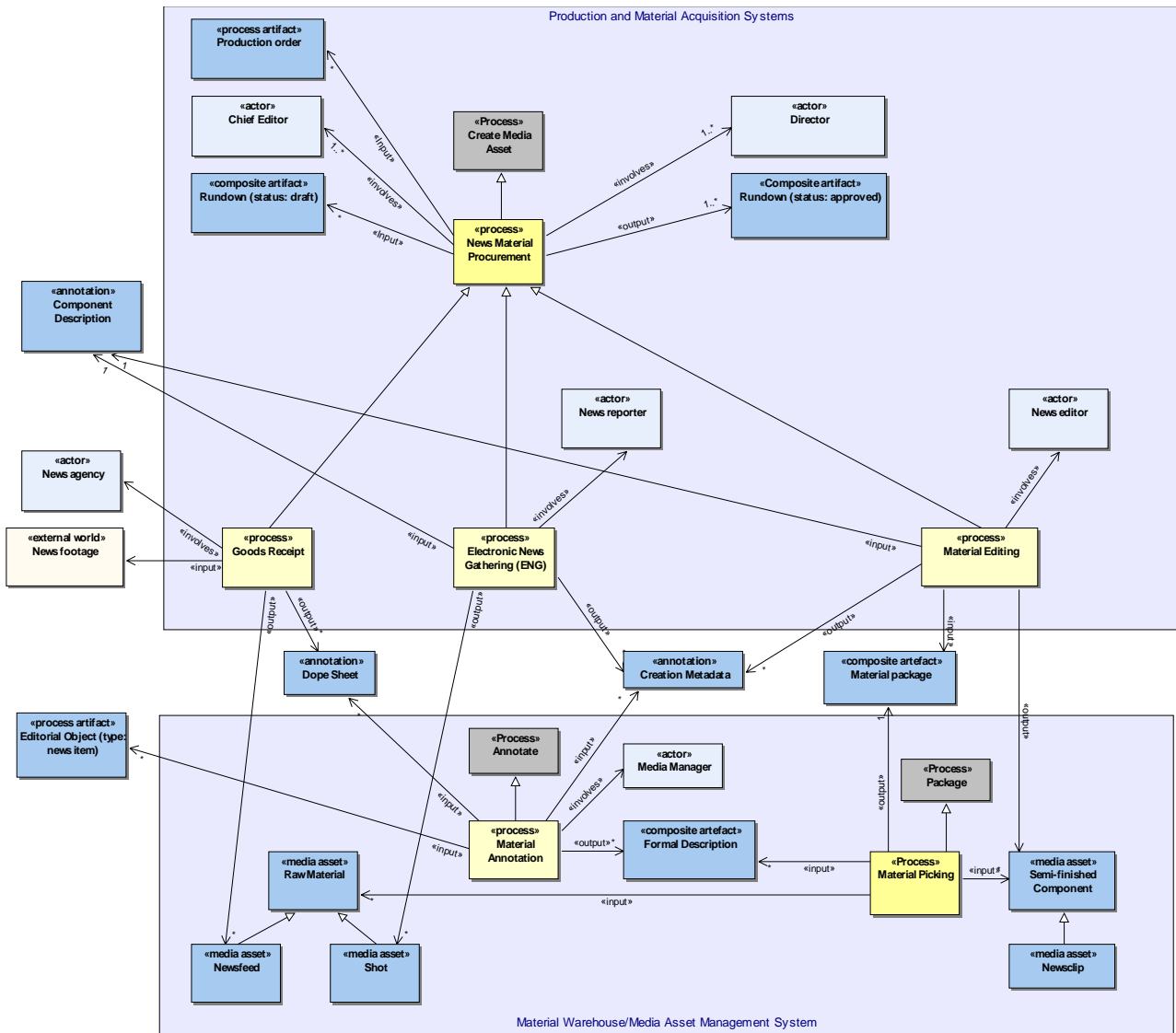
Figure 3: Material Procurement and the Material Warehouse

- A process formally classified as a media asset creation process, not news related, is the **goods receipt** or ingest process. After news footage is captured, aggregated, and issued by a third party such as a news agency or a correspondent, material is recorded and transferred to the material warehouse as news feeds - **raw material** of type '**news feed**'. In case metadata is available, it is usually presented as a separate unstructured document or embedded as an XML-wrapped structured document [14]. This document, referred to as a **dope sheet**, is extracted or retrieved and issued to the material annotation process as a basis for formal annotation.

- The most common process of news material production is **Electronic News Gathering** (ENG). Given the description of a news item and an indication of the material that needs to be captured to illustrate the material, a news reporter, if

necessary assisted by technical staff, captures material on location. Material is checked in as a collection of shots - **raw material** of type '**Shot**' - and the creation metadata is issued to the material annotation process as a basis for formal annotation.

- In normal circumstances, raw material received by the goods receipt or ENG processes will not be distributed as such. It needs to be cut and pasted, mixed with archive material, and sound engineered. In fact, in the context of news, **material editing** refers to any activity associated with the creation of a news report - **semi-finished material** of type '**news clip**' - based on existing material, with the intention of creating a media asset that can be distributed as such.

This formal description of the news production processes represents the VRT implementation and therefore we did not consider an ENG process which includes material editing or

"organise", although this is a widely adopted practice. Equally the VRT implementation of news material production does not implement an explicit annotation step, commonly referred to as "logging", since this activity is executed during the intake transaction in the context of the warehouse system.

2.4 The Material Warehouse – Annotate and Package

Before the DMF had to support scalable multi-channel publishing, the processes of television and radio production were tightly integrated and optimized to deliver exactly one version of a product. The BOM was trivial – a single production process delivered a finished product – and a notion of intermediary components was considered overhead. Mainly intended for preservation of cultural heritage, the *archiving* process was the only instance of a formal annotation process and both annotation and archiving were optimized for long-term conservation and retrieval of end-of-life media assets.

As suggested, multi-channel publishing has introduced a more complex BOM, supporting a configurable product and a modular production process. For example, in the context of news we have defined production processes that deliver *semi-finished components* and a dedicated *mastering* process that will be discussed in the next paragraph. We have built an intermediary system that implements **material warehouse** operations that store intermediary components and make them available again. The system validates or provides the required identifiers, analyses the material and eventually normalises all available metadata in order to enable efficient *query* and *packaging* processes. The process of collecting all available information and normalisation is indicated on Figure 3 as *material annotation*, which is a typical specialisation of the canonical process *annotate*. As shown in Figure 3, the *material picking* process, which is a typical specialisation of *package,* issues a material package to the *material editing* or *mastering* processes.

Although supervised by a media manager, *material annotation* is a largely automated process that delivers a formal and machine-readable description of the asset, which may include any type of identification and descriptive properties [5].

- Identification properties range from low-level object identification such as a *Unique Material Identifier* (UMID) [22,23] or a UUID [15] up to logistic identifiers such as the product identifiers and sales order numbers.

- Descriptive information strictly accounts for the content of the material. In case no descriptive information would be available during check in of the material, we expect that the process of material description has the potential to be automated completely. Based on available research results, we are currently implementing automatic shot and scene detection [2,4], speech analysis, automatic summarisation [6] and object detection based on image processing [3,7].

- Rights related information identifies the copyright holder and the rights that have been granted. Thus, the material warehouse system in fact executes the Intellectual Property Management processes and inhibits improper re-use of material to the extent it has been provided correct information.

The material warehouse is implemented by configuration of a *Media Asset Management* (MAM) system. Being the central node of the hub-and-spoke architecture, as opposed to a conventional linear approach where it strictly implements archiving processes, it is optimized for scalable throughput and fast response times.

Archive-related activities are strongly related with the material warehouse operations. In fact, a*rchiving* has become a virtual operation. Since the introduction of a MAM system that supports the complete production process, the 'archived' state is rather a logical setting in the MAM system and no additional archive records are created. The media manager, formerly known as the archivist, still removes duplicates, improves the available meta-data, and creates clusters of material in order to improve *query* and *packaging* processes. The canonical process "query" represents activities associated with the retrieval of objects from the archive. Since archiving as such is not part of the production logic, it has not been discussed in this paper.

2.5 The Distribution System – Publish and Distribute

As suggested by Figure 4, a *distribution system* usually implements the adaptation logic or the final assembly as function of a particular distribution channel, as well as the actual distribution. As suggested in the introduction, it is primordial to automate these components to a large extent in order to create a scalable multi-channel publishing system.

The canonical process *publish*, commonly known as **mastering** in the environment of audio engineering and as recently being re-introduced in the context of television production by AMWA[1], represents the various packaging and labelling operations of a finished product as function of the capabilities of a physical distribution channel, the type of client used by the consumer, and/or particular user preferences.

Mastering may include the following operations.

- Labelling is easily automated by simple in-line systems and it includes the insertion of logos, embedded programme information and navigation anchors. It applies as well watermarks, and copy protection artefacts, such as scrambling.

- Insertion of interstitials and commercials is automated by integration of scheduling and distribution events. It requires a tight and semantically rich interface between the distribution scheduling and execution systems.

- The final down-mix of the available audio into one, two, or six audio-channels is considered a mastering process as well. This is not a trivial operation because the amplitude must be manipulated as function of the available dynamic range [16] and per type of audio component, being the dialogue speech, the background, the soundtrack, and the *bruitage* or effects. This is a typical example where it is important to define a meaningful BOM and to formally identify the different audio components as different semi-finished components.

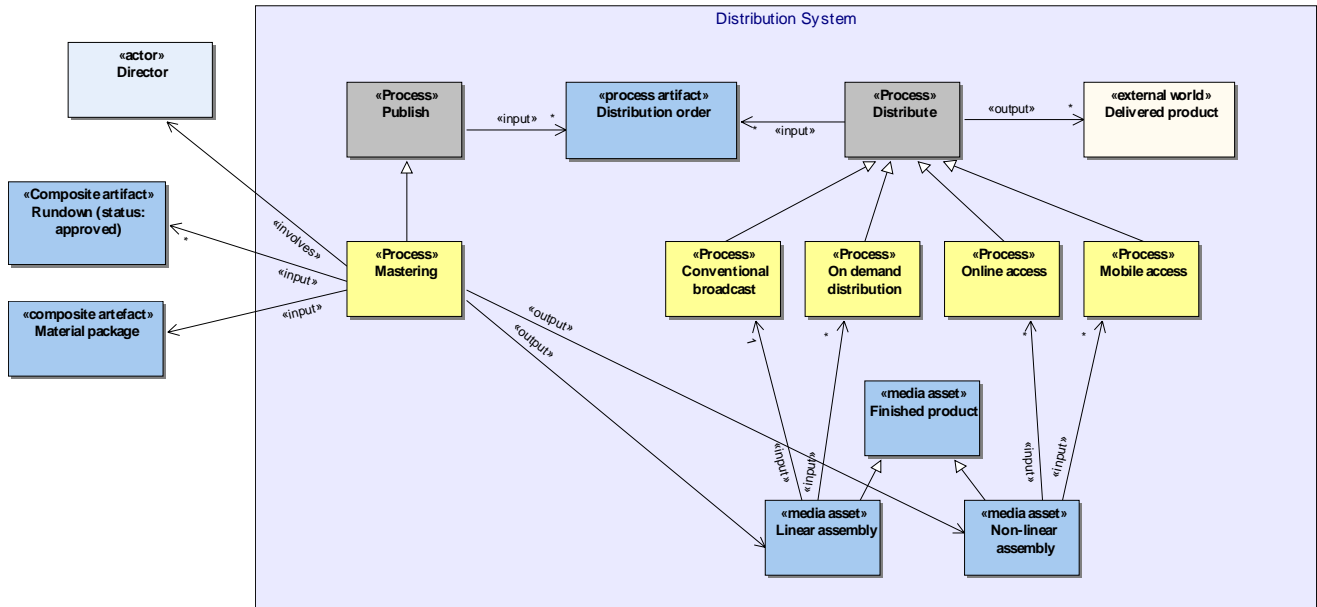---

[1] Advanced Media Workflow Association

Figure 4: Mastering and Distribution

- A complicated task and a problem which is subject of current research, is intelligent scaling and cropping of the video aspect [17]. Given the display capabilities of the client device, the image adaptation requires a notion of the region of interest, which, if not available as a result of product engineering, requires image analysis in order to intelligently reframe the picture.

As opposed to the definition of a single mastering process, we have defined a specific *distribution* process per logical distribution channel, which can be any one or combination of physical distribution channels. For example, simultaneous broadcasting over analogue FM and digital DAB[2] would be considered one logical distribution channel. In the context of news production at the VRT, the canonical process *distribution* represents four typical processes according to four logical distribution channels as depicted in Figure 4:

- *Conventional broadcast* refers to linear radio and television.

- *On demand distribution* refers to ad hoc distribution of linearly assembled audio-visual content. As of today, this distribution process often reuses the product that had been mastered for conventional broadcast services. This compromises the quality of the information, because the original assembly usually includes irrelevant promotional references or interrupts (e.g. traffic information) and therefore it is considered better mastering a specific version of the news bulletin intended for on demand distribution.

- The news bulletin assembled for *online access* is presented as a structured overview and the end-user explicitly selects item per item. In fact, the online news bulletin behaves like

a richly featured web site and the end-user uses a browser that ad hoc fetches the required files.

- *Mobile access* is still under development and research is going on at this moment to explore the possibilities of mobile access [12]. Mobile and handheld devices are featured with multiple radios and it is expected that they will include a broadcast receiver (DVB-H), a communication channel (GSM, GPRS or UMTS) and they will include local storage. They have the potential to overcome their limited rendering capabilities as it is probable they will be equipped with wireless interfaces supporting communication with high-end play-out devices. As such, despite their limitations in terms of quality and capacity, mobile terminals are becoming the most feature-rich terminals.

3. Possible Future Extensions
We have identified interactivity as an extension of a sales process. Before being able to develop and support applications that will be perceived as *inter-active* [22], we will need to be able to formally describe the process that issues the "buy" transaction and that receives a product from the distribution processes and therefore we would suggest considering an additional canonical process that represents "consumption".

4. CONCLUSION
Including the generic processes of sales and operations planning, product engineering, production, and distribution, we formally described the news production as implemented by the VRT. We indicated how these processes implement the canonical processes of media production. Based on the assumption that the news format is the primary candidate for multi-channel publication and distribution, we made a distinction between production and mastering processes and we

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[2] Digital Audio Broadcasting

explained the role of the material warehouse process implemented by a media asset management system. We also identified interactivity as an extension of the sales and distribution processes.

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Canonical Process	News Production Operations Summary
Premeditate	The *Sales and Operations Planning* (SOP) formally defines the news of a single day as a product, and specifies that each news bulletin on radio or television is an instance of this product. Broadband internet and mobile access offer a version of the news bulletin which is continuously being modified. Through an explicit or implicit sales process, the sales order receives sales orders that trigger news bulletin composition, production, mastering, and eventually distribution processes. Input: the business strategy of the media production facility in the form of forecast and production portfolio; a sales order delivered by the sales process Output: a generic Bill of Material; production orders; distribution schedules The *Sales* process triggers the SOP by using explicit or implicit user feedback. Input: a buy transaction confirmation (explicit) from the consumer or a commissioning decision (implicit) from the producer Output: a sales order that triggers the planning and production processes
Construct Message	*Story Editing* is a continuous process during the news day whereby the news reporter specifies the details of the content of each news item, including a specification of the media assets that will be used to illustrate the item. Input: external input in the form of news events Output: partial or complete editorial objects; formal or informal descriptions of raw material and semi-finished components that need to be produced in order to illustrate the news item
Organise	*News bulletin composition* comprises the preparation of a news day. Using various sources such as newswires and dedicated calendar applications, the news reporters select content of the news day. Input: a generic Bill of Material issued by the SOP; Editorial Objects of type News Item Output: a rundown is a composite artefact which will be used as input for further production (create media asset) and mastering (publishing) processes. It is an ordered document structure that includes item descriptions that contain pointers to the underlying media objects
Create Media Asset	*Goods receipt* is in the context of news production, audio-visual footage usually originating from correspondents abroad or news agencies. Input: audio-visual footage Output: raw material media assets in the form of individual shots or newsfeeds; a dope sheet that describes the received material *Electronic News Gathering* is the process of capturing material in the context of an anticipated news item. Input: a component description delivered by the story editing process Output: raw material media assets in the form of individual shots; creation metadata (camera, geographical position, time, etc.) *Material Editing* is a production process, not necessarily news related, whereby an editor uses an editing workstation to process existing audio-visual material in order to deliver new media assets which are here referred to as news clips. Input: a component description delivered by the story editing process; a material package issued by the material warehouse Output: semi-finished material components in the form of news clips; creation metadata (e.g., refs to the original material)
Annotate	*Material annotation* is part of the material warehousing system, during which all available information related with the received material is collected, normalised, translated in order to match reference data, and potentially additional descriptive information is added by unsupervised analysis algorithms.

	Input: All available information related to the media asset that is being received by the material warehouse system, e.g., dope sheets, editorial object descriptions, component descriptions, creation metadata, and the logistic context of the finished product, i.e., a project or a programme
	Output: A formal, multi-dimensional and normalized description of a media asset, often using reference data or a thesaurus if possible
Package	The *Material warehouse* system receives various types of media assets, including raw material, semi-finished components or finished products. These are stored and uniquely identified, in order to be able to issue material at a later stage for further production, mastering or redistribution. The material warehouse indexes the formal description delivered by the material annotation processes, based on which the warehouse can be efficiently managed and queried if applicable. By far the most important task of the material warehouse system is *material picking*, an implementation of *package*.
	Input: A material asset delivered by a media creation process, e.g., goods receipt, electronic news gathering, material editing; a formal description of the media asset delivered by the material annotation processes
	Output: A material package, containing one or more media assets including embedded identification and annotation
Query	Although being an important functionality of any one Material Warehouse/Media Asset Management system, the query process is not that visible in regular news production, unless archived material has to be searched for to be reused for documentary purposes. This particular application has not been discussed in the context of this paper in order to restrict to the core functionality. Of course implicit queries are needed, for example, to search for and fetch the relevant material within a material package if it is needed within the material editing process. In this particular case, identifiers of media assets and the formal description (which is in its turn an aggregate of identifiers to all kinds of annotations) are needed to build the underlying query.
Publish	*Mastering* is the process of packaging and labelling as function of the distribution channel, client capabilities, and/or user preferences.
	Input: a distribution order; an approved rundown issued by the news production process; a material package issued by the material warehouse
	Output: one or more finished products (linear or non-linear assemblies) that are ready for distribution
Distribute	The *distribution* processes are triggered by a distribution order issued by the sales and operations planning process. By transmission, physical distribution, or any other means of making available, it issues the finished product delivered by the mastering process following the specifications of the distribution order (distribution channels, window of availability, conditional access, etc.)
	Input: a finished product (linear or non-linear assembly) delivered by the mastering process
	Output: a product is delivered to the outside world