ICT capabilities for supporting collaborative work on business processes within the digital content industry

Oscar González-Rojas *, Dario Correal, Manuel Camargo

Systems and Computing Engineering Department, School of Engineering, Universidad de los Andes, Bogotá, Colombia

ABSTRACT

The digital content industry requires the integration of specialized information and communications technology (ICT) capabilities to support collaborative work for planning and executing its business processes. In particular, this knowledge-intensive industry lacks for adequate control on product documentation, inter and intra organizational resources management, and process monitoring which is required for supporting the high demand of projects typically constrained in time, costs, and quality. This paper presents a defined maturity model named DigiCoMM to assess collaboration and interoperability capabilities that are specific to pre-production, production, and post-production processes within the digital content industry. It also presents MONO, a computer-supported collaborative work (CSCW) software for supporting the incremental transition of companies through the different levels of the maturity model. MONO was developed in the context of the DAVID research project (Strategic Programme for the Research and Development of the Colombian Animation and Video Games Industry), during the period of 2012–2015. This model and software were used to assess and support the collaborative capabilities of several animation and video game companies in Colombia.

1. Introduction

The industry of digital content development is one of the most dynamic and growing industries worldwide. Its main markets are animation and video games, which have shown a constant annual growth of 7% and 11% in their revenues, respectively [1,2]. This has motivated different economies, especially emerging ones, to promote the industry in order to meet the great demand of services worldwide. Colombia, for example, decided to invest in boosting productivity in this industry in order to increase income generation and the number of domestic jobs [3].

Nevertheless, the digital content industry is relatively young in Colombia—in 2012, 81% of companies had been created in the last five years [4]—and its related companies are rather small with an average of five employees [4]. Even so, this industry demands projects that may require tens or hundreds of people to perform them throughout short periods of time, and which have controlled and competitive quality and production costs. On the other hand, the artistic nature of this industry is usually associated with informality in the execution of its processes [5]. Therefore, it is necessary to define and control inter-organizational production

processes aiming at coordinated work and also at a continuous pursuit of optimization opportunities [6]. The definition of solution strategies to support these opportunities requires new methods to measure capabilities on collaborative work and continuous improvement within business processes [7–9].

This paper presents two artifacts designed and implemented to support collaborative work between companies. First, we present a defined maturity model to assess the collaboration and interoperability capabilities required to manage projects and processes that are specific to the digital content industry. These capabilities cover inter and intra organizational capabilities. Second, we describe how each of the various levels of the maturity model can be achieved incrementally by using different capabilities of a software tool called MONO. This tool allows the definition, configuration, implementation and monitoring of collaborative processes and projects. MONO was developed during the period of 2012–2015, in the context of the DAVID research project (Strategic Programme for the Research and Development of the Colombian Animation and Video Games Industry).

This paper is structured as follows. Section 2 presents the main concepts and requirements that motivated the creation of the maturity model. Section 3 details the work areas and maturity levels of the proposed model. Section 4 explains the main features of the MONO tool and how it can support companies within the industry in their transition between different levels of the

* Corresponding author. Tel.: +57 13394949x1818/2860; fax: +57 13324325.
E-mail address: o-gonza1@uniandes.edu.co (O. González-Rojas).

maturity model. Section 5 compares the maturity level for several companies that were evaluated at an initial level and after adopting certain MONO capabilities. Lastly, conclusions and future work are presented.

2. Preliminaries and motivation

This section presents the main concepts used throughout the article, followed by the main capabilities identified in a research project developed during 2013–2015 for the industry of digital content development. The results of this project justify the need for a maturity model with specific and incremental support in relation to the capabilities required to perform business processes. Lastly, we present the open problems identified in the literature review for controlling these industry-specific capabilities.

2.1. Capabilities and capability models

A *capability* can be defined as a particular ability owned by an entity (*e.g.*, organization, person, system) to achieve a specific goal [10]. The use of these abilities is determined by a combination of resources (*e.g.*, people, processes, technology) [11], and by how those resources are managed in order to respond to market conditions [12].

This definition may imply that a certain capability can only be suited for a specific organization. However, capabilities can also be defined for an industry (*e.g.*, manufacture, oil and gas, services). Eisenhardt and Martin [12] consider the development of capabilities as practices and routines performed individually by companies within a restricted context. If those individual routines face the same problems in the same restricted context, they will eventually converge toward the same point. Lampel and Shamsie [13] indicate that new capabilities within an industry can be the result of an innovation-imitation cycle, where a leading company in the industry develops a new capability that is later adopted by other companies; meanwhile, Huygens et al. [14] relate the further development of those capabilities to the evolution of the industry as a whole.

Since organizations within an industry share capabilities, the differentiating factor has to be the administration of the available resources, the application of such capabilities, and their continuous improvement and evolution over time [13]. A maturity model approach can differentiate the companies that are adapting existing capabilities within the industry from those that are continually improving and innovating toward new capabilities.

The *capability maturity model* (CMM) was initially developed to measure the performance of key process areas within the software-development and maintenance capability [15]. The CMM was later adjusted to fit different elements such as people (P-CMM), process improvement (CMMI—capability maturity model integration) and applied to different industries such as services (CMMI-SVC), and product and service acquisition (CMMI-ACQ). The CMM proposes five maturity levels (*i.e.*, initial, managed, defined, quantitatively managed and optimized). Each level represents a set of capabilities performed by the organization— each with specific characteristics, as well as a foundation for the next level. Therefore, the CMM is a tool that describes how an organization manages its capabilities, and provides guidance on how to improve those capabilities over time [16].

2.2. Capabilities required by the digital content creation industry

The digital content creation industry, as all creative industries, creates value through the use of creativity and individual skills [17,18]. Digital content creation can be divided into three big stages: pre-production, production and post-production. Pre-production

relates to the conceptualization of the project (*e.g.*, define the idea, plan how to produce it), production is the actual development of the project (according to the plan defined on pre-production) and post-production is where the content is edited to its final state [19].

Throughout three years of work, the DAVID project has conducted many actions to support the sector of animation and videogames in Colombia. These actions include the development of tools to support production processes, which seek to ensure that companies can easily monitor and implement such processes, especially when working in a collaborative inter-organizational environment. Such efforts entailed working hand in hand with 72 companies from the videogames, animation development and musical composition sector. Different activities were performed to identify their problems and needs: on-site interviews, more than 300 surveys, and analysis of documentation. At the end, 31 business processes were specified in detail (up to tasks descriptions).

During the execution of the DAVID project, the following problems and challenges were found in different companies.

2.2.1. P1. Un-controlled projects

A high degree of improvization prevails throughout the planning of projects, which leads to many difficulties in the implementation phases, including cost overruns, delays and constant changes in the scope and requirements of projects. Furthermore, cost control is practically zero, thus, the cost and profits of a project are unknown, even after it has already been executed. Also, there is no control and monitoring of the implementation—cost, schedule, state, and quality and technical advancement, thus making it difficult to make decisions toward improvement and resources optimization.

A key challenge is to provide a quick and flexible collaborative environment for configuring, developing and monitoring projects intra- and inter-company. Likewise, collaboration implies facilitating the incorporation of new resources (people, licenses, hardware, software, media assets), either from the same company or from other companies, to coordinate efforts for the implementation of a project. There is a clear need to incorporate tools and methods to support project management [20], however, these project-oriented capabilities must be specialized and adapted to the reality of the digital content industry (*i.e.*, high variability in requirements and resources).

2.2.2. P2. Ad-hoc processes

In Colombia, the development of digital content is perceived as an art, rather than as an industry. This has led to a lack of formalization regarding development processes, thus causing implementation to be dependent on the people involved and on the instant in time when it is developed. The latter, combined with the high turnover of human resources that prevails in the sector, creates problems of traceability and scalability. Moreover, these processes must be properly managed to support the adaptation to the hyper-competition and the fragmentation of the market into small niches, and the creation of innovative proposals delivered efficiently [21,22].

Process-oriented capabilities for the digital content industry must allow modeling, automating and executing business processes supporting the various stages of design and editing of digital content. These capabilities are required for controlling the performance of process executions (cost, time, resource utilization), especially when they are performed by distributed participants. It is necessary to define baseline inter-company production processes in order to promote collaboration and competitiveness between companies in the sector. This entails a uniform way of working and a continuous search for optimization opportunities, and facilitates the coordination and alignment of resources between organizations that are part of the collaborative