Combining CMMI with Serious Gaming and e-Learning to Support Skill Assessment and Development in Tourism

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Abstract:

Experiences from several European projects which are focusing on issues like serious gaming (project PRIME), e-learning activities (project SMART-UP), and assessment methods (project COIN) serve as case studies to learn more about the integration of these methods to better support skill assessment and development. The purpose of this paper is to present an integrated concept supporting skill development based on assessment. On the one hand e-learning approaches could extremely benefit by applying the serious game paradigm. Furthermore assessment methods as CMMI and EFQM have emerged also in such areas as shaping the specific areas of interest (continuous vs. staged representation). Thus, on the other hand according of the results of these assessments goal-oriented improvement measures will be initialized.

1 Introduction

This paper focuses on CMMI (Capability Maturity Models Integrated) which has a clear structure: to each maturity level a set of process areas are assigned which in turn are defined by specific goals and practices. The first part of the paper outlines that these assessments are able to reveal the respective maturity level of the learner/player. Certainly, these assessments can also explain which process areas and specific goals were not met. According to the results of these assessments, goal oriented improvement measures will be initialized. In the past, a large number of tele-learning and/or e-learning projects were set up - many of them fostered by the EU but also funded by the industry. However, the results were not as satisfying as expected. Whenever self-assessment and/or feedback tools were provided it was not really a breakthrough. The reasons remain unclear: Maybe the self-assessment questions were too simple or too difficult or an unqualified (untrained) tutor was in charge. Detailed results are presented in the EU IST project SMART-UP where small and medium-sized enterprises (SME) in tourism should be trained in specific tourism process areas as Quality Management, Human Resource Management, E-Tourism or Capacity Management.

The European project PRIME dealt with strategic manufacturing knowledge creation by the application of serious gaming. This project reveals that gaming seems to have a huge potential for motivating learners to perform trial and error processes (as software developers did in the past) within complex tasks like setting up a company, solving supply chain activities, etc.
From a totally different direction the so-called prevailing assessment methods come into play. Originally, CMMI was developed to support U.S. Department of Defense (DoD) to select among bidders of SW projects (e.g. the Star Wars Programme of President Reagan in the late 80’s) according their maturity level. Exactly this maturity level model enables support in the assessment in game based learning settings as it provides flexible settings of process areas which are linked to maturity levels assigned goals and practices per process area. Thus, a modified CMMI approach could be a solution which on the one hand is widely applied within the industry since years and on the other hand is flexible enough to capture new areas of application (project COIN).

The intended approach can be applied e.g. in tourism for ‘capacity planning’, where a respective serious game must consider following issues: origin of guest arrivals, booking rate of a comparable period, weather forecast, unemployment rate ... According this information the player has to define prices for rooms, the game will present key performance indicators (e.g. vacancy of remaining rooms) based on this data.

In this paper the underlying theory will be introduced and critically discussed and it will be shown how the established methodologies as e-learning, serious gaming and CMMI could be successfully combined in order to develop skill assessment and development means.

2 Theory

Starting with process areas specific goals are required, and to meet them specific practices are expected. To fulfill these practices respective sub practices and work products must be established.

Serious gaming may easily support this process area concept. Experiences with PRIME [7] have shown that for each process area – however it was not called so in that context – it is important to find representative Key Performance Indicators (KPI’s). These KPIs can be used to measure specific goal fulfillment in CMMI. All other mentioned issues, such as specific practices, sub practices, and typical work products, will also become a matter of the game – i.e. gamers have the choice to select one of these items and will wonder if they meet their specific goals. If a serious game is implemented in such a way, it’s very easy to assess, if learners/gamers have met the objectives. If there are principle difficulties, he/she may go back to the e-learning system where the issues are explained and start again with a new game.

The advantage of applying a modified CMMI would be above all that there are enough tools in place and excellent presentation of feedback, which make clear what specific goals / sub practices are missing.

The serious game represents the linking framework of the concept. The game needs to be designed in such a way that the process areas under consideration are covered. Capacity management is done by fulfilling specific objectives (scores) within the game. E-Learning materials need also be accessible directly from the game client. The e-Learning content should be structured in a CMMI compliant manner.

The basic requirements for such a serious game are:

- Appropriate specific goals and practices need to be established for each of the tourism process areas including respective e-learning content.
- An important component of the serious gaming approach is the collaboration between players/learners, which is especially important for domains like tourism.
The game needs to provide CSCW (Computer Supported Cooperative Work) features, where gamers are enabled to communicate, negotiate, setting up contracts together, etc.

In a simulated environment like a serious game, the assessment is not limited to assess individuals only. Furthermore, the outcome of a team might be the right measure of success. This also allows the analysis of player’s behavior as a team member.

3 Methodology

3.1 Capability Maturity Models

Primarily CMMI® [6] was developed at the SEI (Software Engineering Institute) on behalf of the Department of Defense (DoD) in the U.S.A. in order to establish a model that identifies mature and capable enterprises in the market that are able to manage SW projects for the DoD. In the meantime the original intention of CMMI® changed: it can now be interpreted as an instrument to find strengths and weaknesses of organizations in specific process areas where appropriate improvement measures should be implemented [3].

In the current marketplace, there are maturity models, standards, methodologies, and guidelines that can help an organization to improve business operations. However, most available improvement approaches focus on a specific part of the business and do not take a systemic approach to the problems that most organizations are facing. By focusing on improving one single area of a business (e.g., such as marketing or distribution), area focused models unfortunately have perpetuated the stovepipes and barriers that exist in organizations [3].

**Constellations**

This improvement framework can also be applied to other areas of interest, where the framework groups best practices into what is called “constellations.” A constellation is a collection of CMMI components that are used to build models, training materials, and appraisal documents.

Recently, the CMMI® model architecture was improved to support multiple constellations and the sharing of best practices among constellations and their member models. Work has begun on two new constellations (see Figure 1): one for services (CMMI® for Services) and the other for acquisition (CMMI® for Acquisition).

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**Figure 1: CMMI® Constellations [3]**
**Representations**

*Continuous representation* enables organizations to select a process area (or group of process areas) and improve related processes. This representation uses capability levels to characterize improvement relative to an individual process area.

The *staged representation* uses predefined sets of process areas to define an improvement path for an organization. This improvement path is characterized by maturity levels. Each maturity level provides a set of process areas that characterize different organizational behaviors [3].

**Process Areas**

A process area is a cluster of related practices in an area that, when implemented collectively, satisfy a set of goals considered important for making improvement in that area.

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Table 1: CMMI® Process Areas

There are 22 process areas, as presented in Table 1 in alphabetical order by acronym (see [3]).

**3.2 Serious Gaming**

In the knowledge society, life long learning is essential for knowledge workers in their work processes. All learning tools, methodologies and content that mainly consist of digital support can be considered as e-Learning. Serious games are computer and/or video games used beside entertaining goals for educational technology. Serious games can be of any genre and many of them can be considered a kind of edutainment. Computer based serious games are an e-Learning methodology [12].

Before the term Serious Game was coined, games were already being developed for non-entertainment purposes. During the late 1990’s, a number of scholars began to examine the utility of games for other purposes, including e.g. early work by Henry Jenkins at MIT. Additionally, the ability of games to contribute to training expanded at the same time with the development of multi-player gaming. In 2002, the "Serious Games Initiative" was launched to encourage the development of games that address policy and management issues. More focused sub-groups appeared since 2004, including Games for Change, which focuses on social issues and social change, and Games for Health which addresses health care applications [1].

Serious games are considered as the next evolutionary generation of learning tools, which address some of the short-comings of its predecessors. A serious game could be a simulation that has the look and feel of a game, but corresponds to non-game areas, including e.g. business operations, military operations or medical applications. The games are intended to provide an engaging, self-reinforcing context in which to motivate and educate the players. Through modifying existing game applications for educational purposes there is great
potential for learning with games [5]. The application of serious gaming technology is expected to improve European competitiveness [7].

### 3.3 SMEs in Tourism: the Need for CMMI® Solutions

Tourism seems to be an appropriate example, where improvements both in collaboration but also service provision are extremely important. That’s why the envisaged assessment method could benefit SMEs in tourism (SMTEs).

As mentioned above, CMMI® can support the improvement of management processes. This also holds true for service enterprises: However, the majority of leisure and tourism businesses are small or medium-sized and a large number of them are family businesses [2]. SMTEs have not merely strategic disadvantages as described in [11]. Nevertheless the majority of disadvantages of SMTEs exist because small enterprises suffer from lacking economies of scale and scope. This results to high fixed costs and relatively high costs per unit.

These advantages and disadvantages contour strategy alternatives for small- and medium-sized tourism enterprises. Thus possibilities to reduce cost of production hardly exist, while on the other hand differentiation strategies often fail due to SME owner/managers’ short term (myopic) thinking and lack of market research capabilities. It should therefore be possible to communicate the benefits (efficiency and effectiveness) of strategic co-operations within given destinations among small- and medium-sized enterprises and entrepreneurs with respect to these new forms of management [9]. Advantages of local, interregional and / or national co-operations could provide for additional resources, reduced costs and risks in product development, new markets, improved qualifications and/or increased competitiveness.

When having a closer look at the knowledge and qualification hurdle recent industry developments revealed gaps in special SMTEs’ knowledge areas. Much of the differences in the innovation behavior between industrial and service sectors are associated with the different nature and characteristics of services-production and –marketing. Six aspects of services production/marketing in the tourism sector stand out in particular, i.e.:

- Intangibility of services and the associated quality uncertainty of customers,
- Simultaneity of production and consumption of services,
- Non-storability of services,
- High risks/cost associated with fluctuations in the rate of capacity utilization,
- Difficulty in correctly forecasting consumer needs and preferences for hospitality and tourism services and
- Sensitivity of services production to increases in labour cost on account of labour intensity of services production [4].

These characteristics of tourism services lead to an increasing demand for entrepreneurial and managerial qualifications in the following management areas:

- Quality management
- Capacity Management
- Product development
- Human resource management
- eCommerce
**Determination of Tourism oriented Process Areas**

The pilot project SMART-UP cut in on the weaknesses of SMTEs as described above and developed an internet learning and know-how transfer platform for (owner) managers in the tourism industry [10]. Four modules have been developed according to market-research on qualification needs of SMTE entrepreneurs: Quality Management, Yield Management, Human Resource Management, Product Development and eCommerce. In the following, the area of quality management serves as a case study example to adapt a CMM process in SMTEs.

In a first step SMTEs have to identify needs to select a process area by a mode of representation. For SMTEs both forms of representation are challenging, as in the case of continuous representation the SME owner or entrepreneur should be aware which qualification areas can be chosen as process areas. In addition, owner manager have to understand the dependencies between various process areas. For many SMTEs staged representation can be recommended because many owner managers do not really know where they can start with process improvements.

For small businesses many of these requests force them to radically change common patterns of management: constant learning has to be reported and discussed and an open as well as strategic and long-term oriented learning process is a prerequisite for the implementation of CMMI in SMTEs.

**4 Expected Results**

After a thorough analysis of the shortcomings of SMART-UP two reasons were evaluated:

- Self assessment tests were not well accepted.
- E-learning material (mostly presented as slides) could not really convince the participants, who were either hotel owners or employees in hotels.

Therefore CMMI was selected because of its clear and well accepted structure and on the other hand as it supports very well an objective assessment of the accomplished knowledge emphasizing the participants’ behavior within a team.

Furthermore serious gaming (a specific method of e-learning should overcome the obstacles that participants are not interested in the way of presenting the learning material.

As both SMART-UP partners as also the provided e-learning platform is available endeavors will be undertaken to develop respective serious games for the six mentioned tourism process areas. Within the SMART-UP project more than 150 SME’s were registered to trial the e-learning system but their feedback was not very promising. So the new approach with the same SME’s should prove the anticipation that serious gaming is better accepted by learners especially in the tourism domain where mostly young people are employed.

Moreover, the CMMI Check-a three day modification of the classical CMMI Assessment – will be adapted to the mentioned tourism process areas. Serious Gaming on the other hand has proven in the course of the EU project COIN that it has a high potential for requirement collection. Of course, the selected gaming software needs to be adapted to the process areas of the tourism sector.
5 Conclusions

This paper presented a concept on integrating CMMI and E-Learning into a serious gaming environment. The objective of this approach is to overcome known obstacles in skill assessment and skill development of traditional E-Learning approaches. The application of this concept will be the tourism sector.

The combined approach of E-Learning, Serious Gaming, and CMMI should have the following strengths.

Motivation of learners: especially in the field of small business entrepreneurs’ learning research identified a number of barriers. SMART-UP attempted to motivate entrepreneurs to gather knowledge via e-learning but, as other projects before, faced typical hurdles: e.g. small business owners are hardly aware of long-term benefits and do not want to put too much effort or time in learning processes. Instead they try to manage operative business challenges. As small business entrepreneurs are heavily involved in operational management they should learn to sometimes refrain from the daily business to refresh thoughts and to perform some long-term business development.

Directed improvement measures: the authors were able to highlight that CMMI strengthens improvement measures and provides useful information for decision-makers when evaluating their decisions and strategic options.

Assessment of team collaboration: both for practitioners and researchers the assessment of team collaboration is of utmost importance. Entrepreneurs might learn how fruitful collaborative learning agreements can be, researchers need to gather more knowledge about the learning behavior of small businesses: while some knowledge about individual learning behavior exists, more investigations are needed in the field of collaborative learning of decision-makers within enterprises (e.g. family businesses) or between different enterprises.

As outlined above, there is still some development and adaptation work to be done before evaluation of the concept can take place. The most important adaptations concern:

• Modification of the classical CMMI process areas including sub-structures like tasks and work results.
• Development of supporting E-Learning materials reflecting the modified CMMI process areas including sub-structures.
• Selection and adaptation of a serious gaming engine to make the modified CMMI approach playable. The gaming engine should also provide a mechanism to integrate access to the E-Learning materials.

The approach presented in this paper is expected to have the following advantages compared to traditional approaches:

• The application of serious gaming supports strongly the motivation of the players. Learners have a safe trial and error environment to get acquainted with knew knowledge. A strong motivation also supports the skill development of learners.
• The players are provided with directed improvement measures (performance indicators), which allow a better self-assessment of their learning success. The direct success to E-Learning materials makes it easy to explain the outcomes of gaming sessions.
• Facilitators of the game have a tool for the assessment of team collaboration.

References:


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