RESEARCH PAPER: GAMIFICATION RESHAPES THE GLOBAL ECONOMY

FROM INDUSTRIAL REVOLUTION TO THE GLOBAL KNOWLEDGE REVOLUTION

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ABSTRACT

The race towards developing technologies, systems and management models to support organization development, leadership and prosperity created a complexity hard to manage within the existing workforce, especially in the developed world.

The need for simplicity, mobility and accessibility were the major drivers towards creating a new discipline that can make technology 'gamified' for it to be used in a secure and controlled environment by everyone.

Gamification can be seen as a new element in the technological revolution that can change the way people interact with technology and the way technology gets integrated with the current needs of the global economy and society. Gamification is not about making games, but a new culture driven by motivation and activation factors towards moving the gaming experience in the industry. This paper attempts to identify the role of gamification in the global economy, redefine the gamification concept under new uses of game technologies and indicate its significant impact in modern organizational management.

1. INTRODUCTION: CONTINUOUS REVOLUTIONS

The Industrial Revolution marks a major turning point in history; almost every aspect of daily life was influenced in some way by it. Economists say that the major impact of the Industrial Revolution was that the standard of living for the general population began to increase consistently for the first time in history, although others have said that it didn't begin to meaningfully improve until the late 19th to mid-20th century [1], [2], [3].

After the initial revolution, a second revolution gradually grew that included chemicals, most notably petroleum (refining and distribution), and, in the 20th century, the automotive industries developed, marking a transition of technological leadership from Britain to the United States and Germany [4], [5]. A third revolution began with electricity and electrification, and the introduction of hydroelectric power generation in the Alps enabled the rapid industrialization of coal-deprived northern Italy at the beginning of the 1890s.

Until the 1980s, it was universally believed by historians that technological innovation was the heart of the Industrial Revolution and the key enabling technology was the invention and improvement of the steam engine [6]. However, recent research into the marketing era has challenged the traditional, supply-oriented interpretation of the Industrial Revolution [7].

The information revolution, a fourth revolution, describes the development of technologies (such as computers, digital communication and microchips) in the second half of the 20th century that has led to a dramatic reduction in the cost of obtaining, processing, storing, and transmitting information in all forms (text, graphics, audio, video, etcetera)[8], while the knowledge revolution is about a fundamental socioeconomic change from adding value by producing things which is ultimately limited to adding value by creating and using knowledge which can grow indefinitely [9].

These five are certainly not the only revolutions, yet they indicate a continuous effort of humanity towards achieving more for less. Automation, information, and knowledge marked the key generations of the Industrial Revolution's evolution, but still there is more ahead as the integration of the characteristics of each generation creates the needs towards the next supposedly impossible target.

2. TECHNOLOGY BASED MANAGEMENT

The latest generations of the industrial revolutions emphasize the utilization of technology in conjunction with the preexisting knowledge within an organization. By understanding organizational needs, technology is used accordingly as the core tool for optimization, efficiency and productivity. This new management paradigm created the discipline of technology management, a set of management disciplines that allows organizations to manage their technological fundamentals to create competitive advantages [10].

Technology management can also be defined as the integrated planning, design, optimization, operation and control of technological products, processes and services. A better definition would be the management of the use of technology for human advantage. The Association of Technology, Management and Applied Engineering defines technology

management as the field concerned with the supervision of personnel across the technical spectrum as well as across the wide variety of complex technological systems.

Technology management programs typically include instruction in production and operations management, project management, computer applications, quality control, safety and health issues, statistics, and general management principles.

In the last three decades, technology based management was the approach adapted by most organizations in nearly all industries. They believed that information technology automation can reduce costs, increase productivity, efficiency and operations, and created a race between organizations to adopt the newest technologies in an attempt to increase or maintain their position or lead in the market [11].

Technology on the other hand is an equation with the organizational needs on one side and organizational knowledge at the other. Needs cannot be defined if organizational knowledge does not exist to define them properly. Going after technological trends does not assure the best solutions and desired results. After great disappoints, organizations understood that technology without organizational knowledge is not part of the solution, but part of the problem.

3. KNOWLEDGE BASED STRATEGIC MANAGEMENT

The organizational knowledge required for the effective utilization of the automation has been the inflection point in the modern industrialization period. The plethora of technology on offer creates more problems than the ones it solves – if technology is not adapted based on the capability and the maturity of an organization.

Knowledge drives all progressive activities; initiatives, projects, processes and anything that can be considered a step ahead in business and personal development. Despite the fact that knowledge is certainly the magic recipe, it has always been extremely difficult to define what knowledge is and what it is not. The distance between knowledge creation and knowledge utilization is tremendous as there are many steps that interfere in this interpretation, as well as in the transformation of knowledge into something that can be capitalized successfully, effectively and rewardingly.

Today, knowledge management can be defined as the process of capturing, developing, sharing, and effectively using organizational knowledge [12]. It refers to a multi-disciplined approach to achieving

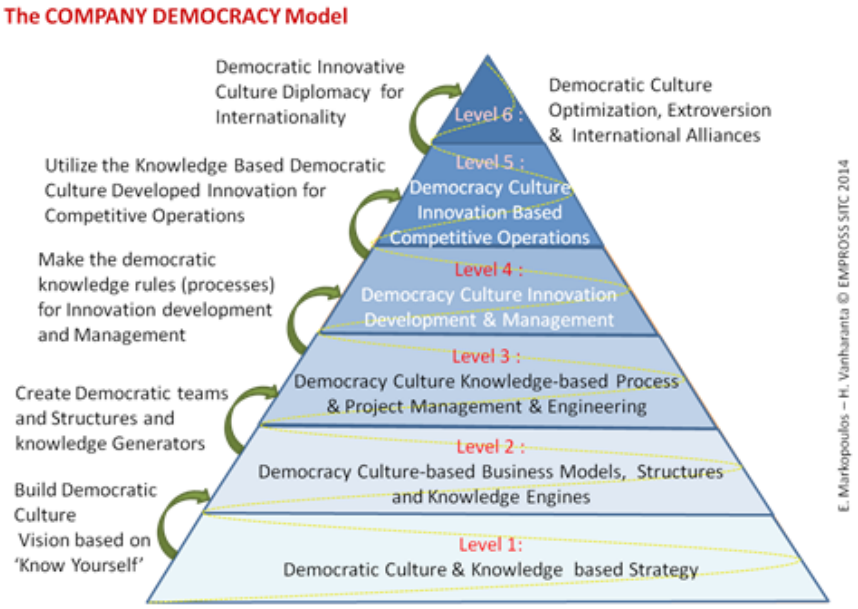

Figure 1. The Company Democracy Model Levels Structure.

organizational objectives by making the best use of knowledge [13]. Knowledge management efforts typically focus on organizational objectives such as improved performance, competitive advantage, innovation, the sharing of lessons learned, integration, and continuous improvement of the organization [14].

It is organizational knowledge that drives innovation, which in turn drives development and prosperity. Organizations fail not because they cannot solve their problems, but because they cannot recognize and find them in the first place. Understanding organizational needs and/or industry trends requires knowledge management models to utilize the organizational knowledge which exists in the people. It is the people who define what is innovative and what is not; what is a solution and what is a failure; as they are the ones called on to apply organizational strategies. The challenge in knowledge based management strategies and leadership is the continuous elicitation of knowledge and its transformation to applied innovation.

A model for knowledge-based strategic management and leadership that significantly promotes applied innovation is the company democracy model visible in Figure 1. This model is based on the utilization of organizational knowledge through democratic methods and practices in knowledge culture, creation, extraction, and sharing – all points toward shared goals and objectives [15].

Problem identification and exploitation of possible solutions are approached in the company democracy model by integrating the concept of democracy for everyone, as long as their problems, needs, ideas or wishes are supported by a solution offering shared value of any type or size.

The model is executed through a framework in which an organizational evolutionary spiral method is utilized for the creation and execution of knowledge-based democratic cultures for effective organizational knowledge-based management and strategic leadership [16]. The co-evolutionary spiral method in the model contributes towards the identification and achievement of the capacity, capability, competence, and maturity needed to turn information and knowledge into innovations [17]. The spiral process, in this context, is based on the idea of the degree of democracy in organizations.

The integrated company democracy model supports an interdisciplinary approach (management strategy, knowledge, innovation, human resources, technology, production, leadership, quality, processes, innovation, research and development, etcetera). It is a union of administrative and technocratic processes in an anthropocentric method that directs all sciences and practices towards the effort to unite people through the freedom of expression and to produce knowledge as raw material for innovation – to challenge complexity with simplification.

4. SIMPLIFYING COMPLEXITY

The evolution of the Industrial Revolution from industrialization to automation and from the technology management to the knowledge management indicates the needs of the port industry and society for creative simplicity. The need for achieving more for less is highly associated with simplicity that needs to

exist in every organizational operation. More productivity with less effort, more efficiency with less errors, and profitability with less expenses requires the primary preservation of sources.

Complexity derives from simplicity, but simplicity requires complexity to become simple enough to achieve complex results [18]. Knowledge management contributes towards making complex things simple through the utilization and integration of the people's knowledge, capability and maturity in the organizational processes and systems. The integration of behavioral sciences within the engineering and management sciences generates the multidisciplinary field of cognitive sciences.

One of the areas cognitive science studies is the simplification of organizational process to be understood and accepted by the capability and maturity of the personnel. By making organizational systems and processes simple, we can assure high-adaptability, and in turn produce the desired results, regardless how complex they can be. People have been trained to believe, not to think, therefore many simplified frameworks that can form a complex organizational ecosystem are much more likely to be followed than a complex process in a simplified system.

This has become a necessity to the Western world as less people have the capability to perform in high capacity or complex tasks. In the New York Times article, 'Why Science Majors Change Their Minds (It's Just So Darn Hard)' [19], it is reported that about 60% of US college students who have started with the intention of getting a science, technology, engineering or mathematics (STEM) degree switch to a non-STEM major, or quit entirely. Although getting a degree can prove to be difficult, obtaining a degree in a STEM field is even more difficult. This result is alarming, as business leaders as well as government officials believe that the only way for the US to remain economically competitive is to have more students, and in turn more professionals, with STEM degrees.

This of courses is not only a US problem. Deutsche Welle, Germany's public broadcaster, reported that Germany needs more immigrants of qualified labour, primarily from the non-EU countries to maintain its needs. Today, Europe has very high unemployment among college graduates, but at the same time there is a severe shortage of technology workers.

In the past five years the need for 'technologically skilled workers' has increased from 16% in 2012 to 25% in 2013. The Association of German Engineers reported that the shortage of electrical engineers, mechanical engineers and software developers is "so severe" [20]. In June, they reported that there were 76,400 vacant engineering jobs – an all-time high [21]. Over the long term, at least until 2050, Germany will need to attract an average of 533,000 immigrants per year, plus the number of those that emigrate from the country, according to a study released by the Bertelsmann Foundation on March 27, 2015 [22].

On the contrary, there are countries that

export high-skilled qualified professionals in the STEM sciences, primarily from Eastern Europe and Asia. Greece, for example, contributed to the German economy with more than 90,000 scientists during the years of the financial crisis, most of those scientists holding doctorate degrees [23].

The reduction of the STEM professional in most of the countries of the Western world who benefitted the most from the Industrial Revolution is now being considered as a major threat to the global economy. Therefore the need for the best possible utilization of the existing workforce needs to be achieved as soon as possible. Knowledge management is a significant approach towards understanding the capability and maturity of the organizational workforce in order to adjust around technologies that can do complex work in a simplified way.

Understanding the limits of what one can do is half the solution. The other half is to develop the processes and systems that can be used. The challenge of hiding operational complexity into simplified processes and technology can be achieved via the upcoming discipline of gamification.

5. THE GAMIFICATION DISCIPLINE.

Gamification as an academic field, management and operations practice is still in its infancy and treated as an original idea. A definition that is frequently cited in relative works presents gamification as the incorporation of game elements into non-game contexts [24]. The word gamification could refer to games created with the purpose of turning a tiresome and hard task into an engaging activity, while the incorporation of educational features is desirable.

Furthermore, gamification may refer to the evolvement of an existing structure, like a website, an enterprise application or an online community, to an educational tool by applying some of the techniques and ideas that make games appealing. In other words, gamification is the strategy which uses game mechanics and techniques in order to drive user behaviour by increasing self-contribution.

Gamification is a popular topic among business professionals as well as the academia and it is exercised in sectors such as engineering, medicine and military. It is described as serious games, pointification, behavioural games and games with a purpose, with the aforementioned terms being similar, yet different.

The work of Seaborn and Fels [25] is proposed where several definitions of gamification and the related concepts are categorized and elucidated. Gamification is considered by industries as a tool for supplementing branding initiatives, or as a business strategy tool [26], [27]. In fact, it has been estimated that by 2015 more than 50% of organizations that manage innovation processes will gamify some aspects of their businesses [28].

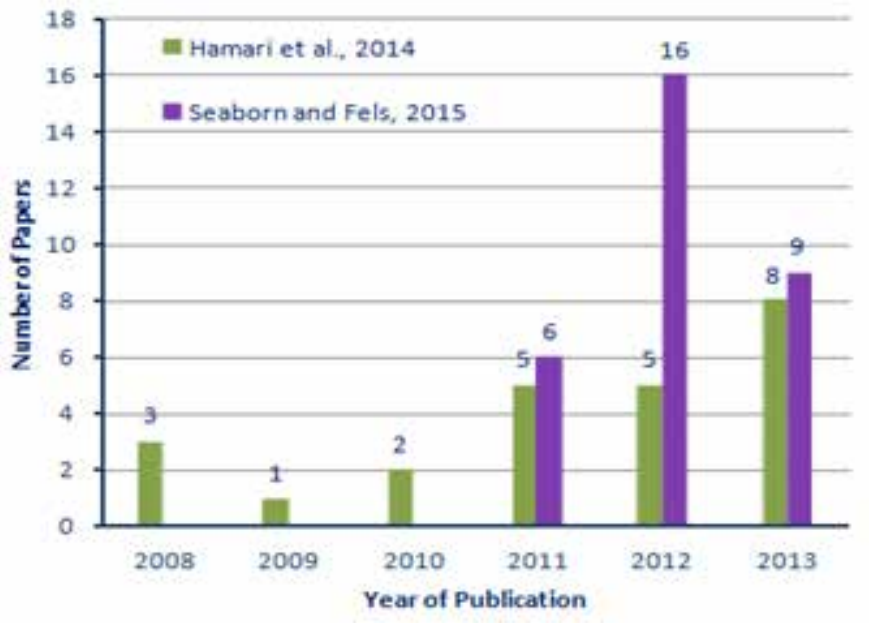

Figure 2: Literature survey on gamification

In the business world and from the standpoint of the entity that applies gamification on its processes and products, there are a lot of benefits to be gained. Although they vary from sector to sector, they can be quantified up to a certain degree in measurable metrics. Some of these metrics include engagement, influence, loyalty, user generated content, time spent and viral appeal, and of course the simple, yet unquantifiable concept of fun, which is probably the main reason for which a game is played.

On the other hand, gamification is criticized because popular gamification strategies are considered sterile, artificial and simply not interesting enough. An opposing community is the game designers who feel that gamification excludes elements like storytelling and experience, focusing instead on simple reward systems. Some critics allege that gamification is a populist idea which does not benefit the ordinary user but rather the business that incorporates it into its content.

Nevertheless, a scientific approach of gamification is needed. Hamari et al. [29] searched well-known databases, including Web of Science, Scopus, Google Scholar, EBSCOHost, ACM Digital library, AI Seland Proquest, for papers including the terms gamification, gamif*, gameful and motivational affordance in the title, abstract, keywords and main body of the texts.

From the query more than 7,500 texts were collected, comprising peer-reviewed papers and other works. From the analysis of the results, only 24 unique, peer-reviewed, empirical research papers were identified, mostly from computer science conferences. Seaborn and Fels [25] conducted a similar literature survey in EBSCOHost, JSTOR, Ovid, ProQuest, PubMed, Scopus and Web of Science databases. All subject areas were searched, as gamification is a multidisciplinary term, with “gamification OR gamif*” keyword search in books, journals, conference proceedings, reports, theses and dissertations.

The search resulted in 769 works, reduced to 31 papers after the authors processed the data. In this search conference papers were the larger group of documents. This can be justified by the fact that as a relatively new topic, works appear first in conferences rather than scientific journals. The graph of Figure2 shows that the papers from the aforementioned surveys are new and grow in number each year; note that although in the second survey there are nine papers reported for 2013, the search of the authors covered only the first seven months of that year [25]. Nevertheless, there are strong indications that the interest in gamification is growing and more theory papers and empirical investigations are reported in scientific journals by the day [30], [31].

6. GAMES, GAMERS, GAMIFICATION TYPES AND GAME MECHANICS

Before examining gamification, its building blocks – i.e. the games themselves – must be studied. Everybody is familiar with

games, mainly through experience. Games have changed over the last 40 years with the huge technological advancements of information technology and the vast commercialization of computers. Although computer game characteristics are recognized almost everywhere, it is argued that computer games either play a big part in modern life, or they are a pastime for male children or teenagers. Statistical data may be used to exhibit the penetration of digital games in modern society and provide the profile of the average gamer [32], [33], [34].

Almost 40% of all gamers in the US are 36 years of age or older; thus clearly not only children play games. The average gamer age is 37 years, with 12 years of gaming experience, while gamers older than 50 years old make up 29% of gamers, according to 2011 results, with an increase of 20% since 1999. Furthermore, the percentage of female gamers in the US was at 48% in the 2011 results (and likely growing) while the percentage of female gamers rose from 10% to 49% in France from 1999 - 2013. Moreover, female gamers are mainly so called mobile social gamers. Actually, the majority of mobile social gamers older than 28 years of age are typically female gamers [35].

Games have a significant presence at home and at work. It is estimated that 77% of American households own videogames. In Germany, 46.6% of employees play games during working hours and 61% of CEOs and CFOs do the same.

Games are a significant feature of one of the most rapidly growing commercial industries, mobile technology. In 2015, nearly 2 billion people own a mobile device of some sort, and 70-80% of all downloads on that device are games. About 215 million hours are spent per day in the US for gaming; 5.93 million years have been spent in total, playing World of Warcraft, a famous on-line game. Regarding the games industry, revenue figures are compelling. The American games industry for 2013 alone was a $21.53 billion market. In 2011, gamers in Germany spent 380 million Euros on virtual items and services and have downloaded 2.6 million games.

From the information presented above, it can be concluded that games are an important part of modern life in various cultures, ages, genders, economic backgrounds and other social features. Gamers are not only novices either, as there are also experienced game technology users. For the latter group it is easier to assume that games will eventually enter other parts of social life like work or education. One of the vehicles that will facilitate that entry is gamification. In support of this statement, it is reported that 68% of parents are of the opinion that playing games provides mental stimulation or education.

The basic way of gamifying an application, process or product is to apply some of the so-called game mechanics.

Game mechanics are the various actions, behaviours and control mechanisms afforded to the player within a gaming context [36]. Game elements that can be helpful have been reported to be achievements, levels, progression, quests or challenges, status, community collaboration, loss aversion, leader boards, recognizing patterns, collecting, and finding random treasures [37], [38] [39].

One approach to gamification would be to implement some or all of the game elements into an existing application without essentially changing the application's original purpose. Another approach to gamification would be to give to applications the form of an actual game. In the latter approach, a

careful game type selection is essential. The most frequent types of games can be considered puzzle games, adventure games, simulation games, strategy and real time strategy (RTS) games, and edutainment games.

7. INDICATIVE APPLICATIONS OF GAMIFICATION: CASE STUDIES

Despite the fact that gamification is a relatively new discipline, its application in many areas can be considered remarkable and an indication of the critical role it will play in reshaping the global industries, economy and society.

In education and professional training, gamification comes to contribute towards making STEM curriculums simplified through learning games, especially in a highly digitized environment as the one that involves engineers and more.

Gamification is often correlated to digital game-based learning (DGBL), which is defined as the use of "…game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning and solve problems" [40]. Digital games have clearly provided a boost in the field of gamification. Scientists, who have grown in a popular culture of video games, game consoles and on-line multiplayer games used for entertainment, find it logical and easy to use these aspects of everyday life for the purpose of education and professional training.

KnowRe is an online adaptive learning platform that helps students to learn mathematics [41], with the use of graphics, instructional videos, practice problems and real-world applications. Students earn coins for correct answers, which they subsequently use to unlock any lessons they wish; they can advance to the next level only if they have successfully completed the previous one. A feature of the system is that it can identify each student's strengths and weaknesses and use supporting videos and instructions based on its assessments, thereby personalizing the learning process. Although aimed at high school students, KnowRe can be important in the process of gamifying technical education in two ways; firstly because it is applied on a purely technical discipline such as mathematics, and secondly because it offers a significant level of customization to the user – a very useful tool when dealing with individuals who come from different educational backgrounds.

Gamification platforms also exist that are addressed to engineering problems and environments. In 2011, Siemens introduced Plantville, an online gaming platform aimed at employees, customers and students [42]. It was based on the hugely successful Facebook game Farmville and simulated the experience of being a plant manager. In the game, players are in charge of a facility and they have the task of maintaining the operation of a plant, while at the same time trying to improve its productivity, efficiency and sustainability.

In more specialized topics, such as in engineering, gamification includes game systems in CAD-type environments. Brough et al. [43] developed the Virtual Training Studio in which users train to perform assembly tasks. Li, Grossman and Fitzmaurice [44] presented GamiCAD, a gamified tutorial for AutoCAD, based on missions, scores and rewards. Furthermore, the Monkey Wrench Conspiracy project is a first-person shooter game that aims to train engineers to move from 2D to 3D CAD systems. A review on such systems can be found in the work of Kosmadoudi et al. [45]. Another example is the PTC Manikin extension [46], a parametric 3D CAD/CAM/CAE software that provides ergonomic and human factor analysis capabilities in the Pro/ENGINEER environment.

Virtual reality training systems (VRTS) are also popular educational tools. BeWare of the Robot is a VRTS serious game that simulates the cooperation between industrial robotic manipulators and humans, executing manufacturing tasks [47], [48]. These digital environments aim to aid engineers' study and analyse interactions between people, products and work stations in a virtual reality context. Working in industrial production is related to interaction with machines, or as depicted in Figure 3, with machine tools.

The trained professional has to achieve an optimal throughput, provide high quality products and reduce downtimes to minimum. Using game inspired features like animated 3D models can help operators visualize and locate problems in immense detail. Other issues include the optimization of idle time and motivation through reward [49].

Additionally, a gamification approach has been designed by the RWTH Aachen University and tested in cooperation with a German car manufacturer in order to enhance training strategies for workers in low volume assembly systems, while increasing ramp-up performance, and they have achieved promising results [50].

Furthermore, Hauge and Riedel [51] tested two serious games, namely COSIGA and Beware, in order to evaluate gamification for engineering and manufacturing training. In COSIGA, a product scenario is introduced and the player takes all the steps from specifications to production, considering several restrictions related to production. Beware is dedicated to teaching users of the risks in enterprise networks and improving player skills in risk management. It was concluded that the evaluation of learning outcome is difficult to be measured and the learning effect can be assessed when the engineers put their learning into practice in their working environment.

Likewise, plantville is an engaging and informative plant simulation which puts the player right in the shoes of a plant manager at Siemens (Figure 4). The goals of the game are the same as those of plant managers in their daily working life, namely, to improve safety, quality and delivery, and manage funding matters [52].

Tom Warney, Head of Marketing and Communications at Siemens, sees Plantville as a tool to raise the interest of younger generations in the manufacturing industry and educate society about the company and its products.

Finally, Pourabdollahian et al. [53] employed a set based concurrent engineering (SBCE) game in order to bring a hands-on experience on lean product development. The game was tested in a real industrial environment of an Italian company and it was concluded that the participants showed a high level of engagement.

Applying game technologies in engineering is a unique business area (and a quite unique research area). As a conclusion, we have seen that an efficient use of existing digital content such as 3D technical CAD drawings together with game technologies is one of the key elements of gamified industrial applications. At present, we are currently studying new value creation, and in our previous experiments we have studied how complicated CAD drawings can be utilized in game development.

These results have been utilized in the game development of the IndustrySim demonstration (in Figure 5) which contains CAD drawings of a coal fired power plant. This study, including the phases of the 3D modeling process, has also been described in detail within IndustrySim: Finding the Fun in Industrial Simulations' [54].

IndustrySim as a case study can be used here as an example of our research philosophy. Our research approach has characteristics which can be found in the IndustrySim research framework presented by Hevner et al. [55]. Both scientific evaluations and industrial pilots have formed an iterative and incremental design process in which essential feedback has been gathered and analyzed for the next construction phases.

8. THE GAMIFICATION REVOLUTION: SIMPLICITY, MOBILITY AND ACCESSIBILITY

Gamification seems to become the next revolution in industrialization, as game technologies come to enrich data visualization, enabling the visualization of something which was not possible with existing technologies. The dramatic reduction of STEM graduates demands simplicity in order to achieve efficiency, sustainability and development of the global economy. Scientists in this field should increase awareness of next generation user interface (UI) design (as we enter the era of the virtuality continuum).

The bottlenecks in this new era are mainly in standardization or in openness, but one of the bottlenecks can be the uncertainty or a lack of knowhow regarding how new visualization technologies such as game engines can innovatively be used in this field of science.

Simplicity can transmute complexity and provide controlled, secure, reliable, measurable fun as well as reducing knowledge gaps and intellectual discriminations. Simplicity can increase the number of qualified personnel to perform in controlled environments [57]. Such a workforce increase will resolve major issues that exist in the most developed countries related with the capability, maturity and qualification of their native population and workforce.

Taking the simplicity issue a step further, its contribution to the mobility can be considered tremendous, with high economic and developmental impacts. Simplified applications, operations, processes, tasks and activities, through gamification, can be executed in mobile devices anywhere and anytime.

As technology moves so fast on mobile technologies, the workstations of the very near future will be able to be carried anywhere (see Figure 4). The combination of simplicity and mobility can give tremendous advantages to the countries that can support, deploy and apply such technologies and management practices to their workforces. Put simply, by working in a simplified and fun environment anywhere and anytime, productivity increases.

Accessibility is another critical dimension of gamification that together with simplicity and mobility concludes the major characteristics of the gamification revolution. Accessibility, which seems to be similar to mobility, is mostly related with the use of simplified technologies that can work anywhere and anytime. The finger can be considered as the device of the future as it replaces keyboards, the mouse, pens, and all other input and control devices that have existed until now [58]. By not having to carry all wireless or cabled devices together with the advanced displays that provide continuous progress, accessibility makes mobility much more effective.

Figure 3: BeWare of the Robot VRTS screenshot

Figure 4: Plantville screenshot

Advanced research on state-of-the-art displays started in the 2000s with applications on smartphones and tablets [59]. Imagine displays thin as paper, that can be folded, and are capable of fitting in a pocket and unfolded enough to cover a wall, while being easy to carry, share and use in any desired way. Such displays, that exist today, bring the concept of accessibility to a totally new dimension, which really redefines what mobility really is [60]. Simplicity gives operational substance to mobility and accessibility.

The next revolution besides organizational efficiency to offer to those who can afford it is the capability to create the workforce needed towards achieving, maintaining, or reaching organizational strategies.

9. GAME DESIGNERS, GAME DEVELOPERS AND THE GAMING INDUSTRY

The discipline of gamification and its impact in the global economy has been identified since the turn of the millennium.

Initially, there were the smartphones, and then the tablets which boosted up the 'apps' concept, generating a tremendous market and global start-up trend. People tend to believe that just a smartphone application is enough to make them rich [61]. To a degree, this might be true as there have been many success stories indicating this new emerging economy of web applications and games [62]. On the other hand this cannot work for everyone as there is not a market and the financial recourses to either sell or fund anything that fails in this trend. Nevertheless it is the hope and the opportunity that counts and not the result [63].

In the game industry it is very difficult to receive publicity in marketplaces and only the big brand names have the resources for aggressive marketing campaigns to make their apps visible in the major lists. On the other hand, if gamified solutions are designed for B2B markets, under a totally new business strategy and even marketplace, a new economy can be revealed.

Innovation in the contemporary age is now much associated with web-applications, especially game oriented ones [64]. This new trend generated the need for certified game developers as a new profession to create the distinction between the professional and amateur in the global market [65].

Previous studies [66] have analysed how universities have started to create game oriented academic courses and programmes that can be studies at all levels (BA, BSc, MA, MSc, PhD). Such programs vary according to the specialization of each course and the type of the university. Academic courses and programmes exist today in game design, game development, game application development, 3D games and animation, game storyboard development, game arts, game engineering, and much more. Such programmes can be studies for both the arts (BA, MA) and the sciences (BSc, MSc). Arts, given academic programs emphasize more on the creative dimension (concept art, design, script, animation, etcetera) of the gamified applications [67], [68], [69] while the science driven programmes emphasize more on the engineering dimension (software engineering, coding, graphics, etcetera) [70], [71].

The subjects covered in game design, game development and game related courses are not restricted in the development of actual games but on the integration of arts and engineering for business and pleasure applications. They emphasize all key characteristics of the gamification discipline (simplicity, mobility and availability) through the development

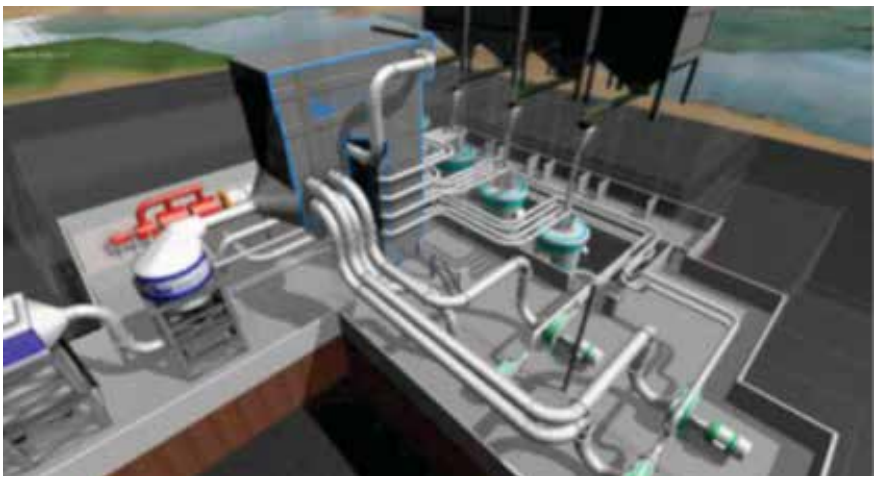

Figure 5: Screenshot (with the GUI disabled) of an example coal-fired power plant built inside the IndustrySim prototype [56]

of real applications, environments, systems and ecosystems for all industry needs and at all types of industries.

Game design and development has turned out to be one of the most popular academic courses one can attend. The wide concept of gamification, which is not restricted to actual playable games, but also to the gamification of business applications, attracts some of the most brilliant minds in arts and engineering with an extremely promising future. In 2013, the median salary for a game designer was US$72,000, while the top salary was $117,000 at a time when there were 520,800 jobs for game designers, while for the next ten years there is an estimated growth rate at least 27.6% per year in both jobs and salaries [72]. In 2015 the average salary is $87,000 ($88,000 in California), while the top salary is $140,000 ($151,000 in California) [73]. This indicates a salary increase of 15-25% in a year. Therefore, game designers and developers with academic qualifications will lead the development of an industry that totally changes the world.

In general, the games industry can be seen as an exceptional one. The profit per employee is one of the highest in any industrial field. Two years ago Supercell, with 100-150 employees sold 51% to Softback for $1.53 billion, while Nokia, with 60,000 employees was sold to Microsoft for $7.6 billion.

Processing those figures further as in Tables 1 and 2, it seems that the average value of a Supercell employee – whom are mostly game designers – is $20,000,000 ($3 billion/150) while the average employee value in Nokia, mostly ICT engineers, is $130,000 ($7,8 billion/60.000), giving a ratio of 1:154.

This analysis indicates that one employee in a top gaming company can generate 154 times the value of what an employee can generate in a top ICT company. Both Nokia and Supercell are considered as exceptionally successful cases, and this is why they are compared. In general, an average ratio between employee value in these two industries is probably 1:100.

The Nokia-Supercell case presents another very interesting index for the booming development of the gaming industry. Supercell was established in 2010, and reached a company value of $3 billion in only 5 years (2010-2015), while the Nokia Corporation was formed in 1967 (originally Nokia was established in May 12, 1865; as Tampere Grand Duchy of Finland, named as Nokia in 1871) and hit a reach company value of $7.8 billion in 48 years (1967-2015).

10. GAMES AND 'SERIOUS' GAMES

Prior to referring to the application of gamification in business management there is a very important issue that needs to be clarified. There is a misunderstanding on the contribution of gaming technology in business management and operations, as games are considered more like entertainment applications. This is not true as clever game technologies can be used in business management various ways (as can entertainment games, serious games, gamified apps, business simulations, and so forth). This is the reason that the term 'serious games' is used to distinguish entertainment games from business games.

The term serious game has been used since the 1960s, long before the introduction of computer and electronic devices into entertainment [74]. It was used to define gamified processes without the use of technology as a scenario based model operating metaphorically as a game of strategy with probabilities, possibilities and skills on handling information, conditions, decisions and results.

This term could be considered quite correct for the time of its development, which was nearly 60 years ago, but it is outdated now, and probably not fair to be used today in order to distinguish the entertainment games, as games distinct from the business games, as serious games. Many references define serious games or applied games as games designed for a primary purpose other than pure entertainment. The 'serious' adjective is generally prepended to refer to products used by industries like defence, education, scientific exploration, health care, emergency management, city planning, engineering, and politics [75]. This kind of characterization can be unfair to the entertainment games that do have serious scenarios, such as technology, graphics, sound, animation, effects and other elements that can turn entertainment games into unique experiences. Serious games are actually successful if they are designed around entertainment game design principles. A good serious game must be entertaining, or at least so immersive that players are highly drawn to the playing experience.

What is a serious game and what is not serious cannot and shall not be determined by the type of its user target group, functionality or operations, but solely on its quality, effectiveness and benefits to those using it for a specific purpose. For those still insisting on such a categorization, the question is if the adjective serious is used to determine entertainment gaming from business gaming, and whether it could also be applied to 'serious' and 'unserious' academicians, managers, politicians, and so forth.

They all act in a serious or unserious manner, but they can't be called 'not serious', even if they are, as there is not such a 'serious' or an 'unserious' university, company or government categorization based on the rankings of a university, sales of a company, effectiveness of a government or other criteria.

11. GAMIFIED BUSINESS MANAGEMENT

The concept of gamification in systems and technologies is a revolutionary approach towards resolving many techno-economic and socio-economic issues that trouble the (primarily) Western world due to the continuous lack of qualified human recourses and unwillingness to step back or slow down progression and leadership in all sectors. The same concept can also be applied in organizational management via gamified processes, organizational structures and operations towards achieving higher organizational goals [76].

By integrating gamified management processes, methods, and practices in the existing organizational operations, management and strategies, organizations can increase efficiency, productivity, innovation and competitiveness [77]. The most critical challenge organizations are facing, and it seems that they will be facing for years ahead, are the identification, extraction and utilization of the organizational knowledge that exists in the people as individuals or teams. Forsten et al. [78] have developed the so called ProDesim game (a business simulation game). In their studies, they have found that it can be anticipated that simulation gaming offers students the possibility for a quicker adaptation of strategic management techniques, which in turn can lead to a more comprehensive understanding of strategic management.

Formality and prosperity has created bureaucracy, and that stands against motivation, inspiration, vision, and creativity at a personnel level. Without organizational knowledge and effective strategy management, it is questionable whether leadership can be possible at all [79]. No plan can work if real and valid knowledge has not taken into consideration, integrated with assumptions, statistics, trends and management intuition [80], [81].

As long as humans, as employees, have a role, be it any role in an organization, then their best possible utilization towards achieving knowledge must be a top management priority. Gamification

Figure 6: Organic Light Emitting Diodes Technology and Displays,

	DEAL COST	EMPLOYEES	VALUE OF EMPLOYEE
NOKIA	$7.800.000.000	60.000	$130.000
SUPERCELL	$3.000.000.000	150	$20.000.000

Table 1: Employee value between NOKIA and Supercell

	EMPLOYEE VALUE RATIO CALCULATION		RATIO
NOKIA	$130.000	100,00%	1
SUPERCELL	$20.000.000	15384,62%	153,85

Table 2: Employee value between NOKIA and Supercell

in technological applications and systems has been created to develop the simplicity needs to make more people participate in using the technology. In the same concept, gamification in management processes will create simplicity and reduce bureaucracy for greater participation which results in more interaction, knowledge generation and utilization.

12. APPLIED GAMIFIED BUSINESS MANAGEMENT

The company democracy model has the ideal structure towards embedding the gamification concept in it. The model has been purely designed for organizational management via the utilization of organizational knowledge. The goals and objectives of the model can be achieved faster, easier and better if gamification management is integrated.

Level one of the model emphasizes on creating a democratic culture in which everyone has the capability and opportunity to contribute with ideas, thoughts, considerations, experiences, and any other type of information, towards optimizing organizational operations. The democratic approach the model integrated eliminated bureaucracy and formality, creating an environment of equal opportunity, not in theory but in practice.

By gamifying level one of the model, the knowledge elicitation, analysis, transfer and utilization can be more easy, effective and fun. The development of a simplified process in game contents and frameworks will increase participation, reduce insecurities, and generated the best results.

Level two of the model emphasizes the best possible utilization of the knowledgeable people within the organization. By moving the right people to the right place in a dynamic organization structure and hierarchy, organizations can successfully manage talent and ambition, as well as anything that comes with it. By gamifying the tasks and roles given to those who have knowledge to prove it and benefit from the chance given to them, the pressure for success is reduced and better results can be achieved for both the people and the organization.

Level three of the model utilizes the proven knowledge, skills and capabilities developed in level two by placing the right people at the right places, towards the transformation of this knowledge and skill into new organizational produces, processes, services, projects and initiatives. Gamified management can be applied in the development of the prototypes and pilot initiatives through which anything new is tested, with a simplified and gamified involvement of not only those developing a new initiative, but also those who can use or judge it.

Level four of the model utilizes the prototypes and pilot initiatives developed at level three towards the development of innovation through the ones that are or can be innovative. Innovation management via gamified process can result in brilliant innovations as they are developed with the democratic freedom and gamified simplicity. Likewise, level five of the model which emphasises intra-organizational co-opetition and extra-organizational competition by turning organizational innovation into competitive advantage, can also adopt a gamified process toward analysing competitive advantages with the simplicity, mobility and adaptability needed for wider acceptance and stronger competitiveness. Level six of the model promotes extroversion through the utilization of the competitive advantages generated at level five, and can also adopt gamification management in the way international partners and initiatives are approached and tested. It is a level that all the benefits of the previous five levels are integrated towards achieving internationalization and extroversion.

The company democracy model is not

the one and only model that can adopt gamified management. All models in an organizational based management strategy can integrate gamified processes and practices in their structure accordingly. Once gamification will enter into organizational management, expanding from today's success in systems and technology, then game process designers, game process engineering and other related professions will emerge to support this new revolutionary advancement of the technology in its integration with organizations management for more promising and effective results and opportunities.

13. CONCLUSION

Gamification stated as a concept that became a promising and leading discipline with current applications in technology and potential applications in management as well. As the world seeks simplicity to resolve complexity, gamification is not only a solution but a strategy as well.

The gamification characteristics based on simplicity, mobility and accessibility are strong enough to ignite a revolution in the industrialization period, whose outcome cannot be predicted at this time. The adaptation of gamification in technology brings us closer to the reality many of the science fiction scenes once considered far away. The gamified usage of technology increases the number of technology users in a pleasant but also secured and control environment. Such an increase of technology users resolves many socio-economic issues, especially in a developed country which loses more and more of its qualified workforce.

Gamification enters also into the cognitive science trend, which is based on knowledge management and utilization. Developing technology that can be used by all, at all times, with pleasure, security and control, requires more than technical and artistic expertise.

Knowledge management in gamification has a significant role in the development of gamified technologies but also gamified organizational management models. Simplicity and pleasure are the keys to unlocking the complexity and knowledge acquisition towards achieving goals and strategies that involve more and more people in it. The art, science, management, discipline, and strategy of gamification, whatever this can be, or whatever it is, for sure will have a strong, if not the strongest impact, in the global economy and society. It is too early to characterize what gamification really is and what it can do, but it will certainly be the subject of a lot of research and management work for years ahead.

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