Massive Open Online Courses (MOOCs) as an Enabler for Competent Employees and Innovation in Industry

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Abstract

The industrial domain is increasingly depending on the rapid technological advances, and to utilize it, new competencies will need to be acquired by the employees in order to strive towards innovation and business success. In this new context, under also the prism of globalization, the rules of competition are redefined, and competent labor is the deciding factor. Especially in fast-paced knowledge-based economies, there is greater dependence on knowledge, information and high employee competency levels, which also play a key role in innovation. It is therefore in the interest of both corporations and individual employees to not only retain existing knowledge, but continuously enhance it, by expanding it and utilizing it more efficiently. Competent people are the key to future success and offer organizations their only sustainable competitive advantage. Among the plethora of available tools to enhance employee competencies, Massive Open Online Courses (MOOCs) are an emerging phenomenon. They have taken the world by storm and recently they also started penetrating the corporate environments. This work focuses exactly on this white-spot area i.e., the relationship of MOOC-empowered employee competencies and innovation. A model is proposed, empirical data is collected via a survey, and is statistically analyzed. Initial results indicate a positive contribution of MOOC related factors such as culture, knowledge, communication, technology, and cost to innovation in modern enterprises.

Keywords: MOOC, modern enterprises, innovation, employee competencies

1. Introduction

Within a corporation there is always the dilemma on how much to invest in employee competency development. This is exemplified in the hypothetical discussion among the Chief Financial Officer (CFO) and the Chief Executive Officer (CEO) of a modern enterprise:

- CFO: *What if we invest in developing our people and then they leave us?*
- CEO: *What if we don't and they stay?*

The goal pursued within an organization is how to optimally take advantage of its human resource expertise and empower them to excel and innovate. New competency acquisition is expected to be a major factor in times of change in industry [1]. In a highly dynamic global business environment, rapid market, technology, competition and organization change frequently. However, what remains constant is the differentiation achievable through the competencies and contributions of the employees of an organization [2]. Therefore, increasingly organizations seek to further develop their employees' competencies in order for them to be able to respond quickly and flexibly to any business needs [3].

The importance of knowledge enhancement is underlined in the OECD [4] report: "Firms with more knowledge systematically outperform those with less. Individuals with more knowledge get better paid jobs. This strategic role of knowledge underlies increasing investments in research and development, education and training, and other intangible investments ...". It is therefore in the interest not only of corporations but also of individual persons to not only retain existing knowledge, but continuously enhance it, by expanding it and utilizing it more efficiently, which enables them to also perform better in their job.

The recent introduction of Massive Open Online Courses (MOOCs) may have a disruptive impact in the corporate world [5, 6], especially when it comes to employee competency development and innovation. Such expectation is raised by some characteristics of MOOCs such as their massive audiences, high-quality content, self-paced method etc. as well as preliminary utilization of them in industry. MOOCs are a fairly new phenomenon that has taken the world by storm. Generally, they are free, open access and scalable online higher education courses, that use a variety of online resources (such as videos and message boards) and seek to capitalize on high volume student classes by encouraging peer learning networks in place of more conventional synchronous learning and academic instruction [7]. MOOCs challenge the traditional educational model [8] with their wide-availability of areas they cover, free access over the Internet, and their self-pacing

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approach [9]. The MOOC revolution is not affecting only the academia but has the potential to disrupt also the corporate world, and employees who can now enhance their competencies on their own pace, (mostly) without cost, and without obligations. Increasingly large corporations are utilizing it as an employee training and knowledge-enhancing tool [5] by either organizing own MOOCs or pointing out to external available courses in internal employee communications. Typical utilization of MOOCs range from executive education [10] to developer training, compliance training [11] etc. For instance, the business software firm SAP offers via MOOCs (`open.sap.com`) among other things, cutting edge technology training tailored towards its products, for application developers both internally and externally.

As MOOCs count only a handful years of existence (most of the well-known platforms were created after 2012), there is very limited research carried out on its utilization, and a consensus on the tangible MOOC benefits is far from being reached [12, 13]. Most of existing approaches build on previous concepts of e-Learning, to which MOOC is an evolutionary step, coupled with cutting edge technologies (video lectures, interactive discussions, simulation tools, automated grading of exams, etc.) which enable it to scale and reach global audiences. Current research focuses mostly on the academic impact, while very scarce results are available with respect to its utilization and impact on the corporate world. As MOOCs are still at a very early stage, mostly the last two years their models and impact are starting to be analyzed in scientific articles, while some more exist in popular press. The work discussed here, focuses exactly on this white-spot area i.e., the usage of MOOCs in modern enterprises, and more specifically within the scope of employee competency enhancement and innovation, which although of key importance is not sufficiently investigated [14].

The research question posed can be considered as "What is the impact of MOOC-empowered employee competencies to innovation?" To address it, first the MOOC relation to employee competencies is discussed. Subsequently a link between competencies and innovation is proposed. Empirical data is collected via a survey, and the proposed model linking competencies and innovation is assessed with statistical methods. The approach is of interest, as it may provide a better understanding of the MOOC impact on corporations at large, especially when it comes to the development of employee competencies and innovation. Apart from the discussion on MOOCs, competencies, and innovation in modern enterprises, the core contribution of this work is the proposal of a model linking MOOC-empowered competencies to innovation, and a quantifiable empirical assessment of the model.

2. Concept Overview

2.1. MOOCs

The acquisition or reinforcing of knowledge, behaviors, competencies, values can be realized via learning. It is a complex process and is heavily influenced also by the means available. Distance/Virtual learning has always been of interest and dates back as early as 1728 when the Boston Gazette printed an advertisement from Caleb Phillips, a shorthand teacher, who offered to send weekly lessons to prospective students in the countryside [15]. A century later in 1833 the Lund university in Sweden was offering the opportunity to study composition via the post [16].

In each era, key available technologies influenced distance education mediums, reach and methods. Picture and sound were introduced in the television and radio era, which was a step forward, but meant that the students were possible listeners. In an evolutionary step, the interactions between phone, email, video conversations have further enhanced distance learning. The prevalence of the Internet has extended the reach of the courses, while in parallel all its aspects can now be realized online e.g., watching videos or attending classes remotely, discussing in real-time with participants, collaboratively engage on activities in real-time, taking exams, accessing globally huge electronic libraries with the latest research etc. which basically removes any physical participation needs. The end of the 20th century saw an explosion on distance learning aspects and especially on open educational resources (OER), open courseware (OCW), and most lately massive open online courses (MOOCs) available for self-directed learning pursuits [17].

MOOCs are delivered online through a portal-like platform in which it is possible to browse several courses for students and for tutors to create and maintain courses for profit or non-profit. The dominating features of a typical MOOC course are short pre-recorded video-lectures immediately followed by short quizzes and potentially larger assignments/homework, all of which are graded either by increasingly sophisticated software [18], engaged alumni, tutors or even peer-students [19]. The MOOC domain is still not always clear [11] though, because there are many subtypes of MOOCs and different settings in which they are used. More than 1800 MOOCs are offered by 2500 instructors and 400 universities [20] via popular platforms e.g., Coursera, Udacity, edX, openSAP, Iversity, Kadenze, FutureLearn etc. These efforts already depict a mix of commercial or non-profit initiatives, and although they are pretty new as they were launched after 2012, they already have large user bases, e.g., Coursera hosts 1500+ courses for a user base of more than 15 million. Accredited courses are the exception, but these have been lately introduced in some of the platforms e.g., in Iversity courses are held in cooperation with a university and are accredited with ECTS credit points [21] (as is any traditional European university course).

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Employee competency development is pursued by several corporations that strive towards innovation and keeping their competitive advantage. In-line with the corporation's needs, also the employees themselves strive towards advancing their competencies. The latter is done in order to improve their performance, gain additional expertise and visibility within the firm, establish leadership in new domains, get promotions etc. Many employees also dealing with innovation are keen on acquiring new knowledge and competencies professionally or personally [17]. While up to now such endeavors had been costly and time-consuming, the prevalence of MOOCs may result that such goals are now significantly easier to reach at zero or very low cost. The latter has the potential to reshape the workforce, which is of key importance in knowledge-based economies.

2.2. Corporate Competencies

Defining competencies is a challenging task and multiple definitions exist [22]. Generally, they can be considered as "the sum of our experiences and the knowledge, competencies, values and attitudes we have acquired during out lifetime" [23]. Similarly, it is considered [24] that competency is a "a set of behavior patterns that the incumbent needs to bring to a position in the order to perform its tasks and functions with competency", and it is also pointed out that several individual competencies are needed to do so. However, as pointed out [25]: "it should be remembered that competencies do not exist in isolation". Although the precise definition of competency depends on the context [25], it can be considered that generally competencies are *"a combination of attributes such as knowledge, abilities, competencies and attitudes which enable an individual to perform a set of tasks to an appropriate standard"* [26]. As the OECD report [27] points out, competency involves "the ability to meet complex demands, by drawing on and mobilizing psychosocial resources (including competencies and attitudes) in a particular context". competencies can be learned and are considered traits of successful employees within an organization. Competencies can be considered from a wider viewpoint to include competencies, knowledge, behaviors etc. that are necessary to effectively complete a task.

Generally, corporations "must follow a certain trajectory or path of competency development" which is tightly coupled with the product innovation [28]. As competency is the "how" of performance [29], it is clear that competent people are the key to future success and offer organizations their only sustainable competitive advantage [23]. From a purely economic viewpoint, competencies of individuals are seen as important because they contribute to: boosting productivity and market competitiveness; minimizing unemployment through developing an adaptive and qualified labor force; and creating an environment for innovation in a world dominated by global competition [27].

Global organizations have identified multiple competencies needed for the workforce [27, 30, 31, 32], while several other scholars and projects [33, 26, 34, 35, 36, 37] have identified similar competencies. In order to proceed with the questionnaire, and collect empirical data, these competencies have been grouped as shown in Table 1. Such grouping is done to ease the empirical data collection and is at large in line with the aforementioned literature. The list is not exhaustive, and in the literature, more fine-grained competencies may be identified, but the high-level grouping enables the at large investigation of their impact to the innovation. There is a general consensus that there are some key competencies that are more valuable, as they have multiple areas of usefulness and are needed by everyone [27]. Constellations of such competencies enable individuals to act effectively in complex situations and combine them to achieve the best result. As such the employee competence overall, is enhanced as a sum of such enhanced individual competencies.

Culture: MOOCs are massive with thousands of participants all over the world. As such any MOOC consists of a wide range of people [38] with diverse backgrounds geographically, ethnically, culturally, work-wise etc. Within the scope of the courses people interact via the forums, often helping each-other and sharing information. Therefore, MOOCs provide a significant opportunity to enhance competencies related to diversity i.e., show sensitivity on the various gender, cultural, religious differences etc. Also, prejudice, biases and intolerance are immediately addressed by other members. As such the participant, may via the social aspect further enhance its diversity understanding and management. Although MOOCs are praised as self-paced, in order to get the most out of it, commitment to the process is required. Participants successfully finishing the course demonstrate commitment to following through, despite of difficulties, personal schedule etc., something that can also benefit their daily activities and work behaviors. Participation in MOOCs exposes individuals also to integrity and ethical standards. As in any system although the possibility of "cheating" is there, people are geared towards keeping the "code of honor" and personally delivering the results as requested. There is also very little motivation to deviate from this, as at least up to now most participants are willingly taking part and completions of courses are mostly for personal satisfaction without widely-accredited certificates. Professionalism may be enhanced not only with the new knowledge acquired, and the potential mastery of subject matter, but also via other factors. In a MOOC people are faced with difficult problems and/or situations (due to the nature of the potentially selected courses), and learning to overcome these and maintain a positive outlook can be advantageous in real-life crisis situations. The proof of capabilities that the participant undergoes e.g., via the course's assessment weekly may result in learning how to handle criticism and learn from mistakes.

Knowledge: Knowledge is important for both corporations and individuals [4]. MOOCs are the prime platform for delivering online new knowledge that may be used

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Table 1: Grouped competency factors

Competency Factor	Example Competencies
Culture	Commitment, Diversity Respect, Integrity, Professionalism
Knowledge	Analyzing, Creating, Learning & Researching
Leadership	Leadership, Entrepreneurial Thinking, Influencing
People	Adaptivity / Flexibility, Networking, Planning / Organizing / Executing, Proactiveness, Reliability, Teamwork
Strategy	Strategic Thinking, Results Driven
Communication	Communication
Technology	Technical Expertise
Cost	Cost effectiveness

to develop oneself further. However modern MOOCs not only provide new knowledge in a purely academic fashion, but utilize a more vivid environment which is often coupled with (real-time) online tools that blur the boundaries between lecture and practice. The result is a enhanced learning experience and acquisition of new knowledge and competencies. Being in touch with new concepts, understanding and testing their applicability within the scope of MOOC may lead to the development of the learning and researching aspects of competency. Due to the large amount of new information and numerous sources, MOOC participants are called upon making rational judgments from the available information and analysis in general. The wide availability also of courses tackling key aspects of data analysis in a variety of domains (engineering, science, financial etc.) can enable the MOOC participants to enhance such competencies both vertically and horizontally.

Leadership: A leader motivates and (in cases empowers) others to develop further their capabilities. Having benefited himself from the MOOC participation (both direct and indirect benefits), the employee may act as ambassador and further guide/coach others to follow-up and develop their capabilities. As such s/he could emerge as an influential figure which comes adjacent to the other competencies s/he might develop including advanced knowledge, multi-angled thinking etc. The entrepreneurial thinking may also benefit as s/he strives towards keeping up with trends and ongoing developments. In addition, the existence of leadership-oriented MOOCs enables the acquisition of the theoretical part and helps to more easily identify and subsequently develop these traits.

People: People competencies are multi-faceted with a variety of traits, among which being able to establish good relationships, set-up new networks and effectively interact with peers are important also in corporate environments. Within MOOCs, participants have the possibility to radically expand their network with similar-thinking people who probably would have never met in real-life. Although most MOOCs are overwhelmingly set-up for individuals, there are tasks that can be carried out in teams, where teamwork comes into play. The team aspect, in addition to managing the interactions, may empower the employees and benefit them also in their professional life. Planning, Organizing, Executing, may also benefit as for instance taking a MOOC requires good time management competencies and self-guided learning [39]; hence this may be one special characteristic of people who succeed to complete a MOOC, especially on their spare time. MOOCs may enhance employee's pro-activeness, especially if these are sought, selected and followed by the employee himself rather than imposed by the firm as mandatory. By being able to understand personal needs for development, search for the right MOOCs and follow them through, a general mentality of "go-get / can-do" and proactive thinking is promoted, which may also benefit the employee in the professional life.

Strategy: Strategic thinking is praised as a key competency that can lead to success. Strategy in today's competitive business landscape is moving away from the basic "strategic planning" to more of "strategic thinking" in order to remain competitive [40]. It is pointed out [41] that "managerial cognition, corporate values as well as individual values and beliefs can have an influence on strategic decision-making choices". The availability of several MOOCs on strategic thinking, may assist the development of this competency as participants learn the theory, and via examples how to do practice it. In addition, MOOCs are promoting a results-driven culture, where in short timeframes new knowledge is put into test and assessed immediately. As such people also learn to work methodologically and focus on the important aspects that yield the best outcome.

Communication: Mastering of communication competencies such as fluency in speaking, efficient argument expression, clear and with confidence discussion etc. enable the employees to be more effective and empower them. Although MOOC participants are mostly interacting via the keyboard (at least up to now), such capabilities can be built via the discussions they have on the forums. Additionally, live "meetings" are held for discussion of hot topics which could also assist participants to perform in front of an audience. Finally, there are also MOOCs that deal with the art of efficient communication from learning new languages to public speaking etc.

Technology: Technology literacy is of paramount importance, especially in modern enterprises. Being able to

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understand the potential and limitations of technologies, being capable to master new technologies, applying technical expertise etc. are indispensable competencies. Today most MOOCs available are having a plethora of technical-oriented offerings, covering many aspects of modern technologies from a theoretical and practical viewpoint. This wide-spectrum of technology-driven aspects are taught by leaders on the area, and MOOC participants can acquire deep (technology) insights in an easy way which otherwise would be hard if impossible to do effectively.

Cost: Most MOOCs are available for free for the participants, while some of them charge mostly for certificates. As many of the offered MOOCs are carried out by high-profile professionals, they constitute an excellent opportunity for the individuals. Cost effectiveness has two dimensions here (i) monetary and (ii) time-wise. Clearly since MOOCs are usually free for the participants, they pose an excellent cost-benefit opportunity without strings attached. In addition, the time aspect is important. Any competency that is developed needs time and while this is not be reduced by MOOCs, efforts are underway to make it as effective as possible [42]. In addition, their flexible scheduling at the convenience of the MOOC participant may be proven beneficial. For the corporations, MOOCs could also be seen as a real low-cost alternative, since no home-grown e-Learnings have to be developed if similar ones already exist and are provided by others. Investments in training and college degrees are in general worth the cost for corporations [43, 44]. Therefore, the MOOCs could potentially pose an alternative where training can reach the masses at a fraction of cost. An example from the business domain is the `open.sap.com` where with low cost from the corporation side, thousands of developers (both within the firm, as well as externally) are trained to the latest cutting-edge corporate products. The later can help corporations to create momentum, especially for cutting-edge technologies, and have the potential to speed-up significantly the creation of an ecosystem for those.

2.3. Innovation

The importance of innovation is paramount, especially in the era of knowledge-driven economies. One of the most important goals for all companies is to achieve competitive advantage in order to enhance profits and long-term survival chances; and innovation is seen as a key source of precisely achieving this competitive advantage [45]. This becomes especially critical, when a new technology wave [1], levels the field by posing new opportunities as well as challenges to the organizations and employees.

The exact definition of innovation is complex; however, it is pointed out that "an innovation is something original, new, and important – in whatever field – that breaks in to (or obtains a foothold in) a market or society" [46]. In addition, an OECD report [4] points out that "An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations". Apart from technical innovations, successful innovation can also include strategic knowledge about business intelligence, funding, marketing and other non-technical areas [46].

Employee competencies constitute a key factor for innovation. Several competencies seem to have an effect on innovation [47]: "Competencies such as alertness to new opportunities, ability to present products, ideas or reports, ability to mobilize the capacities of others, ability to come-up with new ideas and solutions, and ability to use computers and the Internet appear to have stronger marginal effects on the likelihood of innovating and, consequently, emerge as key competencies in explaining the propensity of individuals to become innovators in their working environments". Innovators and entrepreneurs require competency sets for innovation such as technical competencies, thinking and creativity competencies, as well as social and behavioral competencies [48]. In highly innovative economies competent labor, in combination with sector specific knowledge, form the engine for service innovation and quality manufacturing [49]. The level of knowledge and type of competencies constitute key factors for matching supply and demand in the knowledge economy. From the investments in intangible assets, the competencies and qualifications of employees are seen as the biggest beneficiaries [50].

The European Commission report [49] points out that lifelong learning is gaining in importance as the labor market is rapidly changing and the half-life of knowledge is decreasing. In addition, entrepreneurship competencies, may have a positive impact on developing competencies conductive to innovation and employability. In the same report, it is pointed out that cross-disciplinary knowledge and competencies although important are not easily acquired in traditional modes of instruction or classical lab work.

2.4. Linking Competencies and Innovation

Learning can be utilized to enhance employee competencies [51, 52]. The link between learning and the impact innovation is considered important and has been investigated in literature [53, 54, 55, 56]. Especially learning has been found to have a positive effect to innovativeness and subsequently to firm performance [53]. Therefore, one may consider that learnings such as those offered by MOOCs, can enable employees of modern enterprises to acquire new or enhance their competencies, and that this may have a positive impact on the innovation efforts of the enterprise.

The identified key grouped competencies (shown in Table 1) are: Culture, Knowledge, Leadership, People, Strategy, Communication, Technology, and Cost. These are considered as factors in the proposed model (Figure 1). To what extent these factors impact innovation is part of the research carried out in this work i.e., the impact of each individual factor (the collection of which corresponds

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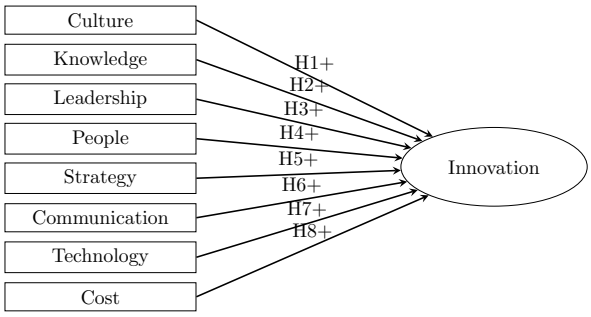

Figure 1: Model linking MOOC-empowered competencies and innovation

to the overall employee competence) to innovation is assessed. While the link of the competencies to innovation is assumed via the MOOC learnings, it is hypothesized that they may directly contribute to innovation, something that is subsequently empirically investigated and statistically assessed, as discussed in section 3. In the proposed model of Figure 1, eight hypotheses (H1–H8), link the MOOC-empowered competencies to innovation, implying their positive impact on innovation.

3. Empirical Results

3.1. Approach and Data

This work follows a structured approach (quantitative research) and addresses the research question in a deductive manner. The literature is used to identify and develop hypotheses on the key employee competencies impacted by MOOC, and the subsequent effect on the innovation processes within a corporation. The derived hypotheses are tested empirically with data collected via an online survey. Advanced statistical methods are employed to examine and quantify the relationships hypothesized.

The sampling group constitutes of randomly selected workforce members (i.e., employees of companies, institutions, etc.) that are also participants of MOOCs. Some control questions were also built in order to assist with the validity and reliability of data such as the number of MOOC participations, working experience etc. The survey was offered electronically and hence it was possible to check for semantic correctness at time of submission. Demographically, the survey has a significant representation from many age groups, firm types, and firm personnel positions. The responders seem to belong to a highly competent workforce with accomplished university education. In the education, one has to note that it probably captures also many of the responders that are currently students in their first degree.

The survey featured several questions per factor, which are encoded as variables, i.e., CUL1–CUL5 (Culture), K1–K5 (Knowledge), L1–L5 (Leadership), P1–P8 (People), S1–S5 (Strategy), COM1–COM5 (Communication), T1–T5 (Technology), COS1–COS4 (Cost), I1–I4 (Innovation) as also shown in Table 2. The empirical data comprises of 181 respondents with valid answers (N=181) which constitute an adequate sample for the statistical analysis followed. All of the variables are based on a Likert scale (1 to 5), and hence there is no reason to exclude variables on skewness unless they exhibit no variance. Hence the focus has been placed on kurtosis. A kurtosis greater than 1 (or less -1) indicates a potential problematic kurtosis and therefore lack of sufficient variance. Some items had borderline kurtosis issues with values between 1 and 1.35, i.e., P1, P3–P8, and I3. These are fairly borderline values and they are simply flagged for potential future issues in subsequent analyses. The only exception may be P6 with a value of 2.096. However, Sposito et al. [57] report that for practical purposes, problems may arise if the kurtosis is > 2.2 (or < -2.2). Since P6 is near but still under that limit, it was decided not to remove it. All the values were normally distributed (with the considerations discussed), and therefore all of them have been retained.

3.2. Exploratory Factor Analysis

Factor analysis is a method that can be used for exploring data patterns, for data reduction, confirming a hypothesis for a factor structure etc. The Exploratory Factor Analysis (EFA) is a multivariate statistics method used to identify the underlying relationships between measured variables [58]. The motivation for carrying out EFA is to identify the number of factors explained via the dataset and investigate if any additional factors from the ones hypothesized in the model are captured empirically.

The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA) was calculated as 0.834 which is characterized as meritorious [59] and indicates that component or factor analysis will be useful for these variables. The Bartlett's test of sphericity calculates x^2 as 5540.082 tests with 1035 degrees of freedom and is significant, therefore the variables do relate to one another enough to run a meaningful EFA.

For the EFA, the Kaiser [60] rule to determine the number of components is used, which is the most common method used in practice. In addition, Maximum Likelihood with Promax rotation are selected, to see if the observed variables loaded together as expected, were adequately correlated and met the criteria of reliability and validity. Maximum Likelihood estimation was chosen to determine the unique variance among items and the correlation between factors. Also, another motivation was to be consistent with the CFA that will follow in the next step, which also uses Maximum Likelihood. Promax was chosen because it can account for the correlated factors.

Kaiser [60] recommends that only eigenvalues that are at least equal to 1 are retained. From the EFA, 9 factors with Eigenvalues greater than 1 are identified. These 9 factors (8 hypotheses and the innovation) explain more than 63% of the total variance. It is observed that this number matches the number of factors also in the initial proposed model. Additionally, the reproduced matrix had 54 (5%) non-redundant residuals with absolute value greater than

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0.05, further confirming the adequacy of the variables and the 9-factor model.

A very clear loading on factors is observed, and the factors demonstrate sufficient convergent validity as their loads are above the minimum recommended threshold of approx. 0.45 for the dataset according to [61]. However, P1, S5 and L1 are below that threshold and hence they are excluded from further analysis. The factors demonstrate sufficient discriminant validity as the correlation matrix shows no correlations above 0.700 and there are no problematic cross-loadings.

Table 2: Cronbach's α per Factor

Factor	Variables	Cronbach's α
People	P2,P3,P4,P5,P6,P7,P8	.916
Strategy	S1,S2,S3,S4	.906
Culture	CUL1,CUL2,CUL3,CUL4,CUL5	.944
Knowledge	K1,K2,K3,K4,K5	.920
Cost	COS1,COS2,COS3,COS4	.927
Communication	COM1,COM2,COM3,COM4,COM5	.888
Technology	T1,T2,T3,T4,T5	.826
Leadership	L2,L3,L4,L5	.795
Innovation	I1,I2,I3,I4	.836

For reliability, the Cronbach's α [62] is calculated, which is a coefficient of internal consistency. For the extracted factors the respective Cronbach's α is shown in Table 2. It is noted that all of them are over 0.79 (with Leadership being on the border) which indicates good internal consistency, while some of them are above 0.9 which indicates excellent internal consistency [63].

3.3. Structural Equation Modeling

Structural Equation Modeling (SEM) comprises of several statistical methods including confirmatory factor analysis. The Confirmatory Factor Analysis (CFA) is used to investigate the model fit, i.e., how well the proposed model of the factor structure accounts for the correlations between variables in the dataset.

The x^2 (CMIN) divided by the degrees of freedom (DF) leads to the computation of the relative x^2 (CMIN/DF), which has a value of 1.403 for the specific model, and indicates a good fit (as $>$ 2.00 represents an inadequate fit [64]). Other indicators of goodness of fit are also the Goodness of Fit Index (GFI), and the GFI adjusted for degrees of freedom (AGFI) [65]. The calculated GFI is 0.773 and the AGFI is 0.748. Both are seen as moderate but this might be an effect of the sample size, and taking into consideration the proposal of [66], these aspects are not further investigated. The Comparative Fit Index (CFI) [67] calculated is 0.929 which indicates acceptable fit. The Root Mean Square Error of Approximation (RMSEA) that measures the discrepancy between the fitted model and the covariance matrix in the population is calculated as 0.047 which indicates a close fit of the model [68].

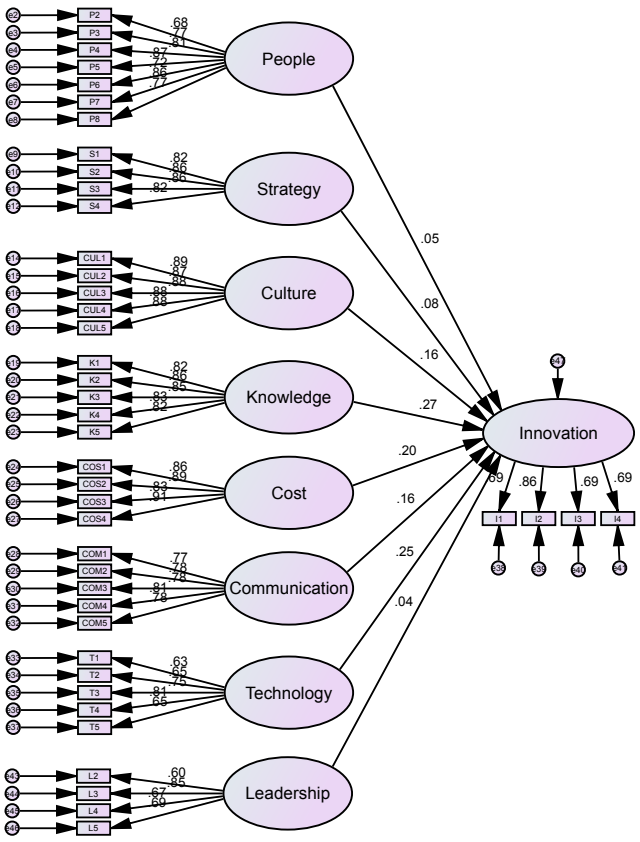

Figure 2: Structural Equation model in AMOS

An overview of the SEM model as this was run in the IBM AMOS tool is depicted in Figure 2. All factors are depicted and the values on the arrows represent the path coefficients (standardized estimates) which show the weight of the links in the path analysis. It can be seen that all eight factors have a positive contribution to Innovation. From them, Knowledge, Technology, Cost, Communication and Culture seem to be the biggest contributors while Strategy, Leadership and People seem to follow.

Table 3: Testing of hypotheses

Hypothesis	Path	Path Coefficient Weight	CR value >1.96	Support Decision
H1	Culture → Innovation	.16	2.060	Supported
H2	Knowledge → Innovation	.27	3.346	Supported
H3	Leadership → Innovation	.04	.455	Not Supported
H4	People → Innovation	.05	.598	Not Supported
H5	Strategy → Innovation	.08	1.058	Not Supported
H6	Communication → Innovation	.16	2.061	Supported
H7	Technology → Innovation	.25	3.045	Supported
H8	Cost → Innovation	.20	2.511	Supported

The calculation of the Critical Ratio (CR), which is the division of the regression weight estimate by the estimate of its standard error, and tests for loading significance are also calculated (as depicted in Table 3). A CR higher than 1.96 (or lower than -1.96) indicates two-sided significance at the customary 5% [69]. The CR criterion holds true

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for all model hypotheses except People, Leadership and Strategy, hence these are not supported by the proposed model.

4. Discussion

The hypotheses pertaining Culture (H1), Knowledge (H2), Communication (H6), Technology (H7) and Cost (H8) are supported as shown in Table 3. Innovators and entrepreneurs require competency sets for innovation such as technical competencies, thinking and creativity competencies, as well as social and behavioral competencies [48]. Since MOOCs include usually participants from all over the world, it is common to have multi-cultural settings and hence interaction with a highly diverse group of people is the norm [38]. Also, Knowledge is a survival competency for the workforce of the future, as indicated also in the European Commission report [49] that points out that lifelong learning is gaining in importance as the labor, market is rapidly changing and the half-life of knowledge is decreasing. The combination of video lectures, coupled with practical experiences and immediate-feedback, reinforce the "learning by doing" approach and this may prove to be much more effective than traditional e-Learning approaches. Active engagement of corporations in MOOC may benefit their employees significantly as many employees also dealing with innovation are keen on acquiring new knowledge and competencies professionally or personally [17]. In addition, the competencies acquired may be cross-disciplinary and this may help towards strengthening innovation [70]. Communication in MOOCs, may have contributed to overall better structured communication and expression competencies of the employees. Discussions carried out, train the participants towards arguing in a goal-driven way, based on course-related info/facts, in a coherent manner and adjust their message to the audience. That Technology is also positively impacting innovation comes as no surprise, since most of the MOOC offerings today are technology driven/focused and enable the participants to further follow their (usually technology-related) interests. It seems that the technical competencies acquired both in-theory and in-practice, in conjunction with better understanding of technology visions and limitations, find their way to the innovation processes of modern enterprises as hypothesized. This is seen as especially critical in the era where new technology competencies will need to be rapidly acquired. Finally, cost-effectiveness of MOOCs i.e., at zero cost for the participants, acts as an enabler to further develop competencies, and hence many people take it up, which results to development of competencies which might have not happened otherwise. This finding is of key importance for organizations that strive towards finding the balance between costs (both in time and money) and employee development programs.

The hypotheses pertaining Leadership (H3), People (H4), and Strategy (H5) are not supported by the empirical data as shown in Table 3. For Leadership, this may be justified, as the majority of content offered in MOOCs is mostly technical and for knowledge expansion. A few MOOCs offering leadership competency development exist, but they may be under-represented generally (and also in the survey sample group). Similarly, People competency development via MOOCs is still at a very early stage to effectively impact them. Development of people competencies assumes a significant portion of interaction with people and large groups of them, which may not be the case as many courses at the moment offer only bulletin board interactions and some collaboration (which could be expanded). Strategy competencies also are not supported. This was a surprising result, but it is assumed that the impact of MOOCs with respect to strategy may not be easy to measure and objectively self-assess [19]. Successful innovation can also include strategic knowledge about business intelligence, funding, marketing and other non-technical areas [46], which depict the areas that potentially MOOCs could focus. Today, some strategy courses are offered, but they may not be well represented in the survey sample. In addition to the potential strategy-related competencies that can be developed, focus on specific aspects might be needed which may not be the case for general-purpose MOOCs, but can be the case for firm-specific MOOC offerings targeted and tailored to an organization's specific needs.

Some responders expressed positive views about some corporate MOOCs they participated and pointed out that it really helped their professional life as such training is not available (the specific technology is too new), and probably would be too costly as well. This clearly highlights a key benefit of MOOCs which is the timely delivery covering cutting-edge needs that traditional approaches cannot do in such a flexible or rapid way. Some participants also noted that if they had to choose between MOOC and a course that would enable them to participate in person without cost, they would probably choose the latter (assuming all other conditions are similar). However, an indication also was given that MOOCs will evolve and the blending of virtual reality with MOOCs may be a good approximation of physical presence courses. With respect to quality however, there are examples of MOOCs having similar quality to traditional classroom teaching [11]. Another aspect one has to consider, is that a significant portion of answers was in the 3–5 range which shows that people consider MOOCS (and some are really enthusiastic about it) have really helped them to evolve their competencies and believe in their future. Generally, this research concludes with a positive outlook for MOOCs and their role in employee competence development as well as its potential impact to innovation.

Consideration of additional parameters such as geographic constraints, exact background, IT literacy, corporation domain, learning capabilities, etc. could potentially help us better understand the results and the interdependencies. Lack of access to a large and diverse pop-

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ulation is seen as a limitation of this research and could potentially lead to failure to identify certain phenomena. The assessment of enhancement achieved via a MOOC is difficult and in this case was relying on self-assessment from the participants of the survey which has some caveats [19]. However, a better method with measurable change on the employee's capabilities (where possible) would help to quantify more accurately the impact of MOOCs and potentially their weaknesses. An example of this could be the access to the scores of the tests and quizzes carried out in the MOOCs, which illustrate the capability of knowledge assessment and usage in practice. In addition, the readiness i.e., the ability to apply a group of technical and core competencies acquired via MOOCs needs to be systematically assessed [71]. An in-depth added-value analysis for all stakeholders should be done to understand the additional benefits for corporations but also society at large. In this research, the unit of measurement was the individual employee and how his competencies could evolve by participating in MOOCs. However, in corporations the employee is part of a group and complements group's activities. As such another limitation of this research is the lack of focus on groups and how their MOOC enhanced competencies complement each-other, empower the groups and increase the collaborations especially among other groups and departments.

5. Conclusion

MOOCs represent a very interesting evolutionary development of the traditional e-Learning experience, which now is empowered with modern technology capabilities and the potential to impact the lives of millions. In their very short lifetime of only a couple of years, they have created tremendous momentum and seem to cover well the need for learning, and personal evolution of a wide variety of people. MOOCs could have an impact on modern workforce, as they could empower their employees with new competencies that can be utilized on the job and boost innovation. The aim of this study was to discuss the role that MOOCs can play towards enhancing employee competencies, link them to innovation via the proposed model, and empirically assess (via quantifiable data) the impact of competencies to innovation. Although the study has several limitations, it provides some indications that MOOCs may positively contribute to employee competency development and there is a validation of statistically significant impact to innovation (for some factors) based on the empirical data collected. The competencies were grouped in factors and the empirical findings indicate that indeed there is positive impact to innovation from Knowledge, Technology, Cost, Communication and Culture. Although also Leadership, Strategy and People relationships to innovation were in the predicted direction (i.e., positive), they were not statistically significant. MOOC-empowered factors such as those analyzed in this work, demonstrate that MOOCs can have a contribution to the enhancement of modern workforce competencies and this has a subsequent positive impact on innovation. With emerging knowledge economies rapidly propelling us to a new era, and innovation being a key competitive advantage, MOOCs seem to be a promising tool to achieve positive impact.

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