

BUILDING FUTURE COMPETENCES

Challenges and Opportunities for Skilled Crafts and Trades in the Knowledge Economy

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SELF-EMPLOYMENT BY OLDER PEOPLE – SOME COMMENTS ON AN OFTEN OVERLOOKED PHENOMENON

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ABSTRACT

The aging and shrinking population in most developed countries is still seen as a major societal and economic problem. But the result of an ageing population is a growing number of healthy older people with human capital, financial resources, and time available to contribute to economic activities. However, the human capital of older people remains mostly unused. This risees the question, how to make use of the economic potential of older people. It will be discussed what factors may positively influence or hinder older people in becoming self-employed. Income and wealth situation, time sovereignty, work experience, previous occupations, health status, household context, but also the institutional framework are exploratory variables which may significantly impact the decision of the elderly. Overall, attention will be drawn to the relevance of older people in the field of business and entrepreneurial economics. Given the ageing population it seems necessary to focus not only on young people but also take into account the large and still growing economic potential of the elderly.

Keywords: Self-employment, older people, ageing society, entrepreneurship, senior entrepreneur

KEY FINDING(S)

- It may be assumed, that the reasons to become self-employed are different for younger and older people. Even
 if the main factors are identical, the ways in which the factors operate differ between young and older people.
- The group of older people has specific characteristics that set them apart from younger people. Foremost, one should distinguish between people, who are still working, and people, who have undergone the transition into the retirement phase due to age-related withdrawal from employment.

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- The following characteristics may have a significant impact on the decision of the elderly to become self-employed:
 - income and wealth situation,
 - time sovereignty,
 - · work experience and previous occupations,
 - health status,
 - household context,
 - institutional framework.
- In comparison to other age groups older people in general seem to be more inclined to take over an existing business than to set up a new one.
- Overlooking the empirical information on the potential for entrepreneurial activities of older people, it seems
 obvious that sufficiently large numbers of elderly are inclined to become self-employed.

IMPLICATION(S) FOR THE PRACTICE OF SMEs

It seems worthwhile to have a closer look at the elderly when fostering self-employment, taking into account their specific circumstances such as secure income out of pension systems, time sovereignty, and work experience. For example, becoming self-employed after retiring means lower financial risk than becoming self-employed during the employment phase. Furthermore, regulative, legal and institutional conditions set the framework for individual decisions to become self-employed. Legal regulations for instance constitute age differences concerning the opportunity to become self-employed. Additionally, the heterogeneity of older people has to be taken into account. Even more, as long as people do not live alone, their decisions are made in the household context. Therefore, not only the individual characteristics, but also the characteristics of the household should be taken into account, when fostering self-employment by older people. In promoting self-employment, for younger people numerous courses at universities, business schools etc. exist. But for fostering self-employment by older people, the learning behaviour of the elderly has adequately to be taken into account. Given i. a. their experience and accumulated human capital, they warrant separate educational measures, which are established in geragogy.

1 INTRODUCTION

The result of an ageing and shrinking population is a growing number of older people with a large amount of specific human capital, financial resources, and time available to contribute to economic activities. Therefore, an impressive economic potential of older people seems to exist. But overlooking the workforce, the human capital of older people remains for the most part unused despite that some people are working e. g. as volunteers or as senior experts. So, from an economic point of view the question arises, how to make better use of the underused economic potential of older people.

One way could be the promotion of volunteering. Though this would exploit only parts of the economic potential as volunteering is carried out by a specific part of the elderly, mainly by so called middle class people. Another option would be fostering self-employment. But self-employment of older people is an economic phenomenon which has been mostly overlooked in the past. For example, most economic policy programmes focus on the support of young entrepreneurs and start-ups. This follows the perception that young people are creative, innovative, and lateral thinkers. Numerous courses at universities, business schools etc. try to convince and prepare young people to take the risk of becoming self-employed and run their own businesses (Qian, Mulas & Lerner, 2018).

Therefore, the economic resources of older people concerning self-employment lie idle and are often overlooked. Older people are mostly seen as economic inactive or non-productive and only as a large mass of consumers, hence the term silver exonomy (European Commission, 2015). Though fostering self-employment of the elderly may be a way to convince older people to become economic active through being self-employed. Those people may then stay in the labour force and generate economic growth. Yet little is known about the reasons and motives why older people become self-employed (Stypinska, 2018; Organisation for Economic Co-operation and Development (OECD) & European Union, 2017; Seco Matos & Amaral, 2017; Caiger, 2016).

Though to develop adequate political measures for facilitating self-employment in old age, it is necessary to know whether this is a serious option for the elderly. It is necessary to know the main factors which support self-employment of older people and what reasons may influence the decision of becoming self-employed in older age. Only when the main factors which explain self-employment of the elderly are identified, it is possible to develop policy measures to support self-employment of older people.

In the following it will be discussed what factors may influence positively or may have a negative impact on older people in becoming self-employed. For example, income and wealth situation, time sovereignty, work experience, previous occupations, health status, household context, but also the institutional framework are exploratory variables which may impact significantly the decision of the elderly. Additionally, main differences between younger and older people in becoming self-employed will be clarified.

Overall, attention will be drawn to the relevance of older people in the field of business and entrepreneurial economics. From an economic point of view it seems necessary to focus economic policy not only on young people but also on the economic potential of the elderly (Fachinger, 2019). The aging population makes this even more important. But at first, it is necessary to take a closer look at the group, which in the following is referred to as older people or as the elderly.

2 OLDER PEOPLE

There exists no commonly used definition of older people (Settersten & Mayer, 1997). Normally the term refers to people who are in the life phase called old age, or – in economic terms – in the phase of diminishing productivity or in the post-productive life stage (Alwin, 2012; Wingens & Reiter, 2011; O'Rand & Krecker, 1990). But this phase

is in itself very heterogeneous. It is not clear at which calendar age the decrease in productivity will start as it depends on the mental and physical capabilities which differ tremendously even between people of the same age. Even at the age of 55 or older the productivity may increase. This is why in the literature of economics, sociology, psychology, biology, geriatrics, or gerontology different classifications of older people exist (Sachverständigenkommission zur Erstellung des Sechsten Altenberichts der Bundesregierung, 2010).

However, in the context of this article the phase of old age starts with the transition into retirement. Older people are those, who have undergone the transition into the retirement phase due to the age-related with withdrawal from employment. Therefore, the beginning of this phase of life is (partly) determined by the age boundary as laid down in the pension law (Kohli, 2007: 20 f.). In literature these people are referred to as the young, independent, active elderly or the young-olds, which are still vital and able to care for themselves. This phase ends with a noticeable increase in health and social risks. The very old or old-old people are more often in need of support or in need of care compared to the young-old people.

3 CHARACTERISTICS OF OLDER PEOPLE

The group of older people has specific characteristics that set them apart from younger people, which are either in dependent work or self-employed. In the following these characteristics are discussed and encompass the income situation, the time sovereignty, and the experience from previous work and occupations (S. C. Parker, 2018; Seco Matos & Amaral, 2017). Additionally, the household context and the institutional framework has to be taken into account for analysing self-employment of older people (van Solinge, 2015).

3.1 INCOME

Overall, the composition of income differs significantly from the situation in earlier life stages. One main characteristic of older people is that after retirement work is not necessary to earn a living. Because to retire means receiving benefits from statutory, occupational and/or private pension systems. What characterises older people is the dominance of income from pensions, whereas income from employment is less important.

Additionally, the entitlements constitute in principle also higher income security, depending on the specific pension system. Most pensions are a continuous stream of permanent income during retirement. As pensions replace earned income, the permanent income component is higher in absolute and in relative terms during the retirement phase compared to the employment phase. Additionally, it may be assumed, that usually the average income during the employment phase is higher than the average retirement income, but also the variance and hence the overall income mobility. Therefore, according to the μ - σ -criterion, it is unclear, whether the overall wellbeing during the employment phase regarding the income dimension is higher than during the retirement phase. Lower annual income does not necessarily mean lower economic wellbeing – it depends on the ratio of individual pensions to (previously) earned individual income, i. e. the replacement rate, and on the differences in the stability of the specific income stream during the two phases.

Considering all aspects on the income situation and its development over time, becoming self-employed after retiring means lower financial risk than becoming self-employed during the employment phase. The fear of failure would be less important for older people (for empirical evidence see e. g. Rehak, Pilkova, Holienka & Jančovičová, 2017). The higher income security constitutes ceteris paribus higher planning reliability and there-fore a positive incentive to become self-employed after retirement, which is often ignored in the literature (e.g. Ahmad & Hoffmann, 2012: 28).

3.2 TIME SOVEREIGNTY

It can be assumed, that after retiring, people's time budgets are mostly not dominated by contractual obligations. During the employment phase, people normally have to work to earn a living. This is done mostly in dependent work and under specific conditions. Despite the process of disintegration of work arrangements over the last couple of years due to the digitalisation – which inter alia leads to abandoning of work from time and place – people have to devote time to work. They may be free in their time regiments and may choose their place of work by themselves, but the process of hybridisation of work (Bührmann, Fachinger & Welskop-Deffaa, 2018; Bögenhold & Klinglmaier, 2016) does not mean an overall reduction of working time. People have to invest time to work. However, in general the working hours normally decrease considerably after retiring and journey time to and from work places does no longer apply. There is not only more time available but this also creates more time flexibility. Retired people have more command over their time and can decide by themselves what they will do and when they will do it.

Furthermore, most people have entered the so-called empty nest phase (Heinze & Naegele, 2010), a phase of live without having to care for their children, parents, or partners. Children are no longer at home, parents may not be in need for long term care, and care work for own partners has not yet begun.

Neither having to work nor caring for others creates free time with a lot of time flexibility, which has to be filled by other activities. People entering the retirement phase will be looking for meaningful actions to fill this time. This could be leisure activities, working as volunteers with less obligations, or as senior experts even abroad, or starting one's own business.

3.3 WORK EXPERIENCE AND PREVIOUS OCCUPATIONS

Older people who retire normally have a long employment history. Therefore, they have a lot of work experience and sometimes several previous occupations. This can be seen as positive factors for becoming self-employed (Solinge, 2014). Older people have potential prior work experience in the relevant industrial sector that provides them with important background knowledge and the x's and o's of the sector in question. They exhibit a work career as dependent worker and/or have experience as self-employed and sometimes they even were serial entrepreneurs. The longer people work, the more experienced they become in what they are doing. Additionally, the closeness to previous work is relevant. The more people have worked in the specific area, in which they would like to become self-employed, the more specific experience they have gained and the more they know about the details and imponderabilities. Therefore, it may be assumed that older people can better foresee what they may experience when starting a new business. This may make it a lot easier to be successful.

Additionally, during their working careers, elderly may have developed networks which may ease the process of becoming self-employed. Network partners might support the idea of working after retirement and may help by keeping the contacts or relationships intact and may even place an order.

3.4 HEALTH STATUS

One main reason for the demographic change is the increase in longevity of people in more developed countries. The discussion, whether the additional live years will be in good health status – compression of morbidity theorem (Fries, 1980; Fries, 1991; Fries, Bruce & Chakravarty, 2011) – or whether the phase of bad health status will be prolonged due inter alia to new medical technics – morbidity theorem (Verbrugge, 1989; Verbrugge, 1994) – relates more to the older people in advanced age (M. G. Parker & Thorslund, 2007).

It may be assumed that overall after retiring people on average are in good health conditions and therefore are able to run a business. Additionally, retired people can choose the field in which they want to become self-employed in dependence of their health status The process of digitalisation may open up opportunities to become self-employed even for people with restricted health. Regarding all this it can be assumed, that the status of poor health may have less negative influence on the decision to become self-employed in future.

However, at present the effect of the health status is unclear as there is a lack of empirical evidence or contradictory results (Zissimopoulos & Karoly, 2007; Zissimopoulos & Karoly, 2009; Wenger & Reynolds, 2009; S. C. Parker & Rougier, 2007).

3.5 HOUSEHOLD CONTEXT

As long as people do not live alone, their decisions are made in the household context. This means that not only the individual characteristics but also the characteristics or type of household should be taken into account when analysing self-employment by older people. The types of household can be distinguished in three categories:

household structure

including all qualitative social characteristics; for example, the way of living together, occupational status, degree of autonomy of the household members, etc.

household composition

qualitative demographic characteristics such as age and gender of the household members

household resources

quantitative household characteristics; for instance, number of persons, who are living in the household, number of employed persons, household income, wealth situation etc.

However, it can be assumed that older people who are or want to become self-employed are supported by their household members. It may even be the case, that a hybrid model of household-business-complex will take shape where business and household activities are intertwined. This applies, in particular, to those activities that are done as home-based work, as small business, or as freelancers. The options for such forms of self-employment are due to the process of digitalisation and the structural changes of the labour market on the whole characterised inter alia by the term platform economy (Bührmann et al., 2018).

3.6 INSTITUTIONAL FRAMEWORK

The institutional framework and legal regulations are important factors which affect self-employment by older people (Abdesselam, Bonnet & Renou-Maissant, 2017: 9 ff.; Ahmad & Hoffmann, 2012: 22 f.; van Solinge, 2015: 106 f.). These exogenous factors are mostly overlooked in economic analysis and typically included in the ceteris paribus assumptions or not even mentioned. A classic example is The Gallup Organization 2007, where people of 55 and older are gathered in one single group, totally ignoring their heterogeneity.

To give an example of the relevance of the institutional framework in analysing self-employment of older people, the legal retirement age has to be discussed. In principel, the legal retirement age determines the end of the employment phase and implies the termination of dependent and – depending on the occupation – of independent work. Even in one country such regulations are neither constant over time nor invariable between occupational groups or industrial sectors (Directorate-General for Employment, 2018; van Solinge, 2015: 107).

There exist different retirement ages for dependent workers and self-employed people. In Germany for example:

- The normal retirement age for employees with compulsory insurance is 67 (§ 35 Sechtes Buch Sozialgesetz-buch SGB VI). But people can retire earlier if they met specific conditions or work longer. After having been insured in the statutory pension system for at least 35 years one can retire after reaching the age of 63 (§ 36 SGB VI) but for each month earlier than 67 the pension will be reduced by 0.3% per month (§ 77 Abs. 2 Nr. 2a SGB VI). With a qualifying period of at least 45 years, people can retire after reaching the age of 65 without any reductions (§ 38 SGB I). If in the statutory old age pension system compulsory insured people work longer than the age of 67 in agreement with the employer, their pensions will increase by 0.5% per month (§ 77 Abs. 2 Nr. 2b SGB VI).
- The normal retirement age for civil servants of the Federal State (not for the public sector workers, which are compulsory insured in the statutory pension system) is also 67 (§ 51 Abs. 1 Bundesbeamtengesetz). But the retirement age for civil servants which work in the fire services of the German Armed Forces is 62 (§ 51 Abs. 3 Bundesbeamtengesetz) as is the retirement age of ordinary professional soldiers (§ 45 Abs. 1 Soldatengesetz).
- The normal retirement age for civil servants of the Bundesland Berlin is 65 (§ 38 Landesbeamtengesetz Berlin).

- Until 2006 the official retirement age of physicians was 70. With respect to the structural socio-demographic changes this age limit was abandoned so that physicians can now practise till they die. Such amendments of law result in cohort effects as they apply as of a certain point in time.
- Notaries have to retire at the end of the month, when they became 70 (§ 48a Bundesnotarordnung).

All these legal regulations influence the decision and constitute age differences regarding the opportunity to become self-employed.

4 EMPIRICAL FINDINGS ON THE INTENTION TO BECOME SELF-EMPLOYED

To get a general impression whether self-employement is an option for retired people, some information is given on the basis of the Eurobarometer (European Commission & TNS Opinion & Social, 2012) and data from the Global Entrepreneurship Monitor (Amorós & Bosma, 2014) in the following. However, by interpreting the results, it has to be taken into account, that the two surveys are not comparable if only for different survey structure, questionnaire design, and differing wordening of questions.

Overall, it seems that at least some older people are interested in starting up a business, as can be seen in Figure 1, where the overall entrepreneurial intention by age groups is shown. At least 7% of the interviewees in the age group of 65 and older have such intentions and around 4% of people from this age group have undertaken early-stage entrepreneurship activities.



Figure 1: Entrepreneurial intentions, in % of the age group, GEM 2009 to 2016 Source: Schøtt, Rogoff, Herrington & Kew 2017: 22.

In the Eurobarometer, people are asked "Q17: If you currently had the means to start your own business, including sufficient funding, would you rather set up a new one or take over an existing one?". The answers reveal differences between the age groups, which are shown in Figure 2. In general, older people seem more inclined to take over an existing business than to set up a new one in comparison to other age groups (Ainsworth & Hardy, 2008). Taking over a business may be easier and less risky as people do not have to have a new business idea, innovative products or services, and may increase the chances of economic success because of the combination of experiences, skills and networks of older people and those of the enterprise and its employees (Organisation for Economic Co-operation and Development (OECD), 2012).



Figure 2: Set up a new business or take over an existing one, in % of the age group, Eurobarometer 2012 Source: Own calculations on the basis of Eurobarometer 2012.

Therefore, it is not surprising, that few older people are involved in an early-stage of implementing their business idea as own calculations on the basis of GEM 2015 indicate. The indicator for such activities is called Total early-stage Entrepreneurship Activities (TEA) which is measured as the "percentage of the adult population that are in the process of starting or who have just started a business" (Schøtt et al., 2017: 22).

Of all people, which are participating in early-stage entrepreneurial activities, a TEA of 3.6% belongs to the age group 60 to 64 and the TEA for people 65 and older is 1.4%. However, 5.5% of the age group 60 to 64 and 3.8% of people 65 and older are active in the field of early-stage entrepreneurship.

Overlooking the empirical information on the potential for entrepreneurial activities of older people, it seems as if there exists a sufficiently large number of elderly who are inclined to become self-employed.

5 SUMMARY

In the face of an ageing and shrinking society with an increase of longevity, the number of older people, who are equipped with high economic potential but no longer participating in the labour market, is growing (European Commission, 2014; Carone, Eckefeldt, Giamboni, Veli & Pamies Sumner, 2016; European Social Insurance Platform (ESIP), 2010). It is often argued that this will lead to a financial collapse of the social security systems, especially of the statutory old age pension systems. Therefore, the question arises how the economic potential of the elderly, especially retired people, can be used. One possibility is starting a new professional career as entrepreneur or self-employed. To develop adequate economic measures for supporting the elderly in the choice for self-employment, the main factors have to be identified. In this context, it is discussed, that the income and wealth situation, time sovereignty, work experience, previous occupations, health status, household context, but also the institutional framework may have a significant impact the decision of the elderly to become self-employed. Furthermore, it is shown, that older people - if only a small part - could imagine to become self-employed or are in the phase of early-stage entrepreneurship. Overall it seems worthwhile to have a closer look at the elderly when fostering self-employment, taken into account their specific circumstances such as secure income out of pension systems, time sovereignty, and work experience. Additionally, the institutional framework as well as the household context have to be considered, as regulative, legal and institutional conditions set the framework for individual decisions, which are taken within the household context and often discussed with family members.

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A KNOWLEDGE-BASED APPROACH FOR LINKING WORKFORCE EXPERIENCE AND LABOR PRODUCTIVITY IN SMART FACTORY INDUSTRY 4.0

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ABSTRACT

Industrialization of Artificial Intelligence (AI) raises several questions, inter alia, whether machines can gain work experience alike human workforce, whether the on-the-job obtained experiences may enrich existing knowledge, skills and abilities (KSCs) and untimely lead to improve its productivity. If so, humanand machine workforce initiate a new competition in the era of intelligentization where not only AI-enhanced and smart machines reproduce human cognitive and physical capabilities, but also they may challenge the unique role of human as a learner. Despite economic, ethical and societal challenges, intelligentization undergoes rapid changes in the manufacturing enterprises. This paper explores the linkage between gaining workforce experience and labor productivity in hybrid man-machine settings. The ultimate goal, partially addressed in this paper, is to anticipate the learning trajectory of human and machine workforce and thus recommend the new division of labors and innovate new processes and products in smart factories.

Keywords: Ontology, Task, Learning, Labor Productivity, Division of labor, Smart Factory

KEY FINDING(S)

- Interlinking job tasks in the World of Work (WoW), and Learning Items in the World of Education (WoE) via World of Competence (WoC) consisting of Knowledge, Skills and Competences (KSCs) required for blue- and white-collars.
- Estimation of the four states of Job-KSC mismatches, namely gap, shortage, surplus, obsolete using Job-Know Ontology.
- Tackling the KSC imbalance problem through a proposed experience collection system, namely Job-Know eXeN.
- Anticipating (individual) productivity curves based on identification of KSC states.

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This article proposes a learning assistance system to supply a blue- and white collar by recommending appropriate learning items, based on his/her KSC state and productivity curve.

IMPLICATION(S) FOR THE PRACTICE OF SMEs

SMEs need to recognize whether KSCs obtained by their employees meet KSCs requested to perform the job tasks. To accomplish this goal, the Job-Know Ontology provides a knowledge-based approach to represent "what is supplied", "what is demanded" and "the relation between supply-demand". Job-Know Ontology bridges the two worlds of work (WoW) and education (WoE), and subsequently infers how much the supply-demand KSCs are matched. Job-Know Ontology, therefore, clusters the supply-demand KSCs into five states of gap, shortage, balance, surplus and obsolete. To tackle the imbalance KSC states, two systems are proposed; one for collecting experiences to generate new knowledge, which is called Job-Know eXeN and the other is a recommendation system, which provides recommendations based on identifying the KSC states and anticipating productivity to balance the supply-demand states.

1 INTRODUCTION

In manufacturing enterprises 4.0, the shift in the division of labor between human and machine is anticipatable (World Economic Forum, 2018). As machines may take over part of the tasks of today, especially routine manual and/or cognitive tasks, employees should perform emerging tasks, in particular, non-routine manual and/or cognitive tasks. Depending on job roles, a human workforce may either i) interact with machine workforce, including smart machinery and devices, artificial intelligence (AI) systems, collaborative robots (cobots) or learning assistance systems, or ii) collaborate with other professionals in diverse qualification levels, including operators, administrative personnel, engineers and/or managers. Involving in structured processes, which consist of a set of sequential, pooled, reciprocal or shared tasks requires a) identifying the job tasks defined as a part of the job description by the employers, and b) specifying the knowledge, skills, and competences (KSCs) demanded to perform the job tasks.

Learning has been understood as part of human intelligence and in fact, human rights e.g. to learn how to perform a specific job. Educational institutions, particularly vocational education and training (VET), support learners (i.e. potential job seekers) to acquire the required KSCs demanded by the world of work (WoW), i.e. a specific job. Moreover, job seekers and/or jobholders improve the level of KSCs and fill the KSCs gap either by participating in off-the-job-training programs or doing the tasks and gaining experiences on-the-job, respectively (Khobreh et al., 2016). In both cases, job seekers/jobholders as lifelong learners reinforce their body of know-ledge, i.e. the required KSCs, towards career development as a lifelong learning process. In this continuous training process, there is a basis of KSCs, which jobholders possessed in educational institutions. Nevertheless, they maintain, enrich and sustain the KSCs level by gaining experiences. In fact, there is a direct relationship between i) what KSCs possessed by learners and ultimately represented by jobholders and ii) what KSCs required to fulfill

expected degrees of employee's on-the-job performance. If what is supplied and what is demanded are not in a state of equilibrium then the actors (i.e. jobholders and employers) faces with KSCs imbalance, performance problem and ultimately job dissatisfaction. To define the KSCs imbalance problem, first the tasks should be identified, second, the required KSCs should be recognized and finally, KSCs represented by the job-seeker/holder should be compared with what is demanded. Considering experience-driven processes at the heart of a job, the jobholders obtain individual-based KSCs by doing the tasks, collecting experiences and fulfilling the assigned tasks competently, i.e. KSCs imbalance problem is tackled. This sort of KSCs is reinforced by experiences collected over time.

Furthermore, the relation between labor productivity and labor experience has long been the subject of scientific investigation. The undergoing digitalization and intelligentization in manufacturing enterprises raise several questions about the new division of labor and its impact on organizational learning and labor productivity (Ansari, 2019). The main reason is the intelligentization of machines, processes, and products. In other words, beside human as a learner and knowledge actor, intelligent machines and AI systems emerge a new group of learnable workforce (cf. definition of Knowledge Actor 4.0 in (Ansari, 2019)). Approaching the aforementioned challenges from the angle of Task-KSC supply and demand, the key questions of this paper are as follows: What will be the effect of workforce experience and learning on labor productivity? How to monitor the evolution of human- and machine-specific KSCs in smart factories? And, how to provide recommendations (strategies and measures) to anticipatively control the evolution of KSCs linked to the variable division of labors?

In earlier works, the Job-Know Ontology, an ontological model of WoW and WoE, has been developed, which represents the relation between the tasks that construct a job and the required KSCs. It supports reasoning out (im)balance state of supply-demand. The methodology of developing "Job-Know Ontology" has been elaborated in (Khobreh et al., 2016). This paper presents the initial steps towards adopting the "Job-Know Ontology" in smart factories. To this end, Job-Know Ontology is used which dynamically collects human- and machine-specific experiences during performing a job in smart factories. In particular, the Job-Know Ontology establishes the knowledge-base, i.e. the semantic representation of task- and KSC elements, including the job tasks, required KSCs demanded, and learning lessons/experiences, which are qualifiers and enablers of the job tasks. It provides set of rules to reason out what is needed and what is missed in the supply-demand chain of learning and performing. Besides, this paper lays the ground for extending the scope of the ontology into an "experience-driven Job-Know Ontology" in which lessons learned are used to tackle the imbalance problem and improve labor productivity, including both human and machine workforce. In so doing, the Job Knowledge Experience Engine (eXeN) and the Job Knowledge Recommendation System (RecoSys) are proposed.

The rest of the paper is structured as follows: Section 2 discusses the background of the research including a detail discussion on learning curve and productivity. Section 3 elaborates the Job-Know Ontology and presents the KSCs imbalance states. Section 4 introduces Job Knowledge Experience Engine (eXeN) and Job Knowledge Recommendation System (RecoSys), which provides new learning items from collected experiences and recommends appropriate learning items for further learning and training, respectively. Section 5 concludes the study by summarization and discussion.

2 BACKGROUND

2.1 WHY MEASURING LEARNING EFFECTIVENESS MATTERS IN SMART FACTORIES?

In conventional factories, a safety zone or a physical/virtual (un-)fixed fence distinguishes human-and machinespecific workplace. The emergence of cobots introduces human-machine collaboration and sharing workplace (Sylla & Satwick, 2017). Al agents, intelligent and learnable software and robot systems fulfill a certain degree of autonomy, where they reproduce humankind of physical and cognitive capabilities (Ansari et al., 2018a). Hence, the new division of labor between human and machine workforce is anticipatable, in which three types of tasks can be introduced namely human tasks for humans, machine tasks for machines, and shared tasks for both human and machine workforce. As depicted in Figure 1, the entire pool of tasks is, therefore, divided into three partitions, whereas today two partitions (Ansari, Erol & Sihn, 2018).

Let us assume that "Learnability" and "Learning Effectiveness" in performing tasks are determinants of "Labor Productivity". In case of human- or machine-specific tasks, monitoring individual learning curves (LCs) may provide valuable information with regard to an optimal division of labor. LCs of human and machine can cross, with the result that the advantage of the alternatives "Human or machine" depends on the planned order volume. For investment decisions on cobots and AI systems, the question whether the target tasks should be performed by man or by a machine must be answered based on estimating the correlation between labor productivity and the total costs or expenditures for both labor alternatives during the working life of human and machine workforce. LCs provide a good basis for forecasting the effect on productivity.



Figure 1: Labor Productivity, Sharing Workplace and Workforce Experience in Smart Factories

In case of the shared task, segmentation of a task into sub-task might be a way to distinguish human and machine profiles and sketch related LCs. LCs of both can be used to evaluate different configurations. For example, if alternatives are available for the system design of Digital Assistance Systems (DAS), their dynamic behavior can be evaluated using LCs. The parameters Handling/Operation Time, Human Error Probability and Learning Time discussed by Ansari, Hold, Sihn (2018) are suitable for this purpose. As a scientific challenge, still investigation is required to identify a target function for measuring learning effectiveness associated with productivity in the shared workplace under boundary conditions such as safety, privacy, scalability, and complexity with regard to product, processes, operations and tasks (Ansari et al., 2018b).

2.2 LEARNING AND LABOR PRODUCTIVITY

2.2.1 DEFINITION AND MEASUREMENT OF LABOR PRODUCTIVITY

Productivity is generally seen as an input-output ratio of quantitative variables. The numerator of such a quotient, i.e. the productivity key figure, contains the product quantity generated (measured in pieces, weight units, etc.) and the denominator contains the quantity of a production factor required for that output. Labor productivity P_L can thus be defined that the quantity q of produced parts or end products is set in relation to the working time t_L (in hours) required for q (Blohm et al., 2016):

$$\mathbf{P}_{\mathrm{L}} = \mathbf{q} / \mathbf{t}_{\mathrm{L}} \tag{1}$$

To reflect a change in labor productivity, the reciprocal P_L^{-1} of this key figure is also used. For example, the improvement in efficiency can be expressed in the assembly of a particular type of car by showing the reduction in the number of required working hours per vehicle. So that labor productivity at a certain point in time and its development over time can be meaningfully interpreted, it should be noted that both, output and input, are homogeneous goods each, i.e. they should be of the same quality. Otherwise, an addition of the output or input quantities would not be possible. If, on the other hand, the output is qualitatively different, but at least similar, and if it is also known in what ratio the *n* different products differ in terms of labor input, then the qualitatively different outputs q_i (i = 1, ..., n) can be summarized additively by using standardization factors g_i in the form of a weighted arithmetic mean:

$$q = \sum_{i=1}^{n} g_i \cdot q_i \tag{2}$$

In this equation, q denotes the output in calculation units. The standardization factors represent the reduced expenditure ($g_i < 1$) or additional expenditure ($g_i > 1$) of working time compared to a standard product ($g_i = 1$). The standard product does not have to exist in reality but can be a fictitious operand. Let us assume that the three products are manufactured. Product 1 requires 95% of the working time of the standard product (= product 2) per unit, while product 3 requires 110%. The production quantities in an accounting period are $q_i = 3000$ units, $q_2 = 5000$ units and $q_3 = 4000$ units. The output q is then 12,250 calculation units. If a total of $t_L = 10000$ working time units was utilized for all products, the labor productivity is $P_L = 12.25$ calculation units per time unit.

The method of productivity calculation by means of a standard product can be applied without great effort in case of traditional mass and large series production. The domain of the Smart Factory, however, is the production of more differentiated products (i.e. Lot Size One), so that the more heterogeneous the production program, the more time-consuming the procedure will become.

If (very) different labor qualifications are involved in the manufacturing of a product, the condition of homogeneity of the input is not met in order to determine labor productivity. In this case, a procedure analogous to that described above with standardization factors h_j with j = 1, ..., m is recommended for the survey of the total required working time t_L , where m denotes the number of qualification levels to be taken into account. Starting from a "reference qualification" which receives the factor $h_j = 1$, the required working hours t_{Lj} of the individual qualification levels are multiplied by a normalization factor $h_j < 1$ if the qualification is below the reference qualification or, conversely, by a factor $h_j > 1$. As a pragmatic solution to the problem of quantifying these standardization factors, it is proposed that the factors be determined in relation to the compensation paid to the employees. In this way, for the total working time required, the following result is obtained

$$t_L = \sum_{j=1}^m h_j \cdot t_{Lj} \tag{3}$$

and for the labor productivity

$$P_L = \frac{\sum_{i=1}^n g_i \cdot q_i}{\sum_{j=1}^m h_j \cdot t_{Lj}} \tag{4}$$

When interpreting labor productivity in an isolated way, it should be noted that the influence of the other production factors (machines, materials, planning, and management) must not be neglected (Blohm et al., 2016). The output always results from the combination of all production factors involved. For example, an increase in labor productivity can be based on the use of more efficient machinery, easier to handle components, improved work instructions or several influencing factors that are working simultaneously. Therefore, an observed increase in labor productivity does not necessarily or solely result from an increase in the efficiency of labor. This is particularly relevant when considering larger periods of time in which production processes, including factor input ratios, have been changed.

For reasons of simplification, the following explanations are confined on one product (n = 1) and one work qualification (m = 1), so that the indexing of the variables q and t_{l} is no longer required. In the following, t is set for t_{l} as well.

2.2.2 LEARNING CURVES AS A LINKAGE BETWEEN WORKFORCE EXPERIENCE AND LABOR PRODUCTIVITY

The fundamental contribution by Wright (1936), which is still frequently cited today, is based on empirical data from the aircraft industry since the early 1920s. Wright's finding of the relationship can be expressed by the following equation:

$$\mathbf{t}(\mathbf{x}) = \mathbf{t}_1 \cdot \mathbf{x}^{-\mathbf{b}} \tag{5}$$

In the above equation of LC, *x* is the cumulated product quantity and $t_i = t$ (x = 1) is the required working time for the first quantity unit. *b* is the learning coefficient, a non-dimensional parameter to be determined empirically, which represents the learning success. t(x) denotes either the working hours required for the x^{th} output unit (unit cost model) or the average cumulated working time per output unit for the production of *x* units (average cost model) (Badiru, 1992). The term "cost model" derives from the fact that cost can be also considered instead of production times, because under the condition of constant compensation rates per time unit (homogeneity of work input), the transition from *t* to cost is a pure linear transformation that does not change the basic statement, i.e. with each multiplication (e.g. doubling) of the cumulative output of a product, the required production hours of a unit or the corresponding unit cost decrease by a constant percentage. LC, a hyperbolic curve, is visualized in Fig. 2.



Figure 2: Learning Curve and Productivity

If we use the reciprocal value of the working hours per output unit, we obtain, as explained above, productivity. Its graph is also shown in Fig. 2 as a function of the cumulative production quantity. In this respect, the term "Curve of Natural Productivity Increase" (Keachie, 1964) for LC is equally appropriate. Another term, "experience curve", is well suited to the fact that workers are becoming more and more productive because of increasing experience, measured in terms of cumulative output. Nevertheless, this term is not very common for learning in the operative area of manufacturing and is mostly used in the sense of a cost experience curve for strategic issues (the composition of the product portfolio, product design, competitive analysis). In this case, not only the

labor cost but also all payments, which result in manufacturing the products are considered. A doubling of the product quantity produced leads to the reduced execution time as in:

$$t(2x) = t_1 \cdot 2x^{-b}$$
 (6)

The decrease can be expressed by the ratio as in:

$$q = \frac{t(2x)}{t(x)} = \frac{t_1 \cdot 2x^{-b}}{t_1 \cdot x^{-b}} = 2^{-b}$$
(7)

Logarithmizing provides

$$\log q = -b \cdot \log 2 \tag{8}$$

and thus the learning coefficient

$$b = -\frac{\log q}{\log 2} \tag{9}$$

For example, for every doubling of the cumulative output quantity, the reduction in working time is 20%, then q = 0.8, that is, there is an 80% learning curve. The resulting learning coefficient is

$$b = -\frac{\log 0.8}{\log 2} = 0.322. \tag{9.1}$$

With double-logarithmic axes, the learning curve acquires a linear form (Fig. 3). The parameter *b* is a measure of the slope of the curve and reflects the fact that the learning rate is constant (log-linear model). However, it also implies that the learning effect is absolutely highest with small-cumulated quantities.



Figure 3: Learning Curve (log-log Scale)

LCs represent a statistical relationship on a "macroscopic" level, while a causal analysis must be based on the single influencing factors of the learning effect ("microscopic" level). The increase in productivity of working people is certainly largely due to the exercise effects of learning by doing, i.e. the increasing routine raises the speed of work operations. Work interruptions disturb the exercise effect, so that forgetting ("de-exercising") begins. Whether and to what extent other influencing factors are effective depends on the conditions of the individual case. Anzanello and Fogliatto (2011) report on studies in which diverse factors have been investigated, as the structure of training programs, workers' motivation, prior experience with the task, and complexity of the task. Unclear work instructions and poor production planning, which leaves a high degree of freedom to the workers, increase the savings potential and steepen the learning curve. A high degree of difficulty of the work task and a small influence of the mechanical equipment on the operation times result in the same effect. In these cases, it can be assumed that not only the improvement of sensorimotor abilities due to the repetition of work processes but also the gradual improvement of the working method by the worker, i.e. adaptations of the micro-processes through feedback (Seidenberg, 2012), lead to an increase in productivity. In other words, the same process is not only always carried out faster but is also modified in the direction of higher efficiency. Interindividual differences in learning ability (intelligence quotient, speed, sustainability, etc.) interfere with the above-mentioned external influences.

Over time, extensions and modifications of Wright's log-linear model have been developed which take into account further influencing parameters and also lead to other curves (s-shaped, transition to a plateau, etc.) (cf. the literature overviews at Badiru, 1992; Anzanello & Fogliatto, 2011; Glock et al., 2018). A plateau, i.e. a parallel to the axis of the independent variable, indicates that learning has come to a stop or saturation point, may it be that all potentials for improvement have been exhausted, may it be that the machine exerts a dominant timing influence. While the log-linear model is the most investigated LC model, exponential and hyperbolic have been discussed also.

Multivariate models consider more than one independent variable influencing workforce learning. Badiru (1992) presented a LC model with the two independent variables "cumulative production" and "cumulative training time", which was statistically analyzed by him with the result that there was a strong (negative) correlation between the variables.

Two examples, which do not originate from industrial production, may illustrate how widely LCs can be applied. Martin et al. (2011) describe the application of LC for evaluating and improving personalized educational systems (intelligent tutoring systems). They use an error rate as a function of the number of times the test persons have had an opportunity to practice a particular knowledge component.

Notably, in machine learning, LC are used as well. As the independent variable "number of training iterations" is chosen in the artificial neural network literature and "number of training examples" in the field of general machine learning (Perlich, 2011). In the former context, the model error is investigated and in the latter the performance, for instance as a comparison of competing for modeling algorithms.

3 JOB-KNOW ONTOLOGY REPRESENTS KSCs SUPPLIED AND DEMANDED

As the jobholders pave the professional level from novice to expert (i.e. five levels is considered: novice, beginner, intermediate, competent, expert), the sort of KSCs that they represent are getting more advanced and mature and the jobholder productivity is increased. This is the result of learning and gaining experience by doing the tasks. The experiences and lessons learned, which result in increasing productivity, should be collected, documented, digitalized and shared as the learning assets.

Lack of KSCs to perform the job tasks, which should be obtained by learning and experiencing represents KSCs imbalance problem. One of the force drivers, which leads to KSCs imbalance problem is the missing link between the World of Work (WoW) and World of Education (WoE). Knowledge and experience management hand in hand with semantic technology contributes to connecting these two worlds and model a connected, integrated and compounded world. In this paper, the authors gain benefit from ontology modeling as a technique to represent the semantic relation of WoW and WoE and establishing the compounded world, so called World of Competence (WoC) as elaborated earlier in Khobreh (2017).

3.1 MOTIVATING SCENARIOS

A jobholder has two roles in smart factories; one is performing the tasks as a worker (i.e. doer) and the other is learning the lessons and collecting experiences by doing the assigned tasks (i.e. learner). These two roles are intertwined, i.e. in a time that the jobholder is performing the task in the same time; she is obtaining the new experiences and upskill/reskill her competence level. LC shows the result of performing, learning, re-skilling/ upskilling and ultimately increasing productivity.

The Job-Know Ontology is mainly initiated based on three motivating scenarios:

- Scenario I KSCs required for performing the assigned job task are less than KSCs required.
- Scenario II KSCs required for performing the assigned job task are more than KSCs required.
- Scenario III KSCs required for performing the assigned job task, meet the KSCs required.

The above-mentioned scenarios define five KSCs states, i.e. gap and shortage, which address the scenario I, surplus and obsolete, which address scenario II, and balance state, which addresses the scenario III. Figure 4 illustrates the five KSCs states, their descriptions, and related scenarios.





The KSC gap and shortage states reveal that the pointed KSCs should be (re)learned/(re)skilled to meet the required KSC level. In contrast, to tackle the problem of surplus and obsolete, the possessed KSCs should be "unlearnt"/forgotten. Finally, the KSC balance is the only state, where the supplied KSC meets the requirements. The balance state can be considered as the "flow" state defined by (Csikszentmihalyi, 1990), where task and KSC meet each other. This state shows that the jobholder holds sufficient KSC to perform the assigned task. So that she flows while she reskills/upskills her possessed KSCs and paves the professional levels. Therefore, she seeks for more challenging tasks.

3.2 WORLD OF WORK - DEMAND SPACE

The WoW consists of jobs and tasks regardless of who should perform the job either machine or human or both. Table 1 defines the basic glossary of terms. The WoW ontology includes five classes of Job, Task, Job Description, Job Specification, Job-KSC, which are defined in the followings.

International Labor Office (ILO) defines a job as "a set of tasks and duties performed or meant to be performed, by one person including for an employer or in self-employment" (International Labour Office, 2012). The job consists of duties, which is a collection of tasks, a task is a collection of activities, and activity is a collection of groups of elements. Finally, an element is the smallest unit of a job, which has a beginning, middle, and end (Brannick et al., 2007). There is a difference between "job" and "role". The role is about people and means "the part play people in their work", while "jobs are about the tasks and duties" (Armstrong & Taylor, 2014). The focus of this study is on the job, not the role.

The job tasks are described by the job description. A job description is about the tasks rather than the outcomes of the tasks and competences required to perform the tasks (Armstrong & Taylor, 2014; Breaugh, 2017).

To specify education level (qualification), experience, specific KSCs and personal characteristics, which represents the potential of being able to perform the job, job specification is defined (Brannick et al., 2007; Breaugh, 2017).

A KSC required to perform a task should be specifiable, definable, and measurable (Allen & Pilot, 2001). Table 1 defines the glossary of the WoW domain to facilitate a common understanding of the terms. The focus of German vocational education is placed on "the ability to apply theoretical knowledge in a practical context" (Clarke & Winch, 2006). In this way, competence refers to both "professional" and "personal" competences and consequently, "professional competence" is subdivided in "knowledge" and "skill", while "personal competence" is subdivided in "knowledge" and "skill", while "personal competence" is subdivided in "knowledge" and "skill", while "personal competence" is subdivided in "social competence" and "autonomy" (German Qualifications Framework Working Group, 2013).

Term	Definition	Source
dof	A set of tasks and duties defined by the employer(s) and performed, or meant to be performed, by employee(s). The job is defined by job description including tasks, specified and elaborated by job specification, including KSCs.	(International Labour Office, 2012)
Task	A task is described by the job description as a statement, which should reply to three main categories of questions i) Do what? ii) To what? and iii) For what purpose?/With what?/ To whom?/What type?. The type of answers to the above-mentioned questions are i) the action (i.e. the verb), ii) the noun and iii) the noun, respectively. The verb can be catego- rized into the linear process (e.g. build) or a cyclic process (e.g. develop).	(Morgeson & Dierdorff, 2011), (Voskuijl, 2017), (Moore et al., 2012)
Knowledge	"Outcome of assimilation of information through learning. Knowledge is the body of facts, principles, theories, and practices related to a field of study or work".	(European Parliament, 2008)
Skill	"Ability to apply knowledge and use know-how to complete tasks and solve problems".	(European Parliament, 2008)
Competence	"Ability to use knowledge, skills, and personal, social, and/or metho- dological abilities, in work or study situations and in professional and personal development".	(European Parliament, 2008)

Table 1: Glossary of Job-Know Ontology (Part I)

The Job-KSC class includes all Job-KSCs, which enable jobholder to perform the assigned tasks and ultimately do the job. The property of *requires()* relates the Task class to the Job-KSC class (Khobreh et al., 2016). The individuals/instances of the Job-KSC class are know-what (Knowledge), know-how (Skill) and know-why (Competence). To identify the dependency of a task to a Job-KSC, a demand degree (DD) is defined. DD is divided into four degrees as follows:

Strong dependency (value 3), which defines as the sub-property of *requiresStrongly()* and identifies the task
requires strongly the Job-KSC to be competently performed,

- Moderate dependency (value 2), which defines as the sub-property of *requiresModerately()* and identifies the task requires moderately the Job-KSC to be competently performed,
- Weak dependency (value 1), which defines as the sub-property of *requiresBasically()* and identifies the task requires weakly the Job-KSC to be competently performed, and
- No dependency (value 0), which defines as the sub-property of *requiresNot()* and identifies the task does not require the Job-KSC.

Table 2 shows the classes and properties of the WoW domain.

Table 2: Classes and Properties of WoW Domain

Class	Property	Value Restriction
WoW: Job	WoW: describedBy	WoW: JobDescription
WoW: JobDescription	WoW: specifiedBy	WoW: JobSpecification
	owl: subClassOf	WoW: JobDescription
WOW: TASK	WoW: requires	WoW: Job-KSC
	WoW: specifies	WoW: JobDescription
WoW: JobSpecification	owl: inverseOf	WoW: specifiedBy
	WoW: consistsOf	WoW: Job-KSC
	WoC: matchesWith	WoC: Knowledge
WoW: Job KSC	WoC: matchesWith	WoC: Skill
	WoC: matchesWith	WoC: Competence
	owl:TransitiveProperty	WoW: matchesWith

3.3 WORLD OF EDUCATION - SUPPLY SPACE

WoE is the encapsulation of learning items learned by learners to obtain learning outcomes within and/or at the end of the learning process. Focusing on intelligentization of manufacturing enterprises, two groups of learners should be considered human and machine. Human learning is a conventional process, while learning by machines and algorithms has been separately studied, known as machine learning (Ansari, Erol & Sihn, 2018). Considering a machine learning profile, three instances can be defines: i) Static Profile: Machine is preprogrammed and no further learning is possible (Conventional Machines), ii) Dynamic Profile with certain learning capacity: Machine is learnable with limited computational and storage capacity (Smart Machines), iii) Dynamic Profile with unlimited learning capacity: Machine is learnable alike human (Next generation of AI-enhanced Machines).

In the scope of this study, we mainly focus on smart and AI-enhanced machines; though today's industry mainly deploy conventional and (semi-)smart machines.

As defined in Table 3, the WoE domain consists of two dimensions of i) Learning Item and ii) Learning Outcome. The aim of learning an Item is to obtain a specific sort of KSCs, which are consolidated as learning outcomes. Sometimes obtaining a learning outcome completely occurs not only by learning one item but also various sort of learning items are needed to be learned. In other words, each learning item may qualify learners to obtain a sort of learning outcomes, and gradually to reach the required learning outcomes for the field at the end of the learning process. The Learning Item is divided into the lesson learned at educational institutions and experience gain by doing the tasks on the job.

Table 3: Glossary of Job-Know Ontology (Part II)

Term	Definition	Source
Learning Item	The component of a qualification, consisting of a coherent set of knowled- ge, skills, and competences called learning outcome that can be assessed and validated.	(Cedefop, 2008)
Learning Outcome	"What a learner knows, understands and is able to do on completion of a learning process", which is defined in terms of knowledge, skills, and competence.	(European Commission, 2010)

The WoE ontology includes Learning, LearningItem, and LearningOutcome classes. The property of *qualifies-ToObtain()* relates the LearningItem class to the LearningOutcome class (Khobreh et al., 2016). This super-property is distinguished to four sub-properties valued by Supply Degree (SD) value. The SD is defined to identify how much one learning item i.e. as an individual/instance can potentially qualify learners to obtain one specific learning outcome. The SD is distinguished into four degrees as follows:

- Strong dependency (value 3), which defines the sub-property of *qualifiesToObtain-Advance()*, and identifies that the learning item qualifies ones to obtain the learning outcome in an advance level.
- Intermediate dependency (value 2), which defines the sub-property of *qualifiesToObtain-Intermediate()*, and identifies that the learning item qualifies ones to obtain the learning outcome in a moderate level.
- Weak dependency (value 1), which defines the sub-property of *qualifiesToObtain-Basic()* and identifies that the learning item qualifies ones to obtain the learning outcome in a basic level.
- No dependency (value 0), which defines the sub-property of *qualifiesToObtain-Not()* and identifies that the learning item does not qualify ones to obtain the learning outcome.

Table 4 illustrates the classes and properties of WoE domain.

Table 4: Classes and Properties of WoE Domain

Class	Property	Value Restriction
	owl: subClassOf	WoE: Learning
WOE: Learningitem	WoE: qualifiesToObtain	WoE: LearningOutcome
VoE: LearningOutcome	owl: subClassOf	WoE: Learning
	WoC: matchesWith	WoC: Knowledge
	WoC: matchesWith	WoC: Skill
	WoC: matchesWith	WoC: Competence
	WoE: qualifiedThrough	WoE: LearningItem

3.4 WORLD OF COMPETENCE - MATCHING SPACE

In WoW, the Job-KSCs demanded to perform a job are specified by the job specification. In WoE, the KSCs supplied through learning are recognized as learning outcomes. In this way, the KSC is the melting point of WoW and WoE, which connects and depends on these two worlds together. WoC facilitates the process of analyzing whether or not supplied KSCs and required KSCs are in balance.

The WoC is a space where the Job-KSC from WoW and Learning Outcome from WoE are matched with Knowledge, Skill, and Competences and provide an opportunity to infer how much the supplied KSC meets the requirement. As depicted in Table 5, WoC mainly consists of three classes of Knowledge, Skill, and Competence, which are related to the WoW and WoE via two properties of WoW: *enablesToPerform()* and WoE: *qualifiedThrough()*.

Class	Property	Value Restriction
	WoW: enablesToPerform	WoW: Task
WaCi Kasuladaa	WoE: qualifiedThrough	WoE: LearningItem
wou: Knowleage	WoC: matchesWith	WoW: Job-KSC
	WoC: matchesWith	WoE: LearningOutcome
	WoW: enablesToPerform	WoW: Task
MAC CLU	WoE: qualifiedThrough	WoE: LearningItem
WOU. SKIII	WoC: matchesWith	WoW: Job-KSC
	WoC: matchesWith	WoE: LearningOutcome

Table 5: Classes and Properties of WoC Domain

Class	Property	Value Restriction
	WoW: enablesToPerform	WoW: Task
WeC: Competence	WoE: qualifiedThrough	WoE: LearningItem
wou: Competence	WoC: matchesWith	WoW: Job-KSC
	WoC: matchesWith	WoE: LearningOutcome

The five classes of Gap, Shortage, Balance, Obsolete and Surplus states are inferred by applying the logical conjunction of *WoW: requires()* and *WoE: qualifiesToObtain()* as follows:

$isQualifiedEnablerFor(li, t) \equiv requires(t, ksc) \land qualifiesToObtain(li, ksc)$

4 JOB KNOWLEDGE EXPERIENCE ENGINE AND RECOMMENDATION SYSTEM

As Figure 5 illustrates to tackle Gap and Shortage states, experiences are required. Therefore, (re)learning, reskilling and upskilling should occur. In contrast, responding to the Surplus and Obsolete states, the previously stored lessons learned should be unlearned and forgotten. The ideal state, which a human or machine workforce can flow there, is the Balance state. Workforces are gaining experiences by doing their tasks. LC shows the result of gaining experiences, reskilling/upskilling and increasing productivity. Right box illustrates Job-Know eXeN, which provides Learning Items and Learning Outcomes out of Experiences. The boxes in the middle are included in the bottom box, which represents WoW and WoE, the middle box shows KSC states and the top box shows, (re)learning, reskilling, upskilling, unlearning trajectory through gaining experience. Left box illustrates the Job-Know RecoSys, which provides a recommendation to tackle KSC imbalance states.



Figure 5: Job-Know eXeN and Job-Know RecoSys

The Job Knowledge Experience Engine (Job-Know eXeN) collects experiences gained through doing the tasks, provides learning items out of them and identifies the learning outcomes of the collected experiences. Thus, Job-Know eXeN provides lessons out of the collected experiences to tackle KSC imbalance problem.

Moreover, the KSC states are the input of the Job Knowledge Recommendation System (Job-Know RecoSys), which anticipates workforce LC and ultimately productivity. Job-Know RecoSys provides prescriptions including strategies and measures for workforces to improve their KSCs level by (re)learning, reskilling and upskilling based on appropriate learning items including the collected experiences. In addition, Job-Know RecoSys recommends lessons to unlearn and forget the KSCs, which are surplus or obsolete. Job-Know eXeN and Job-Know RecoSys are two systems, which utilize the Job-Know ontology as their knowledge-base and reasoning engine.

5 DISCUSSION AND CONCLUSION

While comparatively stable work tasks and thus long-lasting LCs characterize conventional manufacturing, frequently changing work tasks and labor division (job roles) dominate in manufacturing enterprise of the future, i.e. smart factories. As a result of the undergoing change in workplace; rapid trajectory of LCs linked to greater flexibility and higher agility of the workers is required. This increases the importance of initial and continual VET, on the one side, and on the other requires acquiring new/emerging KSCs to reduce reaction times and adaptation speed, and ultimately maintain or increase productivity.

In addition, the scope of tasks to be mastered by the workers increases (Ionescu, Schlund & Schmidbauer, 2019). Changing work tasks lead to LCs starting new each time, with the advantage that the steeper initial phases of the LCs, where the learning effect is absolutely at its highest, can be used more frequently. On the one hand, "less learning opportunities with respect to routine processes exist for human operators" (Ionescu, Schlund & Schmidbauer, 2019). The better the training of the workers before starting work, the further down (at lower initial values for the required working time or the corresponding costs) the LC begins. On the other hand, the LC is expected to be flatter. This results in a trade-off between VET and learning by doing.

Conventional machines do not have a LC. Intelligent machines like cobots are data-driven and may provide data to generate LCs. If technological obsolescence or other reasons require a new machine investment, it must be possible to transfer the acquired know-how from the old to the new machine (i.e. machine to machine generation knowledge transfer). In this way, "forgetting" what happens when there is a change of personnel is prevented (Ansari, 2019).

The KSC states inferred by Job-Know ontology correlates with workforce' LCs. When the inferred KSC is in an imbalance state, i.e. gap/shortage/surplus/obsolete then the LC stop and jobholder needs training/experiencing until the LC runs again and productivity increases. In so doing, eXeN collects experiences and provides learning items out of them and RecoSys analyzes the KSC states and anticipates LC and productivity, and recommends learning items for further learning and training and tackling KSC imbalance states. In this way, the curve of learning is anticipatable.

In future research, the authors will discuss the functions of eXeN and RecoSys in details and present how eXeN and RecoSys use Job-Know Ontology as their knowledge-base and also update it.

The contribution of this approach in increasing learning effectiveness will be measured along with a certain job title, e.g. maintenance operator and engineer of today and future. Finally yet importantly, it should be verified to what extent increasing learning effectiveness will affect labor productivity under certain boundary conditions in a shared workplace.

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INNOVATION PERFORMANCE OF EUROPEAN FAMILY BUSINESSES

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ABSTRACT

The article addresses the issues of innovativeness of family businesses. Such entities must combine goals characteristic of the family and the enterprise. There is a belief that family businesses, due to limitations related to the specificity of this type of entities, are less innovative than non-family enterprises. The research problem of the article is the analysis of factors that may affect the innovation of family businesses. To solve the research problem, the dependencies between independent variables and dependent variable as the number of registered patents (innovation output) were examined. The analysis covered 218 of the largest European family businesses. The data was obtained from databases such as: Global Family Business Index, European Patent Office, Global Innovation Index and financial statements of the companies. The results show that the innovation of family businesses is influenced primarily by R&D expenditures. It was also concluded that the family businesses listed on the stock exchange have a greater degree of innovation. If the CEO is a family member, it also has a positive effect on the family enterprise's innovativeness.

Keywords: innovativeness, family business

KEY FINDING(S)

The analysis of factors favoring the innovativeness of family businesses allows to formulate the following conclusions:

- R&D expenditure is one of the basic factors without which family businesses are not able to run innovative activities,
- making the company public can be a convenient source of financing the company's innovative activity,
- the innovative activity of family businesses is largely dependent on the environment, including the sector in which the company operates and the innovation potential of a given country,
- a family representative who acts as the CEO is an invaluable resource of knowledge and experience supporting the company's innovative activity.

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IMPLICATION(S) FOR THE PRACTICE OF SMEs

Researchers interested in the topic of family businesses have already stated that the very nature of a family business is not an obstacle for it to be innovative. The strategy of this type of company is largely based on tradition, the importance of succession and the involvement of family members. As a result, innovative activities in family businesses are undertaken slightly differently. The problem concerns mainly the financing of innovative activities, which are extremely capital intensive. Family businesses are accustomed to using internal sources of financing and are therefore quite risk averse. Increasingly growing family businesses should be aware, however, that funding for R&D activities is key to boosting enterprise innovation, which is essential for it to remain competitive in an extremely competitive market. Therefore, family businesses should also open up to additional sources of financing, and one of them is going public. This type of solution will probably lead to a decrease in family participation in the company, but in the long run it may result in an increase in the market position of the company. Studies have shown that a family member as a CEO can be a stimulus for innovation. However, one should look at such a person as a guardian of tradition and following the company along the path chosen for years, although with a greater focus on introducing new or significantly improved products and/or processes. Further development is one of the dilemmas of mature family businesses. Whether to remain a typically family-owned company with the majority of the family involved or allow for increased external financing at the expense of losing independence.

1 INTRODUCTION

1.1 THE SIGNIFICANCE OF FAMILY BUSINESS IN THE ECONOMY

The specificity of family businesses was aptly defined by Lansberg, who stated that the owner family shapes the enterprise in a way that family members cannot do in enterprises that are not family owned (Lansberg, 1983). The specificity of family involvement in running a business means that the family business is different from the others and there is a need to conduct scientific research in this area. Defining family enterprises turns out to be as difficult as determining their share in the economy. The concept of a family business functions in everyday language and has many synonyms, but in different cases it has different meanings. Difficulties in defining it arise at least for two main reasons. First of all, there are no formal criteria for distinguishing family businesses. We find here companies with various legal forms, ownership, size and various management methods. Secondly, in the concept of a family business, two entities collide: a family and a company having completely different goals. The first of them is a social institution with its aims of procreation, running a household, organizing the life of family members and securing its internal needs. However, the company has goals related to satisfying foreign needs, risk taking and economic independence (Safin, 2007).

From a family perspective, it will create opportunities to meet the needs of related people, especially their own children, while from the company perspective it will employ only people with appropriate qualifications. In case of fulfilling the needs, the family will try to provide support appropriate to arising needs, while the company will provide the right salary to the contribution and market conditions. From the perspective of the enterprise,

it is natural to differentiate and identify the best employees or business partners, while in family relationships a common rule is to treat all members equally. Finally, the family will create opportunities for everybody to learn in accordance to individual needs, while in case of a company, the possibilities of improving qualifications will depend on the needs of the organization, not the individual (Siefer, 1996). The criteria used to define family businesses can be divided into three groups: broad, middle and narrow definitions (Table 1).

Table 1: Family business definition criteria

Criteria	Broad	Middle	Narrow
Ownership	Significant family shares	Control family shares	Major family shares
Strategic and management control	Minimum strategic control	Strategic control and particip. in management	Strategic control and full management
Succession	Not required	Expected family succession	multiple generations
family members involvement	Little direct family involvement	Some family involvement	A lot of family involvement

In narrow approach to family business definition, the family has a majority in voting rights and control the company in the aspects of strategy and management. In broad definition, the family keeps only significant share in voting rights having some strategic control.

Existing definitions describe the essence of a family business through three different criteria: ownership, ownership and management, and succession. By defining the concept of a family business, the authors place different emphasis on individual criteria. According to Donnelley, there is a family business when at least two generations of one family have had a significant impact on the company's goals and policies (Donnelley, 2002). According to Frishkoff, a family business has any legal form, the company's capital is wholly or in the decisive part in the hands of the family and at least one family member has a decisive influence on the management or the managerial function itself with the intention of sustaining the enterprise in the hands of the family (Frishkoff, 1995). Cadbury points out that a family business is a project that combines property, management and family responsibility for business (Cadbury, 2000). Finally, as defined by Chua, Chrisman and Sharma, a family business is run with the help of family ownership and/or managers who intend to shape and/or continue the company's vision by a coalition that is controlled by members of one or several families in a way that makes it possible to maintain a vision between generations (Chua et al., 1999).

The specificity of this type of enterprises makes it legitimate to seek answers to questions regarding the development of such entities and to compete in a demanding market with large players. It should be noted that family businesses are a key part of the economy, accounting for 40-60% of GDP and 35-70% of jobs (Van Gils et al., 2008). It is estimated that family businesses constitute from 60-90% of enterprises in total, depending on the region of the world (Chang et al., 2010). The significance of family businesses for the economy is regionally determined. The largest percentage of this type of entities functions in South America. In Europe, the percentage of family businesses ranges from 61% in the Netherlands to even 90% in Estonia, Slovakia or Cyprus. Families are also the seeds of new companies. About 85% start-ups are started with family money.

Field research into family businesses has shown that this form of enterprise has significant benefits to the economy and society at large:

- family businesses are more profitable over the long term
- family businesses are less likely to lay people off and more likely to hire
- family businesses are generally better for the communities and engage in philanthropic activities
- family business generally take a long-term view and thus balance short-term rewards with long-term sustainability and prosperity
- family businesses use less debt and are therefore more stable.

Awareness of the existing limitations related to the participation of the socio-cultural factor that is the family for running a business leads to the answer to the question how to reconcile family and business goals, which are not always convergent. The problem of family businesses often indicated by researchers and observers of economic reality is the problem with the innovativeness of this type of enterprises which may constitute a serious brake on their development and building a competitive advantage (Dess & Picken, 2000). Among the key characteristics that distinguish domestic companies from traditional entities, the most frequently mentioned are: constant and multifaceted interdependence of the enterprise and family, correlation of business strategy and family strategy, succession problem, use of family resources, organizational culture based on family values and social capital, which is the emanation of the family as primary social structure.

1.2 INNOVATIVENESS

The innovativeness of enterprises has been the subject of interest for practitioners and researchers for various groups of entities for many years. In most works, it is concluded that innovativeness is an essential source of competitive advantage (Dess & Picken, 2000; Crossan & Apaydin, 2010). Innovation is often treated as a process s of knowledge generation, diffusion and application, stressing the importance of cooperation between enterprises to raise its level (Powell & Grodal, 2005). Currently, it is common in the literature that competitive advantage understood from the point of view of innovation arises as a result of cooperation with external entities (Chesbrough, 2003; Chiaroni et al., 2011). It is essential for the companies operating in in today's highly competitive industries with shortened product life cycles to be innovative. Schumpeter investigating the topic of innovation behaviour of organizations concluded that innovativeness is an important factor for entrepreneurship (Schumpeter, 1934). Innovation is considered as an idea, a practice or an object that is perceived as new by an inventor or the entity adopting it (Rogers, 1983). OECD and Oslo Manual define innovation distinguishing four types of it (OECD/Eurostat, 2018):

 product innovation as a good or service that is new or significantly improved in technical specifications, components and materials, software in the product, user friendliness or other functional characteristics,

- process innovation as a new or significantly improved production or delivery method including significant changes in techniques, equipment and/or software,
- organisational innovation as a new organisational method in business practices, workplace organisation or external relations,
- marketing innovation as a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.

When analysing innovation from the perspective of an enterprise, it is necessary to look at it from the point of view of innovation input and innovation output. Taking this view into consideration, innovation inputs is the set of factors or resources that enable the development of innovation, while innovation output refers to the result and development of innovation. The basic example of innovation input are R&D investment (physical and financial resources) that is dedicated towards the exploration and exploitation of new opportunities. Innovation input should lead to innovation output in the form of patented knowledge or newly developed products or improved processes (Schmiedeberg, 2008; Crossan & Apaydin, 2010). In this case innovation output, researchers take into account 1-0 variable indicating that the innovation or a given type of innovation was introduce or not. This approach, although allows to quickly identify whether the company is innovative or not, says nothing about the degree of innovation. The second possibility is the use of variables showing the number of obtained patents, utility or industrial designs or number of new developed products or processes. For the purposes of this article, the second approach was applied.

1.3 FAMILY BUSINESS IN INNOVATION PROCESS

The innovativeness of family businesses (Casillas & Acedo, 2007; Wright & Kellermanns, 2011) is still an insufficiently researched phenomenon. Innovation is a key factor in the development and expansion of the company (Schumpeter, 1934; Wolfe, 1994; Cefis & Marsili, 2006). The specificity of family businesses and the same restrictions they have can hinder the process of introducing innovations. The problem of innovativeness of family businesses is to a large extent related to low expenditures on research and development than in the case of non-family enterprises. This dependence may result from cautiousness in spending cash on precarious activities, risk aversion or, finally, resistance to changes. Studies show that despite spending less on research and development, family businesses do it much more effectively from the point of view of the number of patent applications (Huang et al., 2015; Duran et al., 2016). On the other hand, we find examples of research that contradict this thesis. Dibrell and Moeller showed that family businesses in the food sector are more involved in R&D investments, and family property is clearly and statistically significantly correlated positively with the culture of stewardship and the strategy of creating value for the client (Dibrell & Moeller, 2011). The presence of the family in the management of the company and thus the pressure to achieve the goals focused on the family, affects the management and implementation of resources (Sirmon & Hitt, 2003), and thus the special involvement of family members who manage the company, has a complex impact on innovation. High family influence on management may negatively affect the process of introducing innovations. Family-managed companies benefit unskilled family members without proper knowledge. At the same time, qualified employees avoid family businesses due to fear of difficulties in professional growth and conflicts (Covin, 1994; Kellermanns & Eddleston, 2004).

2 METHODOLOGY

2.1 HYPOTHESIS

The basic research problem is the identification of factors affecting the innovation of family businesses. In order to solve the research problem, data regarding the functioning of family businesses were obtained and their dependencies were analysed using a multiple regression model. The specificity of family business operations and the limitations resulting from the need to reconcile family goals with the organization's goals encourages to examine whether the level of family involvement can negatively affect the company's innovation. Commitment can be measured as the share of voting rights that belong to the family and the direct involvement of a family member by sitting in the company's bodies. With regard to such problems, hypotheses 1a and 1b are formulated with the following content:

- **Hypothesis 1a:** The percentage share of family ownership in the business will be negatively related to innovation output.
- **Hypothesis 1b:** The family member direct involvement in the business will be negatively related to innovation output.

Along with the development of family businesses, some of them decide to share their shares with external investors by making them public through stock exchanges. This type of activity may result from additional capital needs of the enterprise. Therefore, hypothesis 2 was formulated with the following content:

Hypothesis 2: Public listed family businesses are more innovative than private ones.

2.2 SAMPLE

The analysis covered 218 European family business included in the Global Family Business Index. Index lists the world's 500 largest family businesses. The largest group were German enterprises (79 enterprises), French (28), Swiss (19), Italian (17), Dutch (14) and Spanish (10). The remaining 51 enterprises are Danish, Portuguese, Turkish, British, Swedish, Ukrainian, Norwegian, Luxembourg, Croatian, Austrian, Irish and Greek. Majority of investigated family businesses were established before 1945 (123 family businesses representing 56% of all sample). Therefore, they are managed over several generations.

Dependent variable refers to the innovation output, as mentioned before, the number of patents was used to describe this measure. For each of the 218 companies the number of obtained patents was assigned. The data were collected from the European Patent Office.

Characteristic of family businesses was measured by 9 independent variables. Three variables characterizes the importance of tradition and family influence on company management. They are: age of the company, family voting rights share (family management) and CEO being a family or non-family member (family involvement). Two variables measure the size of the company from the perspective of revenues and employment. The important measure is distinguishing if the company is listed on the stock exchange or not (public vs private company). Characterizing innovation input measure, the share of R&D expenditures in revenues were taken into account. The simple measure describing the country of origin was replaced by the Global Innovation Index of the country. It is better and more informative measure allowing to take into account country specific innovation incentives. The analysed family businesses were assigned to one of 7 sectors: Advanced Manufacturing & Mobility (58 companies), Consumer (69), Energy (25), Financial Services (17), Health Sciences & Wellness (11), Smart Infrastructure (26) and TMT (12). Table 2. provides complete definitions of the variables used in the analysis. Table 3. Presents descriptive statistics and correlation matrix. To check the multicollinearity the Variance Inflation Factor (VIF) was also calculated.

	Variable	Definition
1	R&D	It is defined as the ratio of a firm's R&D expenditures to total revenues as an innovation input measure.
2	AGE	It is measured as the number of years from the creation of the firm.
3	PUBLIC	A measure indicating if the firm is public than takes value 1 or private and taking value 0.
4	REVENUE	Total revenues in USD bn.
5	EMPL.	It is measured as the number of employees.
6	GII	It is measured as the Global Innovation Index of innovation performance metric for the country of origin.
7	INDUSTRY	1. Advanced Manufacturing & Mobility; 2. Consumer; 3. Energy; 4. Financial Services; 5. Health Sciences & Wellness; 6. Smart Infrastructure; 7. TMT (Technology, Media and Telecom).
8	SHARE	It is measured as family voting rights share in percentage. It is family management measure.
9	CEO	Measure indicating if the family member is the CEO than takes value 1 and 0 otherwise. It is family involvement measure.
10	PATENTS	It is measured as the number of patents for last 6 years. It is innovation output measure.

Table 2: Variable definitions

2.3 RESULTS

Multiple regression model was used as a statistical technique to explore the relationship between metrically measured independent and dependent variables. The theoretical multiple regression model takes a form:

$$PATENTS = \beta_0 + \beta_1 R \& D + \beta_2 AGE + \beta_3 PUBLIC + \beta_4 REVENUE + \beta_5 EMPL + \beta_6 GII + \beta_7 INDUSTRY + \beta_8 SHARE + \beta_9 CEO$$

where:

 $B_0, \beta_1, ..., \beta_9$ - structural parameters of the model.

Multicollinearity analysis of independent variables by the Variance Inflation Factor (VIF) allow to assume that there is no multicollinearity (Table 3). All the variables could be included in estimation of structural parameters. Model 1a is estimated on the basis of all independent variables taken into analysis. As a result of the reduction of non-significant variables, the final model (Model 1b) was obtained (Table 4).

	Mean	Std. dev.	1	2	3	4	5	6	7	8	9	10
1 R&D	5,54	3,64	1,00									
2 AGE	90,47	52,19	0,16	1,00								
3 PUBLIC	0,39	0,49	0,02	0,04	1,00							
4 REVENUE	14,98	27,36	0,06	-0,02	0,14	1,00						
5 EMPL.	29169	57732	0,07	0,07	0,19	0,45	1,00					
6 GII	56,42	6,62	0,07	0,08	-0,19	0,06	-0,05	1,00				
7 INDUSTRY	2,91	1,90	-0,15	-0,07	0,07	-0,03	0,04	0,03	1,00			
8 SHARE	79,41	23,26	0,00	0,01	-0,78	-0,18	-0,20	0,15	-0,09	1,00		
9 CEO	0,61	0,49	0,12	0,15	0,05	0,13	0,08	0,09	0,05	-0,02	1,00	
10 PATENTS	564	1675	0,35	0,10	0,15	0,46	0,26	0,14	-0,20	-0,10	0,20	1,00
VIF			1,07	1,07	2,65	1,32	1,31	1,07	1,05	2,64	1,06	

Table 3: Descriptive statistics and correlation matrix

Table 4: Multiple regression parameters estimation results

	Model 1a						Model 1b			
		Pate	ents			Patents				
	coeff		std err	t stat	p-value	coeff		std err	t stat	p-value
Intercept	-2823,49	***	1029,78	-2,74	0,0066	-2148,60	**	827,93	-2,5951	0,0101
R&D	125,00	***	26,03	4,80	0,0000	127,82	***	25,71	4,9714	0,0000
AGE	0,73		1,81	0,40	0,6876					
PUBLIC	601,57	*	305,63	1,97	0,0504	390,13	**	194,25	2,0083	0,0459
REVENUE	24,01	***	3,85	6,24	0,0000	24,81	***	3,42	7,2641	0,0000
EMPL.	0,00		0,00	0,78	0,4341					
GII	30,29	**	14,34	2,11	0,0359	30,04	**	14,23	2,1106	0,0360
INDUSTRY	-144,54	***	49,43	-2,92	0,0038	-145,95	***	49,03	-2,9766	0,0033
SHARE	6,38		6,40	1,00	0,3196					
CEO	325,61	*	193,45	1,68	0,0938	346,62	*	190,95	1,8153	0,0709
Adj R2	0,35					0,35				
F	14,01	***				20,82	***			

* Significant at 10% level, ** Significant at 5% level, *** Significant at 1% level

As a result of structural parameters estimation of multiple regression model of innovation output measured by the number of patents registered, we can conclude that the significant variables include: R&D, PUBLIC, REVENUE, GII, INDUSTRY and CEO. Innovation input characterized by the R&D expenditures in total revenues has a positive influence on innovativeness measured by the number of patents registered. More innovative are also public companies than private ones. Total revenues have also positive influence on the number of patents registered. Higher Global Innovativeness Index for the country of origin, more patents registered by the company. The industry sector, the company belongs is also significant for innovativeness. Family involvement in the management board, especially as the CEO has also positive effect.

The final form of the model 1b is expressed by the formula:

PATENTS = -2148,60 + 127,82R & D + 390,13PUBLIC + 24,81REVENUE + 30,04GII - 145,95INDUSTRY + 346,62CEO

Analyzing the result of the estimation of the parameters of the multiple regression model, we can conclude that all significant variables have a positive impact on the increase in innovation measured by the number of obtained patents. In the case of the variable characterizing the industrial sector, we can conclude that the membership in a particular industry sector is also important.

3 DISCUSSION

The limitations of family businesses resulting mainly from the need to take into account family goals in running a business cause that such entities may have difficulties in competing on the market, including raising their innovation, which is one of the basic elements of building a competitive advantage. Researchers indicate that family businesses are cautious about spending funds on research and development, and thus to stimulate the so-called innovation input. At the same time, there is a positive relationship when it comes to creating innovations understood as innovation output. It follows that R&D investments in family businesses are more effective than in non-family enterprises (Matzleret, 2015). In accordance to estimated multiple regression model we can agree, that high R&D expenditures in total revenues induce positive effect on innovativeness. The company that is investing in research activity and spending money on new assets or intangible assets can expect positive results in creating new product processes or organizational and marketing innovations.

One of the sources of financing the enterprise is the capital market. The companies, especially mature ones, with an established position in the market, enter the stock exchange and gain additional capital for development. In case of family businesses, entering the stock exchange is a difficult decision because it involves the inclusion of external investors in the shareholding structure. This may result in the need to share power in the company. According to the analysis, family enterprises that have decided to publicly register more patent applications from family businesses operating outside the stock exchange. The company entering the stock exchange becomes more recognizable, and the fact of listing on the stock exchange is a kind of ennoblement and prestige. In addition, the company can expand its base of relationships that are different in the process of creating innovation. The subject of the study were the largest family businesses in Europe. It seems natural, therefore, that mature entities are looking for additional sources of raising capital for further development, which may be the capital market and the stock exchange. In the case of family businesses, this type of capital may be a problem and require the acceptance of a change in the ownership structure. The positive impact of the company's IPO on the increase in innovation activity can be generalized to the need to seek funds for financing investment projects, including R&D ones. As discussed above, R&D expenditures are a key factor for creating innovation.

Family business that is increasing revenues and market share can also be more innovative and able to finance innovation activity from generating sources from basic activity. Total revenues refers also to the size of the company. Larger enterprises usually have higher research potential, they can afford to create separate R&D units as well as initiate relations with external partners. Larger entities also have greater opportunities to accept risk, which promotes the creation of innovations. Larger companies can also take advantage of economies of scale and implement innovations in the markets previously served.

The innovativeness of the country of origin has a significant impact on the improvement of innovativeness of enterprises, including family ones. The Global Innovation Index (GII) provides detailed metrics about the innovation performance of 126 countries. State and local government authorities can play a huge role in creating a climate for undertaking innovative activities by enterprises. Creating appropriate infrastructure, special economic zones, clusters and technology centers can undoubtedly stimulate enterprises to become more and more active in the area of R&D. The necessary legal regulations like tax reliefs for R&D expenditures, are indispensable for raising the level of innovation. Authorities should also create opportunities for raising capital to create innovations, through the use of external funds (EU, grants, subsidies, etc.). Besides, each family business belongs to the industrial sector. Some industries are more innovative from others. In some of them, like IT, the development of new products and processes is compulsory to be competitive. On the other hand, the companies within one sector create the relations that can stimulate R+D activity.

It turns out that enterprises in which a family member occupies the highest position (CEO) are therefore more innovative. Such persons have undoubtedly enormous potential. Frequently, from the early age they are familiarized with the specifics of the company's operations, which they will be leading in the future. They are thus aware of the tradition, they perfectly understand the vision and strategy of the company. This contradicts the claims that companies managed by high-level family representatives have an aversion to change and take risky ventures to which we can include innovation. The problem of taking over the most important positions in the company by a family member is connected with the problem of succession (Hauck & Prügl, 2015). Business entities under the management control of one family member emphasize even more the family nature of the enterprise, often focused on family succession. It is connected with the choice of the right moment when you should hand over the reins to the successors. An interesting issue that could be the subject of further research is the age of people who should take over the rudiments after their predecessors. There is a belief that younger people can bring a breath of freshness to the company, be more inclined to create innovations that can imprint their own mark on the new face of the company. On the other hand, it is required that the predecessors allow the successors to introduce changes and their own organizational solutions. Unfortunately, the seniors of the family can claim their rights to continue to influence the family business even though they no longer have a formal legitimacy to manage it. The process of succession can cause conflicts, which can have a destructive effect on the organization, and certainly on the reduction of innovation activity (Kellermanns & Eddleston, 2004).

4 CONCLUSION

Family businesses operate in the long-term perspective. The decisions taken by family businesses are no longer based on a purely economic basis. Certain visions and plans that today have no reason to exist may in the future constitute the competitive advantage of a family business that often refers to history and tradition. Family business culture can lead to innovation if it is used in the right way.

The analysis of 218 European family businesses made it possible to assess the impact of family involvement on the level of enterprise innovation. It was pointed out that family businesses in which the CEO is a member of the family are more innovative. In this context, it cannot be said that the family share in voting rights has an significant influence on innovativeness of the company. Splitting the shares with an external investor, for example through IPO, may result in an increase in the innovation of the family enterprise, which, while maintaining the key positions in the company by the family members, allows to still have a significant influence on the management.

The presented results extends prior research regarding family business innovativeness. However more research needs to be done at it was indicated by adj R-squares of 35% in multiple regression model. Investments in R&D, in terms of physical and financial resources, play a crucial role in increasing innovativeness in the aspect of registered patents. However, the importance of other variables perceived as innovation inputs should be considered. Innovation is an interactive process of knowledge generation, diffusion and application. The literature emphasize the role of collaboration between companies accessing external knowledge that can extend innovativeness (Powell & Grodal, 2005). The importance of relationships both within the organization, between family members and those related to external entities should also be subject to a broader analysis. Finally, an interesting aspect of further research could be the analysis of changes in the ownership structure in family businesses and its impact on the competitiveness of the enterprise within the framework of created innovations.

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ARE MASSIVE OPEN ONLINE COURSES MORE EFFECTIVE THAN TRADITIONAL CLASSROOMS?

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ABSTRACT

Massive open online courses (MOOCs) have become one of the most prominent trends in higher education. In contrast to a traditional classroom where knowledge is delivered through face-to-face interaction, MOOC offers open-access, video-based instructional content, and forums which are released through an online platform to unlimited number of learners. Despite impressive notable features, its effectiveness has yet to be proven. Intrigued with the issue, the objective of this study is to decipher the effectiveness of learning via MOOCs in blended learning and traditional classrooms on academic achievements. An experimental study was employed with non-equivalent pre-test and posttest control group design among sixty undergraduate accounting students from a Malaysian university. The students were divided into two groups; experimental (learning via MOOCs in blended learning) and control (traditional classroom). Results of paired sample T-test indicated that there were significant differences on academic achievements between the pre-test and post-test for both groups. However, the magnitude of effect of the former was higher than the latter. Results of MANOVA indicated that there were significant differences on academic achievements between groups for post-test, but not in the pre-test. The discoveries provide useful insights for educational fraternities on technological and pedagogical aspects of how teaching can best be delivered.

Keywords: academic, achievements, massive open online course, online learning, traditional classrooms

KEY FINDING(S)

The objective of this study is to examine the effectiveness of two methods in teaching and learning namely Massive Open Online Courses (MOOCs) in blended learning and Traditional Classroom in relation to academic achievement. Based on this, an experimental study was conducted among final year undergraduate accounting students of higher institution in Malaysia.

The findings of this study indicated that both methods, which are Massive Open Online Courses (MOOCs) in blended learning and traditional classroom, were significantly related to academic achievement. However, the magnitude of effect of the former was higher than that of the latter. Hence, the findings indicated that learning with technological assistance was more effective than learning in a conventional method.

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IMPLICATION(S) FOR THE PRACTICE OF SMEs

The study provides implication to SMEs that innovation and new technology are crucial not only to educational sectors but also to enterprises. The innovation would help the enterprises to grow and differentiate their products or services from the other competitors. Although on average, SMEs are less innovative than large enterprises, still there are SMEs that highly emphasize on innovation and this leads to higher levels of productivity than the large enterprises.

As the world evolves, and in order to sustain and survive in the competitive market, it is important for SMEs to have a good strategy by initiating an innovative idea. The enterprise would become the inventers and able to lead the market and eventually transform its operation to a higher level. The successfulness of the innovation is commonly measured through its diffusion. The more people adopt, the more diffuse it is in the system; thus, it enables the innovation to sustain over time. It is therefore, a challenge to the SMEs to invent a product or services that would be widely accepted and adopted by people over time for sustainability.

1 INTRODUCTION

The acceleration of Information Communication and Technology (ICT) has dynamically changed the landscape of tertiary education which replaces a classroom from face-to-face teaching to deliver entirely over the internet. The classroom has started to lose its monopoly as the place of teaching and learning (Nguyen, 2015). As of now, the quality and capacity of online delivery has been tremendously evolved and emerged in varieties of forms (Weller, 2014). Many researchers and educators are interested on online delivery due to varieties of attributes that can be applied to make instructions more interesting to learners. Massive open online courses (MOOCs) are a recent innovation of online delivery or pedagogical tool which has drawn great attention from both public and academic fraternities.

MOOCs are open to everyone with web accessibility and for the time-being they are offered without charging any fee. These open online courses are set up by third party as independent online platforms, and educators are encouraged to develop and upload their teaching materials through MOOCs. The courses support lifelong learning and are able to cater for high volume of learners. They offer incomparable classroom experience by developing an effective learning engagement (Baturay, 2014). This is done through displaying the multimedia material extensively on an interface screen and conducted through interactive mode. The presence of these digital courses continues to grow in higher education, as many learners are eager and feel excited to learn with the technology. To date, thousands of courses have been invented via MOOCs that have attracted millions of learners all over the world.

According to Olazabalaga et al. (2016), MOOCs have prevalently become one of the most prominent trends in higher education since they were created in 2008. The demand for online educational platforms coupled with the ubiquitous medium of information delivery means has made MOOC as one of the popular innovative and viable

pedagogical tool applications on the web. Although MOOCs have been supported and favoured by all sectors of society, many still dispel and wary of their effectiveness in delivering educational content because in reality, there are various challenges and threats that would hamper their success (Zheng & Yang, 2017).

To date, abundance of research has been conducted to elicit the effectiveness of online learning over traditional classroom on student's learning outcomes. Some studies found significant positive effects (Bowen & Ithaka, 2012; Deterding et al., 2011; Lack, 2013; Kapp, 2012), some found there were no significant effects (McCutheon et al., 2015; Means et al., 2010), while some indicated mixed or negative effects (Figlio et al. 2010; Xu & Jaggers, 2013). However, it is noted that most of the afore-mentioned studies have investigated the effectiveness of MOOCs as one of online pedagogical and technological tools over traditional classroom teaching in relation to learning outcomes. Scarce studies were found examining MOOCs with regard to academic achievements.

Academic achievements indicate how well students perform in relation to a course or program, whilst learning outcomes are knowledge and skills that students acquire after completion of course or program. Both academic achievements and learning outcomes are of equally important pedagogical tools to assess the effectiveness of student's learning. As abundance of studies have focussed on learning outcomes, this study is motivated to bridge the gap in which its objective is to decipher the effectiveness of learning via MOOCs in blended learning and traditional classrooms on academic achievements.

The following section will review prior literatures in relation to the variables of interest which are the bases of hypothesis developments. It is then followed by the description of the methodology used in data collection. The upcoming sections then highlight discussions, theoretical and managerial implications as well as limitations of the study. Finally, the last section summarizes the entire study.

2 LITERATURE REVIEW

2.1 MASSIVE OPEN ONLINE COURSES (MOOCs) AND BLENDED LEARNING

Blended learning is a mode of learning that combines online learning and traditional face-to-face interactions. MOOCs can be delivered either entirely over the internet or through blended learning. Blended and purely online learning have always been classified in a similar mode by prior studies that is online learning (Nguyen, 2015). According to Bilington and Fronmeller (2014), MOOCs present greater challenges of high-quality interaction compared to other learning modes. These modes of learning are preferable due to their effectiveness in educating learners, enhancing professional development and providing world class education to everyone with internet connection (Koller et al., 2014; Lorenzetti, 2013).

Traditional classrooms emphasize face-to-face interactions, whereby teaching and learning are centred on educators. Online learning, on the other hand, provides opportunity for learners to learn in a virtual classroom. The role of teaching and learning is shifted from educators to learners. Although online learning offers a more learner-friendly approach, the learners must struggle on their own without educator's guidance (ZawackiRichter et al., 2018). Blended learning on the other hand, takes the best features of those two modes, apart from embracing technology, it upholds human connections.

2.2 TRADITIONAL CLASSROOMS

Traditional classrooms refer to physical "brick and mortar" classrooms, in which knowledge is delivered through face-to-face interactions between an educator and learners. Markers and whiteboards are important teaching tools used to impart knowledge. However, due to the advent of knowledge economy, the traditional classrooms have started to lose their monopoly as the place of learning. To date, the internet has made significant changes to almost all spheres of teaching and learning (Nguyen, 2015).

As of now, many studies have been conducted to examine effects of online learning over traditional classrooms in relation to learning outcomes and results have indicated mixed findings (Bowen & Ithaka, 2012; Deterding et al., 2011; Feeley & Parris, 2012; Figlio et al., 2010; Kapp, 2012; Lack, 2013; McCutheon et al., 2015; Means et al., 2010; Nguyen, 2015; Xu & Jaggers, 2013).

McCuthcheon et al. (2015) compared the effects of a clinical skill course between online learning and traditional classrooms on learning outcomes among undergraduate nursing students. They found that both modes namely online learning and traditional classrooms did not have any significant effects with learning outcomes.

Nguyen (2015) did a meta-analysis on 92 studies eliciting the effectiveness of online teaching over traditional classroom in relation to learning outcomes. He found that 92% of the studies indicated that online learnings were more effective than traditional classrooms. Only 3% of the compiled studies showed the reverse, that traditional classrooms were more effective than online learning, while the remaining 4% indicated mixed findings.

Harandi (2015) examined the effect of online learning on motivation to learn among 140 students in one of Tehran universities. The results indicated that online learnings were more likely to motivate students to learn. The students were more likely to be engaged with technology and successfully achieved the learning outcomes.

Lack (2013) conducted a meta-analysis on 30 studies that investigated the effect of online learnings over traditional classrooms on learning outcomes. She found that the studies showed mixed findings. Some studies revealed that students who learned via online learning were more likely to perform better. On the other hand, there were studies that indicated reversed results since students who learned through online teaching were less likely to perform better learning outcomes as opposed to those who learned in traditional classrooms. Meanwhile, there were also studies that showed no significant effects between those two learning modes. She concluded that the studies did not provide conclusive outcomes as to whether online learning was effective than traditional classrooms with regard to learning outcomes.

Bowen and Ithaka (2012) conducted an experimental study by dividing students into two groups. The first group was taught via online through blended learning in which the online teaching was delivered in a classroom, known

as an experimental group. Students in this group met once a week and they did most of the work online. The second group was assigned to a traditional classroom known as a control group. This group learned in a classroom through face-to-face interactions. The study found that the students who learn through blended learning were more likely to obtain better learning outcomes than the students who learned in the traditional classroom.

Feeley (2012) examined the effect of an online pedagogical tool namely PeerWise, over a traditional classroom in relation to learning outcomes. The study was conducted on a course taken by undergraduate political science students using a mixed-method approach. They found that students who used the online tool were more likely to have better learning outcomes than those who learned in the traditional classroom. Moreover, the students in the former mode were more motivated and enthusiast to learn as opposed to the students in the latter mode.

Figlio et al. (2010) investigated the effect of online learning versus traditional classrooms in relation to learning outcomes through an experimental study by grouping students into two groups with different modes of learning. Students for both learning modes were given similar supplemental materials and instructions. They discovered that only the traditional classroom was more likely to have positive effects on learning outcome. Additionally, they found one possible and very likely significant internal validity threat which was treatment diffusion for the "live-only" students since everybody could look at the online lectures using a friend's account. Educators also cannot monitor whether the students focus and pay attention on teaching deliveries as they were conducted in a virtual classroom.

Means et al. (2010) conducted a meta-analysis research from 1996 to 2008 on more than a thousand empirical studies of online learning. They compared online learning with traditional classrooms in relation to students' learning outcomes. Based on analyses, they found that students who learned through online learning were more likely to perform modestly better than those in traditional classrooms. Moreover, the analyses indicated that the difference in learning outcomes was higher in studies where online learning was blended with face-to-face interactions.

Despite that many studies showed online learning was more effective than traditional classrooms on learning outcomes (Bowen & Ithaka, 2012; Deterding et al., 2011; Feeley, 2012; Kapp, 2012; Lack, 2013; Nguyen, 2015;), there were also studies that indicated no significant effects between those variables (McCutheon et al., 2015; Means et al., 2010). Yet, there were studies that indicated negative or mixed findings; either traditional classrooms were more effective than online learning or both learning modes had significant effects on learning outcomes (Figlio et al., 2010; Rush & Yin, 2010; Xu & Jaggers, 2013).

Findings from previous studies provided inconclusive outcomes but intertwining paths that researchers and educators can ponder at this juncture as related to academic achievements. Which modes, either online learning, traditional classrooms or both have significant effects on academic achievement? After reviewing the afore-mentioned literatures, the following four hypotheses are formulated.

- H1: There is a significant effect between the pre-test and post-test of experimental group's academic achievements (who learned via MOOC in blended learning).
- H2: There is a significant effect between the pre-test and post-test of control group's academic achievements (who learned in a traditional classroom).
- H3: There is no significant difference in the pre-test academic achievements between experimental and control groups.
- H4: There is a significant difference in the post-test academic achievements between experimental and control groups.

3 METHODOLOGY

The study employed an experimental method with non-equivalent pre-test and post-test control group design in which the hypotheses were tested by using inferential statistics. Respondents of this study were sixty final year accounting students from one Malaysian university. The selection of students in any of the two groups was done by the system. This was to ensure that there was no selection bias in grouping the respondents.

Integrated case study was chosen in examining the effectiveness of learning via MOOC in blended learning over traditional classroom because it was the only final course for degree in accounting program that can be learned via MOOC. This course was developed and uploaded online by educators in 2018. The course emphasises on complex case studies by integrating knowledge from various disciplines. Students are required to solve and analyse the cases by applying higher order thinking skills. For this research purposes, the course was delivered by the educator to learners in two learning modes. The experimental group learned via MOOC in blended learning (teaching via MOOCs in a traditional classroom) while the control group learned in a traditional classroom in which learnings were heavily relied on face-to-face interactions.

Two instruments were used for this study namely pre-test and post-test. Both groups were required to sit for a pre-test (0) prior to treatment process. The respondents were given a test on a palm oil and rainforest case study of 2 pages-length with 4 main questions. The maximum and minimum scores were 50 and 0 respectively, whereby marks would be awarded on appropriate answers given by the respondents. Allocation time for the pre-test was an hour. After completing the pre-test, both groups were given treatments. The experimental group was treated with MOOC (X_1) in blended learning while the control group was treated with traditional classroom (TC) (X_2). To ensure that the delivering adopted a purely MOOC in blended learning or traditional classroom, the researcher explained the respondents on the meaning of MOOC in blended learning and traditional classroom modes, methods, scopes, schedules and duration of sessions before delivering started.

The Integrated Case Study course was delivered to EG and CG in the same scopes, schedules and durations. Both modes had the same lesson plans and learning outcomes for each session. To ensure that MOOC in blended

learning and traditional classroom was properly performed, the sessions were monitored by a checklist. The checklist contains 16 items that describe the situation or behaviour of an educator when handling the teaching and learning sessions. The researcher was required to indicate either "yes" or "no" to each item based on the situation or what was usually done by the educator. This was important to ensure that there was no bias against MOOC in blended learning or traditional classroom. The sessions were conducted for 4 hours in a week for a period of one month, totalling to 16 hours of delivering sessions. As the test only covered one case, the period of delivering for 4 hours per week was deemed appropriate.

After completing the treatment of X_1 and X_2 in a month period, both groups were required to sit for a post-test (0₁). They were given the same questions with similar assessments. Data or scores obtained by the students were compared to examine any significant effects between pre-test and post-test.

The data were analysed by multivariate of MANOVA and paired sample t-test. These two tests were carried out to examine whether there was a significant effect in academic achievements (pre-test and post-test) before and after the treatment was given for EG and CG. In the context of this study, the results or scores obtained by the students would represent their academic achievements. During the test sessions, the researchers were assured that all respondents were in good health and fit to answer. They were placed in a comfortable and conducive surrounding with no disruptions. Table 1 depicts the research design.

Table 1: Research design

	Pre-test	Treatment	Post-test
Experimental group	0	X ₁	O ₁
Control group	0	X ₂	0,

Note: 0 = Pre-test Experimental Group (EG)/Control Group (CG),

*X*₁= Treatment (the course was delivered via MOOCs in blended learning)

*X*₂= Treatment (the course was delivered in a traditional classroom)

O,= Post-test Experimental Group (EG)/Control Group (CG).

The scores for pre-test and post-test of a case study were analysed using paired samples T-test and multivariate analysis of variance (MANOVA). The paired samples T-test was used to test whether there were significant differences in the scores obtained by the experimental or control group. On the other hand, the MANOVA was used to test whether there were significant differences between marks obtained by the experimental and control groups. Hypotheses 1 and 2 would be tested by paired samples T-test while MANOVA test was employed for hypotheses 3 and 4 testing.

4 RESULTS

4.1 NORMALITY TEST

To ensure that data were within normal distribution, a Shapiro-Wilk test was carried out on pre-test and post-test for experimental group (EG) and control group (CG). Results showed that pre-test and post-test scores of respondent's academic achievements for EG were 0.26 and 0.34 respectively (the academic achievements were based on the integrated case study scores obtained by every student) while pre-test and post-test scores for CG were 0.33 and 0.34 respectively, indicating that the data were within normal distribution.

4.2 RELIABILITY ANALYSIS

A reliability test is conducted to examine whether a measuring instrument consistently represents the items it is measuring (Sekaran & Bougie, 2010). Results of Kuder Richardson (KR 20) of pre-test and post-test reliability Cronbach alpha indicated that EG obtained 0.88 and 0.75 respectively, while CG attained 0.73 and 0.70 respectively. All values were greater than 0.7 as recommended by Sekaran and Bougie (2010) in which the instruments were consistent in representing the measured items. According to Nunally (1978), the values indicate that the data are reliable for further analysis.

4.3 HYPOTHESES TESTING

4.3.1 EFFECT OF MOOCS AND TRADITIONAL CLASSROOM ON ACADEMIC ACHIEVEMENTS

The first hypothesis states that there is a significant effect between the pre-test and post-test of experimental group (EG)'s academic achievements (who learned via MOOCs in blended learning). The EG's mean scores for pre-test and post-test were 20.33 and 42.43 respectively, while the standard deviations for pre-test and post-test were 1.68 and 1.86 respectively. Results of paired samples T-test supported hypothesis 1 which indicated that there was a significant effect in the academic achievement scores for the EG between the pre-test and post-test (t = 28.89, p < 0.05). Table 2 depicts the results of paired samples T-test for experimental group who was treated with MOOCs in blended learning.

Test	No. of respondents	Means	Standard deviation	t value	Significant
Pre-test	30	20.33	1.68	28.89	0.000***
Post-test	30	42.27	1.86		

Table 2: Paired samples T-test within the experimental group who was treated with MOOCs in blended learning

*p<0.05, t value is greater than 1.96 **p<0.01, t value is greater than 2.33 *** p<0.00,

t value is greater than 2.58

The second hypothesis states that there is a significant effect the between pre-test and post-test of control group's academic achievements (who learned in a traditional classroom). Results indicated that the academic achievement mean scores for pre-test and post-test were 21.37 and 32.27, while the standard deviations were 1.98 and 1.83 for pre-test and post-test respectively. The results of paired samples T-test supported hypothesis two and indicated that there was a significant effect in the academic achievement mean scores obtained by the CG between pre-test and post-test (t = 8.34, p < 0.05). Table 3 depicts the paired samples T-test for the control group who learned in a traditional classroom.

Test	No. of respondents	Means	Standard deviation	t value	Significant
Pre-test	30	21.37	1.98	8.34	0.000***
Post-test	30	31.23	1.83		

Table 3: Paired samples T-test within the control group who learned in a traditional classroom

The third hypothesis proposes that there is no significant difference in the pre-test academic achievements between experimental and control groups (before being treated with MOOC in blended learning and traditional classrooms). Multivariate analysis of variance (MANOVA) was adopted to test the hypothesis by comparing the academic achievement mean scores of experimental and control groups, followed by testing whether the scores were significantly different from one to another.

Results of MANOVA indicated that the academic achievement scores obtained by EG and CG were 20.33 and 21.37 respectively. The results further indicated that the *t*-value was 0.07, (p > 0.05), indicating that there was no significant difference in the academic achievement mean scores between the groups; thus, hypothesis 3 is supported. This showed that both groups consist of students with equal level of academic achievements before the treatment was given, which is a pre-requisite for experimental study criteria. Table 4 depicts the MANOVA results for pre-test academic achievements for EG and CG before being treated with MOOC in a blended learning and traditional classroom.

Group	No. of respondents	Means	Standard deviation	t value	Significant
EG	30	20.33	1.04	0.07	0.933
CG	30	21.37	1.15		

Table 4: MANOVA results for pre-test academic achievements between experimental and control groups

p<0.05, t value is greater than 1.96 **p<0.01, t value is greater than 2.33 *** p<0.00, t value is greater than 2.58

^{*}p<0.05, t value is greater than 1.96 **p<0.01, t value is greater than 2.33 *** p<0.00, t value is greater than 2.58.

The fourth hypothesis postulates that there is a significant effect in the post-test academic achievements between EG and CG. Results showed that the mean scores for EG and CG were 42.27 and 31.23. The results supported hypothesis 4 that there is a significant difference in the academic achievement mean score between the two groups (t = 508.85, p < 0.05). Table 5 depicts the results of MANOVA on post-test academic achievements between groups.

Table 5: MANOVA results for post-test academic achievements between experimental and control groups

Group	No. of respondents	Means	Standard deviation	<i>t</i> -value	Significant
EG	30	42.27	1.89	42.85	0.000***
CG	30	31.23	1.57		

p<0.05, t value is greater than 1.96 **p<0.01, t value is greater than 2.33 *** p<0.00, t value is greater than 2.58

5 DISCUSSION

The first research objective is to examine whether there is a significant effect between the pre-test and post-test of experimental group's academic achievements who learns via MOOC in blended learning. Results indicated that there was a significant effect in pre-test and post-test mean scores of the academic achievements within the experimental group (t = 28.89, p < 0.05, n=30). The results are in tandem with prior studies (Bowen & Ithaka 2012; Deterding et al., 2011; Feeley, 2012; Kapp, 2012; Lack, 2013; Nguyen, 2015;) that examined them in relation to learning outcomes, in which online blended learning also had a significant effect on academic achievements.

The second research objective is to examine whether there is a significant effect between the pre-test and posttest of control group's academic achievements (students who learn in traditional classrooms). Results indicated that there was a significant effect between pre-test and post-test mean scores for the control group's academic achievements (t = 13.34, p < 0.05, n = 30). The results were likely to be consistent with the work of Xu and Jaggers (2013), and Figlio et al. (2010) which indicated that traditional classroom does have a significant effect on students' learning outcomes.

The third research objective is to examine whether there is no significant difference in the pre-test mean scores of the academic achievements between experimental and control groups. Results supported the hypothesis in which it indicated that there was no significant difference in the mean scores of the academic achievements between the two groups (t = 0.007, p < 0.05). In other words, the results indicated that both groups (before being treated via MOOC in blended learning and traditional classroom) had equalled level of academic achievements. The results fulfilled the experimental study criteria of the respondent's homogeneity in which members in the two groups should possess an equal level of knowledge before they were given treatments.

The fourth research objective is to examine whether there is a significant difference in the post-test academic achievements between experimental and control groups. Results showed that the post-test mean scores for experimental and control groups were 42.27 and 42.85 respectively. The results supported hypothesis 4 in which it indicated that there is significant difference in the academic achievement mean scores between groups (t = 508.85, p < 0.05). The results concurred with the prior studies (Bowen & Ithaka, 2013; Feeley, 2010; Kapp, 2012; Lack, 2013) who indicated that the learning outcomes/academic achievement for respondents who learned via MOOCs in blended learning was significantly difference from those who learned in the traditional classroom.

5.1 IMPLICATION TO ACADEMIC

This study contributes to the existing body of pedagogical literature on the importance of blending a MOOC in a traditional taught course. Although totally relying on online learning is cost effective, it impedes social interactions between educators, learners and peers. A combination of online learning and traditional classroom is the best pedagogical approach not only to accelerate academic achievements, but also to harness soft skills. The skills can only be acquired through personal interactions which are essential for one to succeed in the workplace.

This study also provides an implication that in blended learning, the burden of learning is shifted from educators to learners. MOOCs provide a platform to facilitate communication between the educators and the learners, and enable them to share learning materials. Learners have opportunities to learn in virtual classrooms. They are motivated to be engaged and take responsibility for what they are learning and possibility to learn at their own pace. These would increase confidence as they are able to learn to use new tools and handle more complex tasks through supports and capabilities provided by technology.

The study also provides implication that blended learning requires both academic fraternities namely educators and learners to be computer literacy and technology acceptance. Indeed, technology is important to increase knowledge retention, reduce stress related to adopting big amount of content and assist learners to face the challenges in the advent of digital and technology era.

5.2 IMPLICATION TO MANAGEMENT

The study provides implications to management as to aggressively support MOOCs through blended learning in various forms. Blended learning is a good fit in academic setting as it takes the best out of the two worlds. Online learning offers open-access, video-based instructional content, problem sets and forums and cater unlimited number of learners, while traditional classroom provides face-to-face interactions. On one hand, it accommodates different learning needs and a well-designed delivery styles and preferences, while on the other hand, face-to-face deliveries are becoming useful in solving complex and personal issues that are unable to resolve by technology.

This study provides implications to management as to increase investments in human and technology resources by formulating policy, strategy and action plans for the diffusion, implementation and sustainability of online courses. Academicians who agree to be involved in the development of online courses should be given incentives by recognizing their efforts. This can be done in the form of alleviation of other duties such as lecturing time, marking, research and administrative duties amongst others.

5.3 LIMITATION OF THE STUDY

A few limitations are acknowledged after the study was carried out. The first limitation notified is that some of the respondents requested others to complete their online assignments. As a result, they may not be able to follow all the self-guidance teaching materials which could affect their understanding on the course. This would affect their scores on the post-test. However, the number of the respondents was minimal and did not affect the validity of the whole result.

Another limitation identified is that this study was conducted in a quantitative mode, whereby the participants were required to answer a case study in two tests namely pre-test and post-test. They could not freely express their views and highlight the problems encountered while learning via MOOCs in blended learning and traditional classrooms. This limits the in-depth understanding of the problem that should be unleashed. To overcome this methodological issue, future studies are suggested to be conducted in a qualitative mode. The qualitative analysis enables the exploring of the problems from the students, parents, teachers and policy makers education point of views. Hence, the issues can be analysed in a more comprehensive and holistic manner that may contribute for a betterment.

6 CONCLUSION

The study found that both modes namely learning via MOOCs in blended learning and traditional classrooms had positive effects on academic achievements. However, the magnitude of effects of the former was higher than the latter. MOOCs are pedagogical innovations that will change traditional learning idea and provide a new way for acquiring knowledge to meet the competency demands of a digital, knowledge driven society. Despite that online learning is highly preferred by those who are technology driven and offers learners the opportunity to learn in virtual environment, it hinders social interactions between people. The interactions are essential to harness soft skills needed to connect with people and make them successful in the real world. This contrasts with the traditional classroom in which the delivery is heavily relied on face-to-face interactions. Blending MOOC with traditional classroom in a taught course would give the best of these two pedagogical approaches in which it impetuses learners' interests in learning, increases motivation and self-esteem, accelerates understanding as well as connects people; individual and worldwide. Hence, it is hoped that MOOC through blended learning would prepare students for the future and be agile to meet the challenges in relation to the vibration of technologies and thus elevate them to achieve the highest academic achievements.

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THE ROLE OF KNOWLEDGE LEADERS TO CREATE A KNOWLEDGE-BASED ORGANIZATIONAL CULTURE CONDUCIVE TO KNOWLEDGE SHARING

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ABSTRACT

Globalized technological and cultural advances changed organizational environments significantly. In order to stay competitive, organizations need to acknowledge the value of their knowledge assets and the necessity to become knowledge organizations to transform and adapt to these changes through knowledge management. Although there are many studies on knowledge sharing, few have examined the role of knowledge leaders and the combined effect they have on the culture of the organization. The commonality of most recent research indicates an emphasised focus on the knowledge management of information creation and sharing to create a knowledge-based organizational culture conducive to knowledge sharing. This emphasizes the role of and need for knowledge leaders for positive intervention to enhance knowledge sharing for problem solving and innovation through efforts to develop a culture of trust and commitment. Where knowledge management focuses on two main

theoretical perspectives, namely human capital and knowledge-based theory, the leadership theories emphasise that leaders should acknowledge the premises of the strategic intent of the organization through the management of information, creative media strategies and environmental scanning based on trust, loyalty, integrity and credibility. Hence, it is argued that the role of knowledge leaders in knowledge management is a combination of continuous enquiry on the systems and processes of an organization and how the functioning of the organization can be improved through proactively and interactively managing the intellectual capital (individual and collective knowledge) under its leadership. The need for further research on these concepts provided impetus for the research problem that there is a lack of existing studies investigating the role of knowledge leaders in creating a knowledgebased organizational culture.

Keywords: knowledge management; knowledge sharing; knowledge leaders; knowledge-based organizations; *organizational culture

KEY FINDING(S)

The role of knowledge leaders in knowledge sharing using knowledge managent (KM) practices is important to create and organizational culture in knowledge-based organisations. Well-planned and well-executed KM practices by knowledge leaders function as enablers for the achievement of better performance through participation, innovation, creative ideas and the sharing and use of knowledge in support of the organizational culture. Individual human knowledge is important and should be considered by knowledge leaders. The concept of "knowledge leaders" does indeed make business sense in that it can contribute to explaining how the management of knowledge is linked or related to the leadership of the organization and how it aligns with the values and strategies of the organization.

IMPLICATION(S) FOR THE PRACTICE OF SMEs

Due to the dynamic environment, small and medium-sized enterprises (SMEs) require the extraction of knowledge to achieve greater participation in the markets, foster innovation, and improve performance. Because knowledge management (KM) is a comprehensive approach that includes the capture, receipt, transfer and sharing of information in an organization that considers the values, procedures, knowledge, and experience of employees, the role of knowledge leaders to fascilitate this process can influence the behavior of employees and strengthen a knowledge-based culture based on the use and transfer of this information. The implications for SMEs are threefold: to develop mechanism for training employees, therefore by allocating greater financial resources to training programs to achieve greater creativity to improve innovation; SMEs might have certain practices for the acquisition of knowledge, but it is important that new actions and strategies are considered, such as the use of ICT; and knowledge leaders in SMEs must establish knowledge management strategies, both in the acquisition and the use of knowledge and the deployment of an organizational culture, based on values to allow a further strengthening of innovation activities.

1 INTRODUCTION

"A fruitful way of further research would be determining proper instruments based on the formulated strategies which could serve as a guideline for organizing an iterative process of navigation through the complex and dynamic system of knowledge sharing within organizations, in particular the development of effective communication instruments for managing knowledge sharing" (Block & Khvatova, 2013: 59).

Although organizational knowledge has been recognized as a valuable intangible resource that holds the key to competitive advantage, little progress has been made in understanding how knowledge sharing at individual level could benefit knowledge use at collective level to ensure added value. Furthermore, although leaders paid attention to the learning organization initiative, it has not been implemented in organizations and this has created the realization that knowledge management should be applied to the entire organization at all levels so

as to ensure that learning takes place through knowledge creation, codification, storing and sharing. In seeking to address this gap, this study sets out with two main objectives: to critically review existing literature through an exploratory interpretivistic approach; and to propose a theoretical framework. According to Bryman and Bell (2016), interpretivism as research methodology stems from an epistemological position and refers to the critical application of analyses of various academic traditions in order to study the social world. The paper is structured as follows: key constructs, leadership, the changing organizational sphere, knowledge-based organizational culture, the role of knowledge leaders and knowledge management in the organization, theoretical framework and conclusion.

2 KEY CONSTRUCTS

The following key constructs are prevalent in this paper.

2.1 KNOWLEDGE

The degree of individual knowledge is personal and based on the individual's willingness to acquire and/or share that knowledge, a process which is difficult to manage. Individual sense making refers to the relationship between the signifier (norm) and the signified (sense) and the meaning created. This means that individuals should participate in the knowledge creation and sharing process in such a way that they interpret the world as their own understanding and in order to ensure that meaning is created to others. Knowledge can be tacit (individually owned, which is difficult to set out in tangible form), explicit (knowledge set out in tangible form at team or organizational level), implicit (information or knowledge not set out in tangible form) or cultural (sharing of knowledge through socialization or capturing it in digital form) (Koenig, 2012; Choo, 2002; Nonaka, 1994). The process of knowledge creation and sharing articulates into innovation, which needs the exploitation and exploration of knowledge. Hence, knowledge is valued experience, skills and understanding through expert insights and contextual information that provides a framework to measure new information - such as documents and reports - available within the organization to achieve mutual benefits. The value of the explicit form of knowledge is dependent on various dimensions such as context, usefulness and interpretation, all of which support a dichotomous view that knowledge must exist before information can be formulated and before data can be measured to form information (Freeze & Kulkarni, 2005). According to Rechberg and Syed (2014), the meaning of the word "knowledge" has been debated since 430 BC in the doctrines of Plato and since 550 BC in the lessons of Confucius. Through these teachings, we have learned that knowledge is a justified true belief (also defined as such by Nonaka, 1994) and a theory or explanation, as well as an idea or form perceived by an individual. Aristotle drew a distinction between "knowing what" and "knowing how" in the fact that knowledge can be attained through an individual's personal experience or by taking note of someone else's experience, making individuals both the vehicle and source of knowledge (Nonaka & Takeuchi, 1995). Although this classical view of knowledge is still valuable today, the modern view on knowledge is associated with competitiveness, power, knowledge as a form of asset, and participation by individuals to generate and share knowledge, as well as their consent concerning how to manage knowledge to add the organizational value inherent in the knowledge management process.

2.2 KNOWLEDGE MANAGEMENT

According to Oluikpe (2012), knowledge management (KM) has generated interest at management levels due to its capability to deliver strategic results to organizations and thereby to enhance profitability, competitiveness and capacity. For the purposes of this study, the following definition of KM is proposed (adapted from Nonaka, 1994; Bounfour, 2003; Scarborough et al., 1999; Zack, 1999; Sunassee & Sewry, 2002; Singh & Kant, 2008; Barker, 2016):

KM refers to any process or system of creating, acquiring, capturing, sharing and using knowledge to enhance innovation and organizational performance where the KM strategy is aligned with the overall organizational strategy of the organization's knowledge resources, capabilities and intellectual requirements through infrastructures, knowledge leaders, reward systems and innovative ideas.

The management of organizational knowledge is seen as a strategic means for organizations to improve their performance, become innovative and sustain a competitive advantage (Davenport & Prusak, 1998; Wang & Noe, 2010; Bollinger & Smith, 2001; Lofti, Muktar, Ologbo and Chiemeke, 2016). The role of KM and its processes has therefore become vital to creating a knowledge-based organizational culture to achieve competitive advantages (Nonako, 1991, 1994; Nonako & Takeuchi, 1995) where organizational culture consists of collective thinking and teamwork to enhance organizational performance (Barker, 2018).

2.3 KNOWLEDGE SHARING

Knowledge sharing is the most crucial process of KM (Gupta & Govindarajan, 2000) and is defined as the process through which explicit or tacit knowledge is communicated to other individuals to enhance organizational innovativeness and performance (Becerra-Fernandez & Sabherwal, 2010). Hence, it involves effective transfer where the recipient(s) acquire and understand the shared knowledge in such a manner that action can be taken through the utilization of knowledge without the recipient(s) necessarily internalizing the shared knowledge. According to Wu and Zhu (2012), there is no all-round definition of knowledge sharing. Hence, for the purposes of this paper the following definition has been developed (Friesl, Sackmann & Kremser, 2011; Barker, 2016):

Knowledge sharing is a process in which one unit is affected by the knowledge and expertise of another unit through formal collaboration or in informal interaction. This process depends on the value of the source's know-ledge, the willingness of the source to share knowledge, willingness of recipient(s) to receive and acquire know-ledge and the absorptive capacity of the recipient(s) to create new knowledge in support of organization strategies.

In brief, it refers to the willingness of employees in an organization to share the knowledge they have acquired or created with their colleagues on individual or team level to enhance skills and understanding.

3 LEADERSHIP

Research indicates that the new leadership movement validates the idea that simple views of the universal validity of characteristics, behaviours or styles are not suitable for explaining the dynamics of the leadership process. To date, no leadership theory or model has been presented to provide a comprehensive and all-inclusive explanation of leadership. Many studies reflect only one philosophical viewpoint or are based on limited, even biased research, explaining limited aspects of leadership and operating as self-fulfilling prophecies (Gill, 2011). Leadership research also seems to lack the cumulative theory building that occurs in other social sciences. Probably, the main limitation is the fact that opinions on leadership are fragmented and based on the different trajectories in isolation, specifically the cognitive, behavioural, emotional, moral and spiritual aspects of human existence and the need for the creation of meaning (Gill, 2011). Goffee and Jones (2006), who argued that the traditional understanding of leadership was primarily concerned with providing meaning, also pointed this out. Furthermore, Glynn and DeJordy (2010) found that understanding how leadership infuses meaning, values and purpose is an underdeveloped and potentially fruitful area of leadership research.

Based on shortcomings of existing approaches to leadership, and since it has been argued that emerging knowledge organizations are associated with adaptive approaches, the most prominent leadership theory used in the literature is usually the transformational approach. Transformational leadership emerged in the 1980s and was first defined by Burns (1978: 20) as a process in which "leaders and followers raise one another to higher levels of morality and motivation", where the process of transformation is based on empathy, understanding, insight and consideration; not manipulation, power or coercion. Notwithstanding the negative connotation of power in this sense, note should be taken that Foucault (1982) said in *Les Anormaux* (referring to the standardization process conducted during the twentieth century), that the rule carries a claim to power and that its role is not to exclude or refuse but, on the contrary, it is always linked to a positive technique of intervention and transformation. It is also important to remember that for Foucault (1982), power relations are deeply rooted in the social nexus; but a society without power relations can only be an abstraction. According to Donate and De Pablo (2015), a distinctive type of leadership behaviour – knowledge-orientated leadership – is used for knowledge management initiatives and attracts the most universal acceptance in knowledge management literature.

Based on existing literature (inter alia Nonaka & Takeuchi, 1995; Singh, 2008; Donate & de Pablo, 2015; Oliveira, 2018), as well as additional viewpoints of the researcher, the main leadership styles are summarized in Table 1 to indicate the importance of a knowledge leadership perspective.

Table 1: Main leadership styles

Leadership styles	Key thrusts
Traditional leaders (trait, servant, leader-member exchange, behavioral, contingency, etc.)	 Rationality and control to maintain organizational goals, resources, structures and people (individual independent agents) No specific description of leadership behaviours to create high-quality relationships Abstract definitions No processes to address environmental changes, cultural differences, interpretation of information and strategic decision making
New leaders (charismatic, transactio- nal, constructionist, transformational, spiritual, pragmatic, visionary, etc.)	 Leaders and followers raise one another to higher levels of morality and motivation Emphasize values such as loyalty, equality, etc. Focus on empathy, understanding, insight and consideration; not manipulation, power or coercion, but motivate and empower followers (although power can also be used as a positive intervention in transformation) Four important skills: self-awareness, self-management, social involvement and relationship management Leader/followers are interdependent The role of the context is emphasised Interpersonal leadership is a system with leadership, organizational and environmental aspects There are rich, interdependent connections between the organization and its leader/follower members Leaders should balance authenticity and adaptation in the context
Knowledge leaders (also referred to as knowledge-orientated leaders in some literature)	 Combine aspects of transformative and transactional leadership styles Act as role models and change agents by encouraging learning, stimulate them intellectually, institutionalize learning through the provision of incentives and training, foster a pro-learning culture through cross-functional and cross-discipline engagement Intensify <i>explorative</i> initiatives by seeking to create new knowledge Encourage the willingness for <i>exploitation</i> practices to retain assets which aim to leverage existing knowledge through storage, transfer, sharing and application Have a direct effect on the application of knowledge through <i>knowledge sharing</i> based on strategic integrated communication and the strategic intent of the organization Provide strategic visions, motivate others, communicate effectively, model good practices and carry out the knowledge management to all concerned through interaction, vision, creativity, innovation and empowerment to create meaning Take a participatory stance, offering interaction, trust and loyalty Leader/follower roles are interchangeable with focus on productivity Collaborative interpersonal relationships are central Organizational culture conducive to transparency, empowerment and a team focus

Knowledge leadership comprises envisioning the future, coordinating the development of a coherent mission and overseeing the development, control, processes and strategic intent of the organization to provide integrated strategies, relationship building, organizational performance, a positive organizational culture and climate (Sanghani, 2009), the use of intellectual capital, especially during change, to ensure competitiveness. Singh and Kant (2008: 6) emphasized the need for knowledge leadership which should be evident throughout the organization and operate on all hierarchical levels from top to bottom, and that the role of knowledge leaders is to "provide strategic visions, motivate others, effectively communicate, act as a change agent, coach other around, model good practices and carry out the knowledge agenda ... knowledge leaders should religiously explain the goals of knowledge management to all concerned". Because knowledge management was presented as the theoretical foundation for this study, specifically the importance and role of change agents or experts (enablers) that can manage all information at all levels (individual, team and organizational), the term "knowledge leaders" has been adopted. Denrell (2005) came to the conclusion that, during the change process, (knowledge) leaders should conform to the following: empower individuals (like employees) to respond creatively; adopt personal and active attitudes towards individual and organizational goals to contribute to resonant leadership practices; be self and socially aware (and therefore be able to recognize, understand and react empathetically to their own and others' emotions and goals); be equipped with skills such as self and relationship management (which are characterized by transparency, adaptability, collaboration and inspiration); should be associated with a supportive organizational climate due to a constructive organizational culture; have, in the change process, the role of inspiring people. This is in contrast to the traditional approaches that focus mainly on rationality and control to maintain organizational goals, resources, structures and the people involved with these.

4 CHANGING ORGANIZATIONAL SPHERE

In terms of change management, the traditional approaches such as the action research model (systematic analysis of change), the three-step change model (unfreezing moving and refreezing), and the phases of planned change approach (organizational development which focuses on processes and participation), have been criticized by authors such as Overman (1996) and Jaatinen (2002) in that they are too rigid, their phases or steps are not chronologically ordered because of changes in the environment, incremental and isolated changes are addressed rather than radical transformation, they over rely on a management approach to reduce conflict, create order, control chaos and simplify the complexities in the turbulent environment and that they will not work in all organizations. Furthermore, these authors have argued that the underlying viewpoint is that information is power which needs to be controlled, hence the need for structures. According to Oliveira (2018), organizational change may occur during complex processes such as mergers, successions, acquisitions and the like, which means that leaders should focus on the obstacles to the organization culture. Based on these viewpoints, it is arqued that although these approaches were effective for many decades, the introduction of new technology, overload systems, better-informed employees and worldwide access to modernistic approaches meant that conflict or crisis usually resulted from poor planning and control. In the new leadership movement approaches - such as the chaos theory (which touched on the participatory nature of change management), complexity theory (rooted in the systems theory) and the contingency approach (role of external environment to develop congruence) - the focus shifted to dynamic environments moving away from planned change and organizational development to the management of change and transformation at a strategic organizational level. This supports the underlying purpose of this paper, which sets out to emphasize the need for knowledge-based and strategic integrated communication with the emphasis on true and interactive participation and a holistic perspective where all systems and subsystems are integrated to create shared ownership and commitment (Barker, 2016). Jaatinen (2002) made convincing arguments as to the importance of interdependence, participation and relationship building in terms of new approaches to change management. Hence, it is posited that the process of the system becomes important where all the subsystems should participate in adding to the richness of information, knowledge creation, codification and storing, shared responsibility, trust, transparency, connectivity, creativity and relationship building. This argument is supported by authors such as Grunig and Hung (2000) who indicated the importance of the concepts of control mutuality, joint acceptance of degrees of symmetry, trust and satisfaction with the relationship to communication management and relationship building. Today most organizations tend to follow a combination of the planned and emergent approaches to change management, usually based on their specific strategic goals and objectives.

5 KNOWLEDGE-BASED ORGANIZATIONAL CULTURE

A knowledge-based organizational view proposes that knowledge is the strategically important resource of the organization. To build a knowledge culture in a dynamic organization, it is argued that knowledge-based organizations should transform, develop and nurture systems and processes to ensure knowledge creation, storing, codification and sharing in a meaningful way so as to expand individual knowledge (implicit) to collective organizational knowledge (explicit). This explicit knowledge can then be interpreted and applied, or used to ensure that learning is created to clarify and adapt the strategic vision of the organization during change. Nonaka and Takeuchi (1995) also refer to embodied, tacit and narrative knowledge and the "absent presence" of the body as an essential part of everyday communication because it allows for the creation and sharing of knowledge (Barker, 2016). In spite of the growing interest in knowledge management, it has been critiqued by researchers such as Andreeva and Kianto (2012) for being too optimistic and promising more than it can deliver - and also because it is difficult to manage knowledge. However, Massingham (2014) addressed these concerns in an empirical study using action research from a critical systems perspective and provided empirical evidence that knowledge management can be used to manage knowledge resources (strategic integrated communication, human, monetary and information-based) and that it can be used to create a knowledge-based organizational culture. He did, however, agree that it is difficult to implement. The challenge for knowledge leaders is to develop an organizational culture conducive to the sharing of knowledge and where learning becomes the norm. While it is realized that such a culture might be a little problematic to implement, it is argued that it could encourage and support a range of positive outcomes in the dynamic changing environment and transformations of organizations. However, research has yet to reveal whether it would indeed be implementable because research-based evidence is needed to provide the expected outcomes. In spite of this, the importance of this viewpoint is re-emphasized by the growing interest in knowledge management which has, according to Oluikpe (2015: 351), "moved the topic from a relatively new discipline to an important strategic source for competitiveness".

6 THE ROLE OF KNOWLEDGE LEADERS AND KNOWLEDGE MANAGEMENT IN THE ORGANIZATION

According to Koenig (2012), the domain of "knowledge management" seems to continue its growth and attract new researchers on a continuous basis. For the purposes of this paper, the main researchers in the field, namely Nonaka and Takeuchi (1995), Davenport and Prusak (1998), Nonaka (2008), Argyris and Schon (1978) provided the context and background theories on knowledge management. The main thrust, according to them, is that knowledge management is about organizations and problems related to learning, information management and innovation, which are classical themes in most organizational studies. Hence it is argued that knowledge management is a combination of continuous enquiry on the systems and processes of an organization as well

as how the functioning of the organization can be improved through proactively and interactively managing the intellectual capital under its leadership. According to Ra'ed, Gharaibeh, Tarhini and Obeidat (2015: 2) this discovering of new knowledge is defined as "the development of new tacit or explicit knowledge from data and information or from the synthesis of prior knowledge ... and capturing of knowledge is defined as the process of retrieving either explicit or tacit knowledge that resides within people, artifacts of organizational entities and knowledge reside outside the organizational boundaries ...". Tacit knowledge is the skills and expertise ("knowhow") within individuals, while explicit knowledge is that which can easily be captured in documents or databases. According to Al-Alawi, Al-Marzooqi and Mohammed (2007), the process of KM involves several activities, with the most commonly discussed being knowledge sharing. Hence, studies that are more recent acknowledge the need for further research to identify the precursors that could enhance the occurrence of knowledge sharing (Mishra & Bhaskar, 2011) and to study the impact of knowledge sharing on organizational performance (Mills & Smith, 2012). The need for knowledge management and the importance of knowledge leaders are therefore driven by the following factors: organizational survival, competitive differentiation, globalization affects and aging workforce.

The findings in a study by Crawford (2005: 14) provided evidence of a "growing interest in the relationship between the "high touch" nature of leadership and the "high tech" aspect of the workplace ... and demonstrated the link between person-centered transformational leadership and some technical construct, in this case knowledge management". This is emphasized by Oluikpe (2015) who posited that the importance of knowledge management in the organization should include both the capabilities to enable the capture and leverage of intellectual capital and the deployment of this capital to the advantage of the organization. According to Mårtensson (2000), the term "intellectual capital" is the preferred umbrella term because it refers to the possession of knowledge, applied experience, stakeholder relationships and professional skills which link to strategy. Based on the conceptual roots of intellectual capital identified by Edvinsson, Roos, Roos and Dragonettel (1997), the strategic contributions of knowledge are based on the way in which knowledge is created or developed as well as the way it is leveraged into value. In spite of this realization, knowledge creation and development is mostly examined from the learning organization perspective; whereas it is argued that, in order to create this value, there should also be a focus on "knowledge sharing" to enhance the value and, ultimately, to give an organization a sustainable competitive advantage. One major issue that has hardly been dealt with is the integration of knowledge from both perspectives where the focus shifts from individual perspectives to an emphasis on knowledge residing within the organization as a whole. For the purposes of this study, intellectual capital is linked to strategic integrated communication; human and monetary sources needed for the processes and structures in the organization; and knowledge-based resources which include the management of leadership styles, technology, stakeholder relationships, innovation, creativity, participation, strategic intent and corporate culture of the organization. The importance of knowledge leaders in creativity, innovation, participation and organizational culture are, according to Chase (1998), the heart of creating successful knowledge-based organizations.

7 THEORETICAL FRAMEWORK

Based on the above discussion, the author constructed a new theoretical framework, as presented in Figure 1.



Figure 1: Theoretical framework for knowledge-based organizational culture conducive to knowledge sharing by knowledge leaders

From Figure 1 it may be deduced that knowledge management allows for organizational strategies based on *structural* elements including intellectual capital, systems, processes and knowledge codification and storing in databases (technical component), *connectivity* through strategic integrated communication which is know-ledge-information-meaning-based (communication component) and focused on *behavioral* aspects to ensure relationship building, which should be culture-based to obtain trust, satisfaction, transparency and engage-ment by all (human/organizational component). It is argued that if tacit knowledge is made explicit, individual knowledge can be transferred, shared and used at all organizational levels. Due to the difficulty of transferring tacit and individually owned knowledge to explicit and organizational knowledge, the major contribution is that if knowledge leaders as change agents apply knowledge management, it will lead to greater possibilities to manage and control this knowledge effectively, especially during change and transformation. From a strategic perspective, knowledge management is firstly about the acquisition of information, secondly about the codification and storage of this information and of the knowledge in various databases which can be used for

datamining, thirdly to make the information available and accessible to all hierarchical levels in the organization and, lastly, the fact that this information should be *shared and used* through sharing, socializing, externalization and exchange of information.

Hence, it is posited that by using knowledge management, knowledge leaders can be used as role models to empower others because knowledge management can be described either as an operational tool or as a strategic tool. In order to do this, participation becomes a key element to ensure the three components of knowledge management (technical, communication and human/organizational) are implemented through connectivity, structural and behavioral constructs. This will lead to creativity and innovation, which are key elements for emerging knowledge-based organizations. It is further argued that if knowledge management is implemented in the organization during change and transformation, knowledge leaders will emerge as change agents or role models with the necessary skills to enhance decision-making, shared responsibility, relationship management and stewardship at all levels of the organization (from individual to organizational levels). This emphasizes the need for knowledge leaders to have a sound understanding of people, processes, systems, strategic visions and similar within the organization. In order to do so, these knowledge leaders should rely on integrated communication to fulfil the roles of both collaborator and catalyst. Hence, it is argued that, if these change agents or knowledge leaders respond to changes in the outside systems and borderless aggregates during transformation, knowledge-based organizations could be created. These knowledge-based organizations will then create a learning culture in line with the strategic vision through integration of both implicit and explicit knowledge. Reward systems and performance measures will become important to ensure that motivation takes place to empower people through the knowledge application or use, which will ultimately lead to cultural change. Lastly, it is argued that, in the long-term, this process will enhance the value of knowledge organizations, specifically in terms of their culture, knowledge creation and sharing to the benefit of all.

8 CONCLUSION

In bringing together the ideas and interrelationships of the key concepts that have been discussed, this paper attempts to contribute to the theorization of the link between knowledge management, knowledge leaders, knowledge sharing and knowledge-based organizational culture. While it is argued that the paper can be seen as useful for understanding knowledge-based organizations on a macro level, it is also important to keep in mind that knowledge itself is not directly accessible; rather it is accessed through individuals that hold knowledge at a micro level (Nonaka & Nishiguchi, 2000). Hence, the focus on individual human knowledge is emphasized and should be considered by knowledge leaders through a participative approach, innovation, creative ideas, and the sharing and use of this knowledge in support of the organizational culture. Hence, the concept of "knowledge leaders" does indeed make business sense in that it can contribute to explaining how the management of knowledge is linked or related to the leadership of the organization. The need for the development of the new theoretical framework in this study, as well as its relevance, are probably best described by Gold and Arvind Malhotra (2016: 186) in the following statement: "... the issues of effective knowledge management from the perspective of organizational capabilities suggests that a knowledge infrastructure consisting of technology, structure and culture along with knowledge process architecture of acquisition, conversion, application and protection are essential organizational capabilities of 'preconditions' for effective knowledge management".
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STRATEGIC ALLIANCE AND PROCESS INNOVATION: THE MODERATING ROLE OF THE ALLIANCE DURATION AND THE FIRM SIZE

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ABSTRACT

The objective of this paper is to characterise substantial aspects related to acquisition and exchange of knowledge in a strategic alliance. In this context, the results of the empirical research are presented, to determine the significance of selected aspects of obtaining and sharing knowledge within the alliance. It was also applied the logistic regression models that allow to predict the probability of introducing a process innovation depending on the size of the company and duration of the alliance, as well as other variables characterising the company and the knowledge obtaining process. It was shown that obtaining, creating and sharing knowledge within an alliance determines the introduction of innovations by the enterprises. I also indicate that process innovations may potentially depend on the alliance duration and the size of the companies, as well as on others features that could determine the knowledge obtaining process. Finding the relationships between these variables and connecting them with the enterprise size and the alliance duration is an added value to what has already been achieved in this area. These proposals are an important course of action for companies in the context of acquiring or creating and transferring knowledge that forms the basis for innovation development.

Keywords: knowledge management, strategic alliance, process innovations

KEY FINDING(S)

The data and the regression analysis allow the following conclusions:

- the longer the duration of the alliance, the easier the implementation of process innovations;
- the analysis of the probability of introducing process innovation shows that the large enterprises can most
 effectively introduce them irrespective of the duration of the alliance;
- smaller ones may achieve similar effects as a result by extension of the cooperation within the alliance (only
 if the alliance lasts at least 3 years);

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- variables: employment and duration of the alliance have a positive impact on the introduction of process innovations;
- increasing the size of the company, as well as extending the duration of the alliance, has a positive effect on implementation of product and process innovations;
- variables affecting the probability of introducing process innovation were: book value, smaller employee teams, informal communication and complementary nature of resources;
- the recruitment of an additional employee increases the probability of introducing process innovation by 2.25%, while the extension of cooperation within the alliance increases the probability more than 8.5 times;
- large enterprises can introduce process innovations with nearly 100% probability regardless of the duration
 of the alliance. The same effects may be obtained by medium-sized enterprises, but only in the situation of
 more than one year of cooperation within the alliance. Small enterprises can achieve similar results, but only
 in cooperation within the framework of an alliance lasting at least 3 years;
- medium-sized enterprises with a short period of cooperation within the alliance (below one year) and small enterprises with medium-term cooperation within the alliance (from one to three years) introduce process innovations with approx. 60% probability.

IMPLICATION(S) FOR THE PRACTICE OF SMEs

The data analysis and the regression models show that most of process innovations were implemented by medium enterprises, which might result from their high development potential, whereas fewer of those innovations were implemented by large enterprises. Perhaps they aim at different effects resulting from a formed alliance than innovations. In 11 instances of formed alliances no innovations were found. However, it is noteworthy that this mainly concerns small enterprises, which may not possess the competitive potential yet, or the duration of an alliance is still too short for effective development and implementation of innovative solutions. Moreover, the longer the duration of the alliance, the easier the implementation of product and process innovations. The majority of innovations (product and process innovations) were implemented by enterprises that have been engaged in an alliance longer than 1 year (alliances from 1 to 3 years and over 3 years). It can be concluded that developing and implementing innovations within an alliance requires time, whereas frequent disappointments in this type of agreements result from not gaining quick benefits related to quick joint implementation of innovations. In fact, enlarging the size of the company increases the probability of implementation of innovations in fact, enlarging the size of the company increases the probability of implementation of process innovation by 9.11 times. A longer cooperation provides an opportunity to improve a product offer through process innovations oriented mainly at strengthening or obtaining competitive position and striving for business perfection. The knowledge acquired in the alliance can induce the development of innovative process solutions than the implementation of product innovations. At the same time, the alliance between medium and large enterprises results in a much higher probability of implementing product or process innovations than in the case of small enterprises. Moreover, complementary resources owned by larger enterprises seem to be the driving force of innovation within the alliance. The knowledge is the crucial one among alliance resources as a basis for the development and implementation of new or significantly improved production or delivery methods, new solutions in the field of technology or software. According to the logistic regression model, it can be concluded that longer duration of the alliance and better strategic match determine the practices supporting mutual learning and knowledge sharing. It also promotes integration of partners and increases the probability of implementing process innovations. Additionally, simplification of alliances tasks is not a positive circumstance in developing process innovation. This kind of innovation engage much more efforts during the development, testing and final implementation of a new or significantly improved processes.

1 INTRODUCTION

Enterprises are forced to search for innovative solutions in various areas of operation: organisational, product-related, technical, information-related and others. High-quality innovative projects require clearly defined resources (including knowledge), or own capabilities, including various practices for managing innovations at the strategic and operational level (Ernst, 2002). To meet these requirements, enterprises should look for new ways to reach and obtain resources, as well as capabilities based on knowledge, which will not bear the risk of becoming obsolete quickly. Knowledge and the ability to use it are becoming an imperative of building competitive advantage (Nonaka, 2000). In this sense, knowledge is a set of non-material resources of an entity, resulting from human activity, whose application can be the basis of creating competitive advantage (Zhang et al., 2009). Among numerous sources of obtaining knowledge by an enterprise, we can distinguish external sources (e.g. clients, suppliers, partner enterprises, institutions and others) as well as internal sources (e.g. employees, unions created by them, internal mergers and others). One of the effective ways to obtain new knowledge, competences and skills consists in establishing and executing cooperation with other enterprises within strategic alliances. In fact, this activity has become a popular strategy in many industries (Teng, 2005). Thus, depending on the purpose of the alliance and thereby the type of complementary sought, companies can select to cooperate with various partners (van Beers & Zand, 2014; Ashok et al., 2016).

Various external sources (from clients and suppliers to competitors and government bodies) constitute very rich source of knowledge. However, in order to be able to use it, an organisation must know how to identify what is interesting and useful in the external environment, obtain that knowledge, spread it and apply commercially (Zahra & George, 2002). The rationale behind this tendency is to minimise the risk of investment, distribute operating costs among a larger number of partners, and ensure a more flexible (faster) adaptation to the changing conditions in the international environment. Knowledge management in agreements between enterprises takes into account the bilateral process of learning by partners. This includes obtaining knowledge from partners, creating new knowledge together, and finally, using it to create the value of the whole alliance, as well as of each

partner enterprise. In this context von Krogh et al. (2000) emphasise that creating knowledge cannot be managed, but enabled. Knowledge becomes a key element in the strategy of enterprises participating in a strategic alliance, which as a consequence favours strengthening the innovative potential of the allies, as well as that of the entire alliance. Most of the research in that field focuses on the cognitive aspects of knowledge-related processes, such as absorptive capability or complexity etc., as well as on how they can affect the transfer of knowledge between partners (Foss & Pedersen, 2004; Inkpen, 2002; Capaldo et al., 2015). There were few attempts to identify the determinants that support knowledge acquisition through a strategic alliance, or to determine if the obtained knowledge favours implementation of innovations. Although knowledge is very valuable and can help enterprises gain competitive advantage, the process of obtaining knowledge is a difficult task, and can lead to as many problems as expected benefits (Junni et al., 2013). Managers of alliances must deal with problems related to organisational mechanisms of knowledge acquisition and sharing within the executed agreements. There are review works, largely based on the methodology of a systematic review of literature (Niesten & Jolink, 2015; Kale & Singh, 2009; Kohtamäki et al., 2018), deals with specific issues related to the premises and objectives of alliances, their results and success factors. However, the empirical studies carried out so far insufficiently contribute to the understanding of knowledge management practices in alliance and obtaining results in the field of innovation of cooperating enterprises (Natalicchio et al., 2017). Although this knowledge is well-established, this classification applies in particular to factors affecting knowledge management. There is a clear need to explore the analysis for demonstrating the relationship between the acquisition of knowledge in the alliance and the results of cooperation at the level of individual partner enterprises, measured by the development and implementation of innovative solutions (Meier, 2011; Niesten & Jolink, 2015). Therefore, the presented considerations as well as results and research conclusions foster the fulfillment of this research gap, which allows to better understand the conditions and mechanisms that favor the development and implementation of innovations within the strategic alliance. There is a surprising lack of consensus regarding the basic processes related to the transfer of knowledge within the alliance and its results. The analysis of the systematic literature review of the alliance management indicates the existence of a cognitive gap in this area (Kohtamäki et al., 2018; Natalicchio et al., 2017; Niesten & Jolink, 2015). It suggests the need for in-depth research on factors supporting learning in the alliance and their impact on the results at the level of partner enterprises (Meier, 2011; Niesten & Jolink, 2015; Natalicchio et al., 2017). This type of research would significantly expand the current knowledge base. In a broader context, there is also a cognitive gap regarding the way of transforming the knowledge absorbed in the alliance into innovations at the company level. Therefore, there is a need to fill this research gap, which would allow for a better understanding of the determinants of obtaining and diffusion of knowledge within an alliance.

2 THE KNOWLEDGE DIFFUSION WITHIN STRATEGIC ALLIANCES

Intellectual assets of companies constitute the driving force of innovation and contribute to the increase of competitiveness by providing new opportunities to compete (Belderbos et al., 2018). Therefore, they can be the foundations for building, maintaining and/or strengthening competitive advantage by presenting new sources of obtaining it. Zack et al. (2009) suggest that the practices of knowledge management, which promote generating new knowledge and organisational learning, are of fundamental importance for achieving benefits based on innovation. Donate and Guadamillas (2011) also associate these practices mainly with product innovations,

creating new sources of competitive advantage. This ability to create competitive advantages is determined by the flexibility of operations achieved through guicker introduction of new products/services adjusted to the changing needs and preferences of customers. The process of creating knowledge consists in transforming the intangible knowledge into a formalised form, updating and modifying learning routines to suit innovation efforts better (Walsh et al., 2016). The process of knowledge management serves this purpose, resulting in improvement of the strategic characteristics of an enterprise (value, intellectual potential, or competitive advantage). Sarala et al. (2016) found that knowledge transfer between cooperating enterprises is universally considered an important source of competitive advantage and can be defined as "successful knowledge transfer, including sending or presenting knowledge to potential recipient and absorption of knowledge by the recipient" (Sarala et al., 2016). In this context, Ramadani et al. (2017) argues that innovation activities are inherently related to the enterprise's performance, which is also influenced by knowledge spillovers and innovation activities. Many authors focus on internal factors within the alliance, they emphasise the significance of social-cultural connections between companies and the relational capital that can help partners foster innovation and creativity (Subramanian & Soh, 2017; Cuevas-Rodriguez et al., 2014; Ho & Wang, 2015; Vlaisavljevic et al., 2016). These connections complement employees' skills, trust, effective management of cultural integration, the routine of sharing knowledge and HR flexibility (defined as adaptation to changing conditions). All these factors constitute another reason for considering the processes of knowledge management and sharing through strategic alliances. However, absorption capabilities and organisational inertia exert conflicting pressure on the search and exploration in relation to the function of the alliances value chain, partners' attributes and position (Lavie & Rosenkopf, 2006). However, even the research analysing the characteristics and features of a company resulted in outcomes different from the previous studies on search and exploration. For example, Rothaermel and Deeds (2004) noticed that exploration increases relatively to the size of a company, whereas Beckman et al. (2004) proved that the size of a company also contributes to searching for resources.

3 A KNOWLEDGE-BASED APPROACH TO INNOVATIONS

Knowledge management is a set of actions, initiatives and strategies used by companies to generate, store, transfer and apply knowledge with the purpose of improving organisational efficiency (Zack et al., 2009). This process involves e.g. transfer of *know-how*, getting to know organisational procedures and programs, or the company's strategy. According to the knowledge-based view on business efficiency, organisations operate as mechanisms that help to transfer knowledge through the development of absorption capabilities (Junni & Sarala, 2013; Hong & Snell, 2013). This constitutes a peculiar structure for transferring and sharing knowledge within the frame of concluded agreements. Enterprises enter a cooperation convinced that the transfer of skills and knowledge will be mutually beneficial – it is one of the essential factors affecting the success of a planned strategic alliance (Khamseh & Jolly, 2014). For this purpose, a company can either cooperate fully, or within certain limits. Full cooperation incurs substantial costs related to teaching the ally, and as a consequence possibly strengthens one's future competitor. Due to the benefits resulting from such an exchange, full cooperation is more desirable than the one where both parties limit their cooperation (Kale et al., 2000; Liu et al., 2010; Yam & Cliff Chan, 2015). The possibility to obtain missing competences and root resources through cooperation favours entering into strategic alliances, which provide a quick and relatively easy way to complement the desired re-

sources and boost innovation by enhancing combinatory search (Lee et al., 2017; Asgari et al., 2017). Van Beers and Zand (2014) argue that accessing and combining the knowledge and capabilities of partners crucially contributes to innovation performance. However, alliances based on knowledge, founded on combining intellectual resources and mutual knowledge exploitation, need to be managed in a different way than traditional agreements. It is associated with a higher risk of uncontrolled takeover of intellectual assets by an alliance partner (Alcácer & Oxley, 2014; Martínez-Noya & García-Canal, 2015), than in the case of heavily guarded and evidenced tangible assets. This also requires significantly higher capabilities and better control of both alliance partners. In fact, the degree of differentiation regarding partners' characteristics (Jiang et al., 2010) can result in divergence from the anticipated outcomes, and it could act as a 'double-edged sword' for knowledge acquisition (Wang & Chen, 2016). On the other hand, cooperation within an alliance does not require incurring as high costs as those related to a takeover or a merger. At the same time, the threat of unfair copying, as well as possible legal sanctions, are eliminated. The problem of enterprise convergence resulting from copying good examples is also avoided. Ahammad et al. (2014) emphasise that transferring knowledge to and from partner enterprises may lead to developing a permanent competitive advantage. Therefore, people engaged in managing such type of undertakings should provide support and resources in order to guarantee a steady knowledge transfer. Combining various resources and skills of enterprises within the alliance creates a synergy effect, and triggers the process of mutual learning of partners (Howard et al., 2016; van Beers & Zand, 2014). Moreover, integration of internal and external innovation resources is the guidance for sustainable growth practices of entrepreneurial enterprises (Pan et al., 2018). That undoubtedly creates added value and facilitates strengthening of the competitive advantage of the allies.

These issues also include the concept of a learning organisation, which is perceived as a dynamic subject, characterised by a constant increase in its own operational flexibility, as well as a high degree of adaptation to changes in the environment. Cooperating within strategic alliances provides access to the sought for (missing) knowledge and enables achieving strategic flexibility (Schoorman et al., 2007; Park et al., 2002). Therefore, the process of learning should not be perceived as a motivation to create strategic alliances, but as a determinant in the process of alliance management, as the obtained knowledge is of essential importance for the evolution of an alliance. Strategic alliances can generate knowledge, which then will be used by the ally partners to strengthen their own strategies, possibly unrelated with the areas of alliance operation (Khamseh & Jolly, 2014; Junni & Sarala, 2013). The so-called strategic alliance competences (Inkpen, 2002) created in this way constitute an autonomous value of an agreement resulting from the transfer of partner's capabilities. These could bring unilateral benefits for enterprises in the future, such as creating knowledge concerning various aspects of organisational operations: from products and technological processes to managerial practices (Andreeva & Kianto, 2012). This knowledge can be used for undertaking tasks other than the ones within the alliance, improving products or entering new markets. This resource of an enterprise constitutes a value that would not be obtained by the company without participating in a strategic alliance.

Huang et al. (2015) emphasize that partner's ability to learn new knowledge through its cooperation within the alliance requires sufficient technical understanding to capitalise on that knowledge. A close, personal relationship between partners favours this and the quality of alliance relationship has a positive impact on the

innovation performance of the enterprise (Xie & Jing, 2017). Learning or transferring such *know-how* depends on the environment of the transfer, and on the mechanisms existing between alliance partners. However, von Hippel (1988) and Marsden (1990) argued that close and intense interactions between individual members of interested organisations work as an effective mechanism for transferring or learning of tacit knowledge. Tacit knowledge is very difficult to transfer outside the boundaries of an organisation, as it is based on common experience and is deeply rooted in everyday practices in the scope of learning, coordination and communication (Feinberg & Gupta, 2004; Gupta & Govindarajan, 2000; Nielsen & Nielsen, 2009). Communication among enterprise members also has a direct impact on collective entrepreneurship, and contributes to broader understanding of markets, products, and technologies (J. Yan & L. Yan, 2016).

Accumulation of knowledge obtained through an alliance is based on a conscious transfer of bilaterally contributed resources based on the needs of the partner enterprises, conducted through strategic meetings, staff exchange, directing the flow of knowledge etc. After the knowledge has been shared and accommodated in relation to routine operational procedures, it needs to be codified in organisational memory (keep or store knowledge). This codified process of organisational memory results in an effective distribution of organisational knowledge. This knowledge consists of previous individual experience, existing and new internal operational procedures, and any type of knowledge related to organisational operations (Zollo & Winter, 2002). It also leads to an increase in the capability to generate new ideas and own knowledge (Liu et al., 2010; Richter & Vettel, 1995). Finally, it increases the extent of innovations implemented by the companies participating in the alliance.

4 METHODOLOGY

Empirical research was conducted on a group of 70 enterprises that started cooperation in a strategic alliance. The selection of units for the study was purposeful, while the general population consisted of 76 enterprises belonging to one of the industrial clusters in Poland. The research sample consist of companies from different sectors. The major group (25 companies) are the companies manufacturing plastics and rubber products. The second biggest group (20) are the companies producing machines and equipment. Other companies operate in the following sectors: metal products manufacturing (9), wholesale trade (4), production of chemicals (3), architecture and engineering (3), activities related to software and IT consultancy (2), activities related to real estate (1), activities of head offices and consulting (1), repair, maintenance and installation of machinery and equipment (1), and production of computers, electronic and optical products (1). The enterprises were divided into 3 groups: small (employing up to 50 people) - 27 companies, medium (employing less than 250 people) -31 companies and large (employing over 250 people) – 12 companies. Additionally, all the alliances formed by them were classified according to their duration: ones that have lasted for 1 year, from 1 to 3 years, and more than 3 years. Despite the abundance of the many determinants of success of the alliance classification we can find common elements that are most often mentioned as key success factors in the alliance. These are (Ireland et al., 2002; Kale & Singh, 2009; Orr et al., 2011; Feller et al., 2013; Schreiner et al., 2009; Niesten & Jolink, 2015): defining tasks of the alliance, trust, strategic adjustment, number of employees in the team, informal communication, complementarity of resources. These factors were adopted in this study as variables to exemplify the empirical assessment of these factors in the knowledge diffusion in the alliance. The data was collected using an electronic questionnaire, and the representatives of management were asked to evaluate the influence of six previously specified categories (simplification of the alliance tasks, trust, strategic match, number of employees in a team, informal communication, complementarity of resources) on the exchange and sharing of knowledge with a partner enterprise within the formed strategic alliance. For this purpose, a score ranging from 1 to 5 was used, where 1 means no influence of the evaluated quality on obtaining and sharing of knowledge, 2 – low influence, 3 – medium influence, 4 – significant influence, 5 – essential influence. The conducted research provided data concerning the implementation of innovations (product, process and organisational innovations) that resulted from the new knowledge and skills obtained through the alliance. Additional characteristics of the investigated companies were acquired from the EMIS (Emerging Markets Information Service) corporate database. The data include financial variables, such as total revenues, EBIT, ROA, book value and other information, including employment, age of the company, and the sector it belongs to. All these measurable variables were included in the logistic regression models described below. Table 1 presents basic statistics of quantitative variables that were taken into account in the analysis.

	Mean	Median	SD	Min.	Max.
Total revenues (in thousands of PLN)	36647.09	19918.27	45584.99	1498	219684
EBIT (in thousands of PLN)	2905.66	2067.30	3148.69	-54	20626
ROA	0.19	0.12	0.30	-0.05	2.44
Book value (in thousands of PLN)	12505.57	7659.24	14628.96	-2	73253
Employment (in numbers)	126.33	90.00	118.60	1	350
Age (in years)	10.34	11.00	5.55	2	29

Table 1: Descriptive statistics of quantitative variables.

In many cases, the decision-making processes are based on multiple regression models, i.e. in which we analyse the impact of several independent variables on one dependent variable of the measurable type. However, in a situation where the dependent variable is of the dichotomous type, we should apply logistic regression.

The logistic regression model is based on a logistic function. This function is defined by the formula (Hosmer & Lemeshow, 2000):

$$f(z) = \frac{e^z}{1 + e^z} \tag{1}$$

The logistic function has values from the interval <0; 1>. The logistic regression equation, like the linear regression equation (Ferguson & Takane, 1998), allows us to calculate the expected value of the dependent variable. Because the logistic regression model applies to dichotomous dependent variables (taking only two values: 0 and 1), the expected value of the dependent variable Y has been replaced by the conditional probability value that the dependent variable Y will take the value 1 for the independent variables $x_1, x_2, ..., x_k$. Based on the properties of the logistic function, it follows that both of these values (the expected values of the variable Y, and the conditional probability of assuming the value 1) are equal. Hence the logistic regression model for a dichotomous variable is expressed by a formula (Kleinbaum & Klein, 2002):

$$P(Y = 1 / x_1, x_2, \dots, x_k) = \frac{e^{a_0 + \sum_{i=1}^{k} a_i x_i}}{1 + e^{a_0 + \sum_{i=1}^{k} a_i x_i}}$$
(2)

where:

 $P(Y=1/x_1,x_2,...,x_k)$ - conditional probability of reaching the value of 1 by the dependent variable with specific values of variables $x_1,x_2,...,x_k$

 a_0 - regression constant for logistic regression

 a_1-a_k - logistic regression coefficient for the i-th independent variable

 x_1 - x_k – independent variables, which can be both quantitative and qualitative

In logistic regression, apart from the interpretation of regression coefficients, one parameter still present – the odds ratio. It is the ratio of the probability that an event will occur to the likelihood that it will not. It can be expressed by the following formula:

$$S(A) = \frac{P(A)}{1 - P(A)}$$
 (3)

The odds ratio for individual variables can be expressed according to the formula:

$$OR(x_i) = e^{a_i} = \exp\left(a_i\right) \tag{4}$$

When the selected independent variable increases for a unit, the odds ratio changes by exp (a_i) times. If exp $(a_i) > 1$, it is expected to increase the odds ratio, whereas when exp $(a_i) < 1$, it is expected to decrease the odds ratio. In the case when the independent variable is a zero-one variable, the exp (a_i) indicates how many times the ratio for a dependent variable equal to one increases.

Estimating logistic regression models I try to predict the probability of the introduction of process innovations, depending on sets of variables. These include: total revenues (TR), EBIT, return on assets (ROA), book value (BV), employment (EMPL), age of the company (AGE), as well as: alliance duration (DURATION), size of the company (SIZE), sector to which it belongs (SECTOR). I also included those related to the process of acquiring knowledge

through an alliance: simplification of alliance tasks (SIMPL), trust between allies (TRUST), strategic match (SM), smaller employee teams (SET), informal communication (IC) and complementary character of resources (CR). There were used three logistic regression model defined by:

$$P\left(Y_{\underline{i}} = 1 \mid X_{1}, X_{2}\right) = \frac{e^{a_{0} + \sum_{i=1, j=1}^{15} a_{i}x_{j}}}{1 + e^{a_{0} + \sum_{i=1, j=1}^{15} a_{i}x_{j}}} = \frac{e^{a_{0} + \sum a_{1}x_{1} + a_{2}x_{2} + \dots + a_{15}x_{15}}}{1 + e^{a_{0} + \sum a_{1}x_{1} + a_{2}x_{2} + \dots + a_{15}x_{15}}}$$
(5)

where:

X₁ - total revenues (TR) in thousands of PLN,

X₂ – earning before interests and taxes (EBIT) in thousands of PLN,

 X_3 – return on assets (ROA) in decimals,

 X_4 – book value (BV) in thousands of PLN,

 X_5 – employment (EMPL) in numerical values,

 X_6 – age of the company (AGE) in number of years from establishing till 2018,

X₇ – sector belonging (SECTOR), taking 1 for production of chemicals, 2 for plastics and rubber products manufacturing, 3 for metal products manufacturing, 4 for production of machines and equipment, 5 for wholesale trade, 6 for activities related to software and IT consultancy, 7 for activities related to real estate, 8 for activities of head offices and consulting, 9 for architecture and engineering, 10 for repair, maintenance and installation of machinery and equipment, 11 for production of computers, electronic and optical products,

X₈ - size of the company (SIZE), taking 1, 2 or 3 values respectively for small, medium and large companies,

 X_9 – alliance duration (DURATION), taking 1, 2 or 3 values respectively for agreements till one year, more than one year till 3 years and longest than 3 years,

 X_{10} – the level of simplification of alliance tasks (SIMPL), and, taking values from 1-5,

 X_{11} – the level of trust between allies (TRUST), taking values from 1-5,

 X_{12} – the level of strategic match (SM), taking values from 1-5,

 X_{13} – the level of smaller employee teams (SET), taking values from 1-5,

 X_{14} – the level of informal communication (IC), taking values from 1-5,

 X_{15} – the level of complementary character of resources (CR), taking values from 1-5,

Y – introduction of process innovation (1 for successful introduction and 0 for an absence of process innovation), a_0 , a_1 , a_2 - a_{15} – structural parameters of the model.

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5 FINDINGS

The conducted research allowed to establish the percentage share of the researched features that determine obtaining and sharing knowledge within strategic alliances formed by the studied Polish enterprises. The outcomes are presented in Table 2.

	No significance		Po	or	Medium		Medium Significant		Essential	
	No. of indications	Structure								
Simplification of alliance tasks	14	20%	22	31%	11	16%	16	23%	7	10%
Trust between allies	0	0%	16	23%	10	14%	25	36%	19	27%
Strategic match	1	1%	9	13%	12	17%	32	46%	16	23%
Smaller employee teams	12	17%	25	36%	8	11%	16	23%	9	13%
Informal communication	2	3%	15	21%	26	37%	19	27%	8	11%
Complementary character of resources	0	0%	2	3%	22	31%	34	49%	12	17%

Table 2: Evaluation of the features that d	letermine obtaining and sharing o	f knowledge within a str	ategic alliance (N=70)
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The research results show that the studied enterprises most often reported strategic match between cooperating enterprises (obtained 48 evaluations of significant or essential influence), complementary character of resources (46 indications of significant and essential influence) and trust between allies (44 evaluations of significant and essential influence) as the features that, in the opinion of management staff, influenced the most their knowledge acquisition and sharing between partners in an alliance. Therefore, we can state that partner enterprises are aware of the fact that both the common mission, as well as vision and strategy of mutual agreement, and inherence of the resources contributed resources to the alliance constitute significant determinants for the process of knowledge management in a strategic alliance. Additionally, very interesting is the fact that the enterprises involved in the research valued the significance of the level of trust towards their allies regarding their intentions concerning development perspectives of the mutual agreement. There is a separate question of the uncertainty and risk that one of the partners might take opportunistic actions. Among the factors which have the least influence or no influence on knowledge acquisition and sharing within an alliance, the researched enterprises chose the necessity to simplify the tasks of an alliance (36 indications as poor or no significant influence), and forming smaller teams of employees responsible for completing tasks (37 indications). This could be a consequence of diversity in the scope of the tasks, and frequently the engagement of different employees depending on the stage of a common undertaking.

Another very interesting effect was found in the conducted research, it was related to the data demonstrating the correlation between characteristics of an enterprises and formed alliances and the implemented process innovations as a result of executing an agreement (Table 3). In this case the correlations were also analysed in terms of the size of an enterprise (small, medium, large) and the duration of an alliance (up to 1 year, 1-3 years, over 3 years).

Table 3: Numbers of process innovations implemented as a result of forming an alliance (N=70)

Size of an enterprise	Small	9
	Medium	29
	Large	12
Duration of an alliance	1 year	2
	1-3 years	31
	Over 3 years	17

The data presented in Table 3 shows that most of process innovations were implemented by medium enterprises, which might result from their high development potential, whereas fewer of those innovations were implemented by large enterprises. Perhaps they aim at different effects resulting from a formed alliance than innovations. In 11

instances of formed alliances no innovations were found. However, it is noteworthy that this mainly concerns small enterprises, which may not possess the competitive potential yet, or the duration of an alliance is still too short for effective development and implementation of innovative solutions. We can also observe that the majority of process innovations were implemented by enterprises that have been engaged in an alliance longer than 1 year (alliances from 1 to 3 years and over 3 years). Therefore, it can be concluded that developing and implementing process innovations within an alliance requires time, whereas frequent disappointments in this type of agreements result from not gaining quick benefits related to quick joint implementation of innovations.

I also estimated logistic regression models for dependent variables that refer to the introduction of process innovation. The structural parameters of the models were estimated using the Quasi-Newton method (with the level of significance $\alpha = 0.10$). The R² coefficient of determination is a statistical measure of how well the regression predictions approximate the real data points. It can be used for linear regression models. In case of logistic regression it can be used pseudo R² measures by Cox and Snell or Nagelkerg. In logistic regression we can also present a prediction accuracy measure.

Table 4 presents 3 models of logistic regression for the dependent variable of process innovation. Model 1 is estimated on the basis of all independent variables considered in the analysis. Model 2 presents the results of estimation for significant variables only, and model 3 presents the influence of only two variables (size of the company and duration of an alliance) on the probability of introduction of a process innovation.

		Model 1			Model 2				Model 3		
	Coeff	p-value		Coeff	p-value		exp(b)	Coeff	p-value		exp(b)
Intercept	6.2792	0.7039		1.9636	0.4567		7.1247	-7.0609	0.0001	***	0.0009
TR	0.0000	0.9342									
EBIT	0.0003	0.4018									
ROA	0.7218	0.8091									
BV	-0.0001	0.3610									
EMPL	0.0214	0.4471									
AGE	0.0027	0.9863									
SECTOR	-0.1428	0.5975									
SIZE	-1.6776	0.7920						2.7105	0.0025	***	15.0361
DURATION	2.4852	0.0378	**	2.5660	0.0050	***	13.0139	2.2097	0.0051	***	9.1128
SIMPL	-2.3454	0.1183		-1.6760	0.0021	***	0.1871				
TRUST	-0.4502	0.6174									
SM	0.0196	0.9849									
SET	-0.0241	0.9857									
IC	0.3909	0.5834									
CR	0.1772	0.8529									
R-Sq (L)	0.64			0.58				0.54			
R-Sq (CS)	0.53			0.50				0.48			
R-Sq (N)	0.76			0.72				0.68			
Prediction accuracy	0.90			0.91				0.89			

Table 4: Logistic regression parameters for process innovation models (N=70)

Signif. codes: 0 '***' 0.01 '**' 0.05 '*' 0.1 '+' 0.12 ' ' 1.

Model 2 after reduction of insignificant variables presents the probability of introducing a process innovation depending on the duration of an alliance, and simplification of alliance tasks. Increasing the duration of an alliance increases the probability of introducing a process innovation by more than 13 times, while increasing a simplification of alliances tasks results in reduction of the probability by more than 81%. The final form of model 2 is expressed by the formula:

$$P\left(Y=1 \mid DURATION, SIMPL\right) = \frac{e^{1.9693+2.5660 \, DURATION-1.6760 \, SIMPL}}{1+e^{1.9693+2.5660 \, DURATION-1.6760 \, SIMPL}} \tag{6}$$

Model 2 provides material for conclusions regarding not only the duration of an alliance, but also some features that can facilitate knowledge acquisition as a result of alliance agreement. The interpretation of this relations is presented in the discussion section.

In models 3, only two independent variables were considered: the size of the company and the duration of the alliance. For process innovation model, both independent variables (size and duration) are significant. The final forms of the logistic regression model 3 are expressed by the formula:

$$P\left(Y=1 \mid SIZE, DURATION\right) = \frac{e^{-7.0609+2.7105} SIZE+2.2097 DURATION}{1+e^{-7.0609+2.7105} SIZE+2.2097 DURATION}$$
(7)

Increasing the size of the company, as well as extending the duration of the alliance, has a positive effect on implementation of process innovations. In fact, enlarging the size of the company increases the probability of implementation of this innovation by 15.04 times. Respectively, extension of the alliance agreement increases the probability of implementation of process innovation by 9.11 times.

Using structural parameters of logistic regression models we can calculate the probability of introducing process innovations determined by the size of an enterprise and the duration of alliance agreement. The results are presented in table 5.

		Du	uration of alliance agreeme	ent
		up to 1 year	1-3 years	more than 3 years
	Small	11%	52%	91%
Company size	Medium	64%	94%	99%
	Large	96%	100%	100%

Table 5: Probability of introducing process innovation according to the company size and alliance duration

In the case of process innovations, data analysis allows the following conclusions:

- variables: employment and duration of the alliance have a positive impact on the introduction of process innovations; the recruitment of an additional employee increases the probability of introducing process innovation by 2.25%, while the extension of cooperation within the alliance increases the probability more than 8.5 times;
- variables affecting the probability of introducing process innovation were: book value, smaller employee teams, informal communication and complementary nature of resources.

Particular attention should be paid to variables related to diffusion of knowledge within the alliance, i.e. the greater the scale of the separation of smaller employee teams, the higher the incidence of informal communication

and the greater the complementarity of resources, the lower the probability of introducing process innovation. However, taking into account only the impact of the size of the company and the duration of the alliance (model 3), compared to product innovations, in the case of process innovations, the effects are even greater. Regression analysis shows that increasing the size of the company increases the probability of implementing innovations. Correspondingly, the longer duration of the alliance, the greater the probability of implementing process innovations. Graph 1 shows these relationships for process innovations. Two clear dependencies are visible:

- Large enterprises can introduce process innovations with nearly 100% probability regardless of the duration
 of the alliance. The same effects may be obtained by medium-sized enterprises, but only in the situation of
 more than one year of cooperation within the alliance. Small enterprises can achieve similar results, but only
 in cooperation within the framework of an alliance lasting at least 3 years.
- 2. Medium-sized enterprises with a short period of cooperation within the alliance (below one year) and small enterprises with medium-term cooperation within the alliance (from one to three years) introduce process innovations with approx. 60% probability.



Graph 1: The probability of introducing process innovation depending on the size of the company and the duration of the alliance

The longer the duration of the alliance, the easier the implementation of process innovations. The analysis of the probability of introducing process innovations shows that the large enterprises can most effectively introduce them irrespective of the duration of the alliance. However, smaller ones may achieve similar results as a result by extension of the cooperation within the alliance (only if the alliance lasts at least 3 years).

6 DISCUSSION AND FURTHER DIRECTIONS OF RESEARCH

Intellectual assets are the driving force for innovations, and they could be obtained from the resources of a partner enterprise in a strategic alliance. In fact, strategic alliances are essential factors driving innovations, and help partner companies get access to essential resources, broaden their technological competences and build reputation (Lee et al., 2010; Brunswicker & Vanhaverbeke, 2015). Bilateral exchange of knowledge,

know-how, technologies and modern management systems between cooperating international enterprises results in releasing improved products on the market. Knowledge management and knowledge transfer associated with it is a condition for being competitive on a global market, sometimes contributing to active influence of business entities on global economy. The influence of this process on the competitiveness of economies, in which innovative enterprises function, is also significant (Cunningham & Link, 2016).

The presented research results indicate that compatible missions, visions and strategies of mutual agreement (strategic match), as well as inherence of resources (complementary resources of partner enterprises) contributed to the alliance constitute significant determinants of the knowledge management process in a strategic alliance. According to the logistic regression model 2, we can conclude that longer duration of the alliance and better strategic match determine the practices supporting mutual learning and knowledge sharing. It also promotes integration of partners and increases the probability of implementing process innovations. Additionally, simplification of alliances tasks is not a positive circumstance in developing process innovation. This kind of innovation engage much more efforts during the development, testing and final implementation of a new or significantly improved processes. Process innovations usually provide solutions to specific problems. This may require solving many more complex tasks. There are no shortcuts here, and all activities aimed at improving the process are closely related. Thus, Zhao et al. (2016) also emphasise that the knowledge flow has a positive influence on alliance innovation performance. The longer the alliance cooperation, the larger the possibilities of developing and implementing process innovation (increases the probability more than 9 times). Longer cooperation provides an opportunity to improve the product offer through process innovations aimed mainly at strengthening or gaining a competitive position and striving for business excellence. It manifests itself by autonomously strengthening the learning process and acquiring the discipline of action in the scope of further continuous development of skills and knowledge. In addition, maintaining a competitive advantage requires improving processes, entering new markets or raising barriers in current areas. In turn, the implementation of process innovations is conditioned mainly by the creation of larger employee teams, despite the still maintained low complementarity of resources and formal communication. The knowledge acquired in the alliance can induce the development of innovative process solutions than the implementation of product innovations. At the same time, the alliance between medium and large enterprises results in a much higher probability of implementing product or process innovations than in the case of small enterprises. Moreover, complementary resources owned by larger enterprises seem to be the driving force of innovation within the alliance. The knowledge is the crucial one among these resources as a basis for the development and implementation of new or significantly improved production or delivery methods, new solutions in the field of technology or software.

The presented results and conclusions have some limitations. The research was conducted among the Polish enterprises, hence the conclusions could be applied to other countries with a similar development level and innovation potential. Among the limitations that should also be taken into account are: the degree of enterprises' involvement in knowledge management, sources of technology transfer, models and systems of knowledge management and technology transfer, public support (from government and European Union) in technology transfer processes, the degree of cooperation between enterprises, universities and research institutions.

The process of knowledge diffusion and implementation of innovations largely depends on the conditions for enterprises created by state and local government authorities. Pro-innovative legal regulations encouraging enterprises to increase the R&D expenditures as well as infrastructural solutions, e.g. by creating clusters or special economic zones should be considered as positive incentives. These factors are largely dependent on the economic policy and long term development strategy.

So far, empirical studies have been insufficiently contributing to the understanding of knowledge management practices in alliances and results in the field of innovation of cooperating enterprises (Natalicchio et al., 2017). Although this knowledge is well-established, this classification applies particularly to factors affecting knowledge management. Undoubtedly, the presented research results do not exhaust the issues of knowledge management and innovation implementation by enterprises within the strategic alliance. An interesting direction of further research may be the importance of other characteristics of knowledge diffusion in alliance that differentiate between enterprises such as capital (foreign/domestic) and the geographical scope of activities (national/ international). Further research should take into account other measures describing the level of innovativeness of enterprises related to the specific effects, such as cost savings or increasing market share. In addition, the fact of introducing a specific type of innovation is a relative term. The analysis ought to include more reliable variables, such as the number of obtained patents (innovation output measures).

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ABSORPTIVE CAPACITY IN HIGHLY DYNAMIC MARKET: MULTIPLE CASE STUDY ON THE BEHAVIORAL ASPECTS OF THAI IT SMEs

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ABSTRACT

Many past researches have shown that behavioral factors strongly influence knowledge transfer in highly dynamic markets. However, there has yet any studies that focus on the transfer of knowledge in the evolvement of absorptive capacity in firms. Firms such as IT SMEs rely on the absorption of new knowledge to survive. Under such dynamic market condition, these firms require regular update of their organizational knowledge to sustain competitiveness. The lack in research leads us to the question of how behavioral factors impact the absorptive capacity in highly dynamic market. This study uses qualitative exploratory multiple case study. Data were collected from six Thai IT SMEs. A cross analysis was conducted between

the current findings and exiting literatures. The findings indicated three significant deviation. Conforming behaviors such as trust or buy-in can be found in both the general and highly dynamic markets. Inconsistent behaviors which include Not- Invented-Here, or Only-Used-Here, do not appear in the highly dynamic context. Emergence behaviors, such as fear-of-speaking, or knowledge hoarding, only appear in the Thai context and not in the general market. Understanding these characteristics in knowledge transfer will enable ease of transfer, effectiveness of transfer and avoidance of misapprehension in the knowledge transfer processes.

Keywords: Absorptive Capacity, Knowledge Transfer Behaviors, Highly Dynamic Market

KEY FINDING(S)

The study is based on the exploration of behavioral aspect when an organization is developing absorptive capacity for its new external knowledge acquisition. Base line behaviors were constructed from the review of literature as the norm of behavior commonly found in any organizations. The study focuses on the behaviors that are specific to the highly dynamic market that pertain distinct characteristics like those in IT SMEs industry. Then the behaviors are compared with the baseline for differences.

The first contribution is the common behaviors in any organization, but not exist in the highly dynamic market. These behaviors are the intuition, not-invented-here syndrome, all-stored-here syndrome, only-used-here

1) 2) Institute for Knowledge and Innovation Management, Bangkok University, Thailand syndrome, and sell-out-here syndrome. These syndromes commonly serve as strong resistant to accepting of knowledge from external sources to be adopted in the workplace. This indicates that the distinct characteristic of the organization survivability relies on the absorption of external knowledge.

The second contribution are the behaviors that were not mentioned in the literature but exist in the exploration of the study in highly dynamic market. These behaviors are the fear of communicating in foreign language, the fear of asking questions and providing feedback in front of large crowd, and the fear of loosing face by asking stupid questions or act of stupidity. These symptoms are specific root of the explorative local Thai culture, which was the target exploitation of the explorative study. The cause of these are from the psychological factors that have the impact on the development of absorptive capacity.

IMPLICATION(S) FOR THE PRACTICE OF SMEs

In the process of developing absorptive capacity in an organization, these behaviors surfaced and addressed as necessity components to help achieve the successful building of firm's absorptive capacity.

First is the building of trust relationship between the knowledge transferrer and knowledge recipients. No matter if the knowledge transferrers are from the external sources or from internal network, the trust relationship between the transferrers and the recipients helps with the ease of the transfer. The firm should focus on the process to build the trust relationship between the two sides.

Second is the learning mindset. Learning mindset is the core competitive behavior that leads the firm in highly dynamic markets to adopt to the turbulence of changes. Firm should consider implementing and embedding the learning mindset into the company culture.

Third is the used of reward. Use of rewards has two-side-of-coin effect. It can be both positive and negative. Reward can be used as incentive to motivate staff to improve their efficacy in absorptive capacity development. However, overuse of reward, especially the prize reward, can lead into perception of target-achievement award, rather than incentive, which may lead to competition against others.

Fourth are the negative influencers. These deteriorate the efficacy in the development of absorptive capacity and should be avoid. These behavioral factors are the local fear factors that are stemmed from psychological factors, such as fear of using foreign language in communication, fear of asking question, fear of providing feedback, fear of expressing ideas in front of large crown and fear of losing face from acting with stupidity.

Last implication is the knowledge hoarding. This behavior exists when the transfer of knowledge involves cross-boundary of inter-disciplinary network. This can be overcome by implementing the multi-disciplinary knowledge transfer project team or an effective implementation of knowledge management practice.

1 INTRODUCTION

In the systematic literature review on absorptive capacity by Senivongse, Mariano, and Bennet (2014), it reveals that there are several impacting exploratory regimes when exploring the internal process of absorptive capacity. These regimes comprise of the agent roles that facilitate the flow throughout the process of absorption, the socio-psychological factors that accommodate the knowledge in-flow process, the process and routines of the absorption, and the behavioral aspect of the absorption. Among these regimes, behavioral aspect plays a significant role in the transfer of knowledge across organizations. Knowledge transfer occurs when the transferor and the recipient find the transfer beneficial and useful (Kwok & Gao, 2005). However, there are limited literatures on this aspect and existing studies mainly focused on the influence of behavioral factors to the overall concept of absorptive capacity and less on the internal capability elements of absorptive capacity. This research gap is significant especially in highly dynamic market where knowledge absorption occurs frequently in the organization. This study selects the Information Technology Small and Medium Enterprises (IT SMEs) as the study venue. An explorative multiple case studies is adopted for the study.

The purpose of the study is to define and compare the behavioral context that have impact on absorptive capacity for firms in highly dynamic market. This leads to the first research question (RQ1).

RQ1: What are the behavioral factors on absorptive capacity that co-existed and do not exist in highly dynamic market?

Since behavioral aspects are specifically influenced by cultural norms, there should be some behaviors that emerge and present only in the Thai cultural context. This leads to the second research question (RQ2).

RQ2: What are the specific behaviors that only existed in Thai IT SMEs context?

2 THEORETICAL BACKGROUND

From the theory of organizational learning, three observations are drawn from behavioral studies; the first behavior is based on routines capability; the second, relates to routine capabilities that are based on past performances; and third, organizations are oriented toward target (Levitt & James, 1988). Organization is learning by associating the past performance into routine capabilities that guides behavior. Thus, behavior govern the routines of knowledge absorption (Fernhaber & Patel, 2012).

Minbaeva, Pedersen, Björkman, Fey and Park (2003) conducted research on absorptive capacity under the perspective of employee ability and motivation. The study confirmed that both ability and motivation played important roles in facilitating the transfer of knowledge. This aspect agitates the need to explore behavioral factors that impact the development of absorptive capacity.

2.1 ABSORPTIVE CAPACITY

Cohen and Levinthal (1989) initially defined and conceptualized a construct that contained capability of a firm to absorb new external knowledge and named it as "absorptive capacity". Absorptive capacity is the firm's ability to realize the value of the new emergence of external knowledge, assimilates the knowledge across the organization, and exploits the newly absorbed knowledge to deliver the value that contributes to the firm's competitive advantage (Cohen & Levinthal, 1989, 1990).

Zahra and George (2002) redefined the construct and suggested that absorptive capacity is a concept comprising of four internal elements of acquisition, assimilation, transformation, and exploitation. These capabilities which are oriented in sequential manner will allow the firm to gain and sustain competitive advantage. Adding transformation capability into the construct allows absorptive capacity to be treated as dynamic capability. The transformation therefore allows a firm to adjust its resources to undertake the turbulence threat in the market. Transformation allows the firm to change its operation mechanism and adjusts the process to enhance the firm's competitiveness (Raisch & Birkinshaw, 2008; Rothaermel & Alexandre, 2009; Teece, Pisano & Shuen, 1997). Transformation becomes the key in realizing and combining newly absorbed knowledge into the existing knowledge structure. However, it has been argument weather transformation is a necessary capability element in absorbing knowledge as the firm's in this market segment requires high responsive reaction to the emergence of new knowledge. With existing knowledge trait, firm can leverage its absorbed knowledge instantly without having to adjust its resources before the utilization of the new knowledge.

Todorova and Durisin (2007) proposed an enhancement of the construct by indicating that transformation is a capability in parallel structure which might be needed in modulate and low turbulence markets, while assimilation alone was enough for the high turbulence, highly dynamic, market. These researchers also added a feedback loop to reflect the result of the exploitation in cyclical approach. The new proposed model clustered around the original construct of Cohen and Levinthal (1989). This preservation is significant as the construct does not deviate too much from the original intention (Lane, Koka & Pathak, 2006).

Todorova and Durisin's (2007) conceptualization of absorptive capacity is used as the referring construct in this study. It is the latest conceptualization based on recent evolution from the original ideas of Cohen and Levinthal (1990).

2.2 THE POSITIVE REINFORCEMENT OF BEHAVIOR ON KNOWLEDGE TRANSFER

Absorptive capacity is the organizational level construct (Cohen & Levinthal, 1990; Lane, Salk & Lyles, 2001; Roberts, 2015). It has two elements. Firstly, the prior level of knowledge traits and secondly, the intensity of effort (Minbaeva et al., 2003; Zahra & George, 2002).

The intensity of effort comes from the motivation that employees wish to contribute to the company. Motivation is an important element of organizational behavior in constructing absorptive capacity (Rose-anderssen, Baldwin, Ridgway, Allen & Varga, 2009). Motivational problems, such as willingness to absorb or share knowledge, can be overcome by socialization, compensation, documentation, toleration, communication, and rotation (Kalling, 2003: 117)

2.3 THE NEGATIVE REINFORCEMENT OF BEHAVIORAL EFFECT ON KNOWLEDGE TRANSFER

Szulanski (1996) studied on "stickiness" characteristic of knowledge transfer in the organization found that the major barriers to the efficacy of knowledge transfer came from causal ambiguity and the inter-personal relationship between the knowledge transferrers and the recipients. Causal ambiguity results from the lack of knowledge trait to help understand the context of the new knowledge in absorption. Trustworthiness of the transferrer-recipient also impacts on the efficacy of the knowledge transfer. In an untrusted environment, the transfer will be more difficult. This also leads to the behavior of "Not- Invented-Here" (NIH) syndrome that any foreign knowledge is rejected. The rejection results in the restrained behaviors, such as "foot dragging, feigned acceptance, hidden sabotage, or outright rejection" (Szulanski, 1996: 31).

Simonin (1999) discussed that causal ambiguity had direct impact on knowledge transfer. His study confirmed that the knowledge aspects of tacitness, cultural distance, and organizational distance causes ambiguity which impact the outcome of the transfer. Tacitness is the deep personal knowledge that is difficult to communicate and share, and it requires inter-personal relations to elevate the transfer (Elwyn, Taubert & Kowalczuk, 2007; Nonaka & Takeuchi, 1995). Cultural distance is the major difference in the cross-cultural setting. The distance determines the difficulties that impact relationship and understanding between transferrer and recipients when they come from different cultures. For example, the lack of common language causes difficulty in understanding the transferred context. This also include the lack of cross-cultural skills, exposure, and understanding which impair both the ability to learn and applying the knowledge. The organizational distance represents the degree of dissimilarity in practices, norms, values, and organizational cultures (Xu & Ma, 2008).

Psychological safety is a shared belief held by the members of the group which is safe among the members (Edmondson, 1999). It anticipates the belief of how other members will respond when one acts on something, such as asking question, expressing opinion, and sharing idea (Carmeli, Brueller & Dutton, 2008; Edmondson, 2014). The belief will lead to negative consequences of being embarrassed or criticized. Psychological safety is found to have impact on learning and team performance (Cauwelier, Ribière & Bennet, 2016; Edmondson, 1999; Edmondson, 2014). Learning in team is based on interpersonal relationship among the team members. Trust is treated as the driving mechanism to the construct of the learning climate (Edmondson, 2014).

Psychological safety is influenced by the cultural norms that exist in the country where the individual or team members grew up (Cauwelier et al., 2016). This reflects negative behavioral symptom which appears as fear of expressing oneself in public or fear of using English as communal language for knowledge transfer. Such behaviors are quite common in the Thai enterprises setting.

2.4 IT SMEs AND IT SMEs IN THAILAND

Thailand's Office of Small and Medium Enterprise Promotion (2007) indicated that IT SMEs in Thailand lacked competitive edge. The lacking was attributed to various reasons such as weak production and management structures, lack of marketing capabilities, low on product and service development, low labor quality, inefficient use of technologies, low access to capital funding, lack of environmental accountability, and lack of networking and collaboration among their peers in business operations. There are hundreds of IT SMEs entering into the market each year (Kim & Mauborgne, 2004). Some of them survived and lived through their years of existences. Some had to close down after a few years in operation. One of the common understanding of the Thai IT SMEs is that they tend to rely on products that are developed by their global partners. Without having products of their own, they systematically became technology brokers.

Being technology brokers, the key value of their business is the provision of fast technological update to their customers. In the highly dynamic market, there are several technological knowledges updated a few times a year for each product (Volberda, 1997). These IT SMEs have to keep learning and updating their knowledge in order to survive and gain competitive advantage over their rivals in order to satisfy their customers. The numerous learning efforts that occurred throughout the years provided the perfect setting for case study to examine the impacts of absorptive capacity on firms in highly dynamic market.

Another key consideration to assess data from this industrial segment is to use the performance of IT SMEs. These indicators can include product differentiation, or marketing related activities. Due to the nature of the industry, products and services offered to them may be widely available from multiple suppliers. The only factor that influences customer in making decision to choose a supplier is customer's preference. Absorptive capacity is the only profound strength that leverages this privilege.

Knowledge transfer in this industry starts from the foreign product owner along its eco system value chain to IT SMEs (Ernst & Kim, 2002), before being re-transferred to the end customers. The transfer involves surpassing several barriers. These barriers determine the efficacy of the absorption. This study focuses on the behavioral factors that facilitate or prohibit the transfer of knowledge in the segment of this industry.

3 RESEARCH METHODOLOGY

There are two parts in this study. The first part explores the past literatures on absorptive capacity and behavioral aspect during 1989-2015 using systematic literature review approach. The objective of the first part is to define what scholars have mentioned about behaviors that impact absorptive capacity. The analyzed data from this part is used as the foundation to compare with the data collected from the highly dynamic market. The second part used qualitative analytic approach from collected data. The findings reveal specific behaviors that impact absorptive capacity in this specific market.

3.1 SYSTEMATIC LITERATURE REVIEW ON BEHAVIORAL ASPECT OF ABSORPTIVE CAPACITY

Senivongse, Bennet, and Mariano (2017) reviewed 189 absorptive capacity research documents that were published in the past 25 years. The review explored into details following the relevant impact to the internal elements of absorptive capacity. Behavioral aspect is one of the exploratory regimes that govern to explore the characteristics of absorptive capacity (Senivongse et al., 2014). For each of the absorptive capacity element, the behavioral aspect was explored to identify of what scholars had mentioned. The extracted findings are used as the based-line that represents general behaviors that influence absorptive capacity. Table 1 denotes the findings.

Table 1: Literature review of behavioral analysis on Absorptive Capacity

Acquisition	Assimilation	Transformation	Exploitation
 Intuition and interpretation of individuals and groups (Sun & Anderson, 2010) Incentives drive the need for new knowledge (Schmidt, 2010) Trust between partners, cultural compatibility, prior knowledge, relatedness of business (Lane et al., 2001) 	 Not-Invented-Here (NIH: refusal of foreign knowledge) & Buy-In (strong focus on external knowledge acquisition) syndrome (Lichtenthaler & Ernst, 2009) Common interest across or- ganization (Alin et al., 2011) Learning process involves socio-psychological process of interpretation at group- level (Sun & Anderson, 2010) 	 All-Stored-Here (Knowledge generated internally is to be used inside the firm) and Related-Out (Strong reliance on external in-sourcing, omit building own capabilities) syndrome, interpreted at group level (Lichtenthaler & Ernst, 2006) Managerial encouragement and experimentation on the shared understanding of newly acquired knowledge (Sun & Anderson, 2010) 	 Only-Used-Here (Incomplete or underutilization of existing knowledge due to fear of strengthening competitors) and Sell-Out (overvalua- tion of external exploitation potential and undervaluation of consequences for internal knowledge exploitation) syndrome (Lichtenthaler & Ernst, 2006) Behavior and output controls (Li et al., 2010) Reward and recognition, effective allocation of resources, effective res- tructuring of organizational memory (Sun & Anderson, 2010)

3.2 QUALITATIVE APPROACH ON BEHAVIORAL EVIDENCES

Data are collected from multiple sources and triangulation are performed to validate the findings (Yin, 2011). Multiple persons from each organization were interviewed to validate the trustworthiness of data. The interpreted results were verified by multiple scholars. In addition to interviewing, observation and revision of documented evidences were performed to cross-check for data integrity.

Six IT SMEs were explored with 34 interviews to all level of personnel from executives, managerial level, and operational level. The six IT SMEs were evenly classified as two Product Distributors (Company A and B), two Value-added Resellers (Company D and M), and two System Integrators (Company C and T) to cover the typical range of services in IT SME industry. The distributors perform the import of products into the country and resell them using partnering channel before reaching the end customers. The value-added resellers are the representors of the product manufacturers who resell products and services to the end customers. The system integrators integrate and combine multiple technologies and customizes them to fit the needs of customers.

To analysis the data, thematic coding was used. Coding categorizes, and contextualized data into themes (Boyatzis, 1998). Recurring behavioral patterns are identified. Table 2 defines the finding and first order codification of the emerging patterns. Table 3 takes the first order codification from table 2 and categorizes them into the second order codification.

Table 2: Data analysis and 1st order codification on behavioral aspect

AC Capability	Evidences	1 st order Codification
Identification and Acquisition	"He [an engineering subordinate] may have fears, or the way I talk is wrong. It might be too strong, making him feels that he cannot speak like me, cannot defend like me so he chooses to be quiet" (MD, M) "For me, I see that learning new things challenges me. Exploring into new things that I have not known before." (Procurement Officer, T)	Fear of speakingChallenges as motivator
Assimilation	"I don't talk to everyone all the time, only the Sales. The communication in the company is always one-way. But after attending the coaching, we are now discussing more in a positive way" (MD, A) "There is no blaming culture. Whole team is responsible. There is no dominating person; the whole team has to go together." (MD, A) "We appraise them with performance indicators. We give out awards." (MD, A) "It's the habit of Thai persons when they are with a small, familiar, group they tend to be more open. But when they are in the larger discussion group, they seem to hold back and become silent" and "Thai people are not like Americans. Americans, when they are in doubt, they fire questions right away. For the nature of a Thai person, even when they are in doubt, they will not ask. I'm not sure if they are shy or do not want to lose face" (MD, B) "My father taught me three things – Goodwill, Punctuality, and Integrity. These three words are the foundations that build everyone in this company." (MD, B) "What I have done to share knowledge with the customer is my pure passion that I have toward my customer" (MD, D)	 Use common language Trust from customer Trust from management No blaming culture Staff motivation by monetary incentive Fear of asking question Passion to learn
Transformation	"I had introduced the coaching class to my staff. The outcome of the training is to create a shared vision to ensure their employees know where the company is heading, and they put this into practice so the employees can follow." (MD, A) "We have the attitude to be a contributor, rather than a taker. Since we are exposed to learning environment at all time, we continuously upgrade ourselves" (MD, B) "With loosely formed alliances designed to serve customer needs, everyone on the team must have a high discipline in self-learning." (MD, D) "The way I motivate my subordinates is to create the crave of learning. I will tell them where we are heading. I challenge them that learning the new thing would let them be the only team in Thailand to know about this new stuff." (Presales Engineer, T)	 Build shared vision Attitude of service mind Attitude of continuous learning Self-learning discipline Challenge as motivator Recognition of being a part of successful team
Exploitation	"When you are talking to your customers, there is certain information that is by the Marketing." (Sales Manager, A) "There is no KPI, there will never be. We use a result-oriented approach to get things done." (MD, C) "Using a monetary incentive as a performance measuring index must be transparent and fair. It must not be based on feeling, but a clear and agreeable judgment" (HR, T) "The managing director does not speak directly. If his subordinates do not inform him, he would assume there was no problem." (Administrator Manager, T)	 Sharing culture KPI result in stress and turnover Incentive has 2 sides Insincere Feedback damages trust Not share culture

Table 3: Analysis and 2nd order coding on behavioral factors

1 st order coding	2 nd order coding	Reinforcement
 Trust from customer Trust from management Recognition of being a part of successful team Insincere feedback damage trust 	Trust Relationship	
 No blaming culture Recognition Build shared vision Leadership 	Building of Trust Relationship	Positive
 Attitude of Service mind Attitude of continuous learning Passion to learn Self-learning discipline Challenge as motivator Sharing culture 	Learning Mindset	
Staff motivation by monetary incentiveIncentive has 2 sides	Incentive	Neutral
Not share culture	Knowledge Hoarding	
 Fear of speaking or asking question in public Language barrier 	Psychological Safety	Negative
KPI results in Stress and Turnover	KPI as Demotivator	

4 FINDINGS

From qualitative analysis, the study focused on the exploration of behavioral aspect on the internal capability elements of absorptive capacity. From the collected data of the six IT SMEs, the emergence of behavioral factors consists of positive, neutral, and negative reinforcements for the development of absorptive capacity. The positive reinforcement is the factor that influences the increase of the firm's absorptive capacity. The neutral shows the inconclusive measure if the factor is to support or deteriorate the development of absorptive capacity. The negative reinforcement has negative influence of the development of absorptive capacity.

4.1 POSITIVE REINFORCEMENT

The positive reinforcement from this study consists of 'trust relationship', 'building of trust relationship', and 'learning mindset'. Trust is the socio-psychological behavior (Sun & Anderson, 2010) that eases the transfer of knowledge across the organizational transfer network. Trust relationship concerns both external customers and internal customers, such as the management. Trust from customers allows the positive exploitation of the absorbed knowledge. Trust from the supplier encourages the transfer of knowledge from outside of organization across the organizational boundary into the receiving team.

Trust from management gains empowerment and agility to react to the new knowledge, which increase the flexibility of the knowledge transfer. Trust from peers gains recognition and enhances the efficacy of knowledge assimilation.

Building of trust is the process that ensures the trusted relationship is properly developed (Roxas, 2008). From the study, trust is built through the process of coaching and mentoring program. The objective of the program is to develop a 'No blaming culture', which allows the sharing of knowledge to happen without any fear of this being taken as a wrong decision or an act of stupidity. The process to build this trusting culture is through the shared vision of where the new knowledge will bring the company and the benefits the company and individuals will realize. The establishment of recognition among peers in a peer culture helps the individuals feel that they are important members of the delivering team. The leader of the team must also lead and act to ensure that team members are on board to deliver something important.

Learning mindset has a direct impact on absorptive capacity. From the study, the learning mindset is developed through the act of top executives as the role model, encouraging other subordinates to follow. The attitudes toward the learning mindset that emerge from the cases are service-minded attitude, continuous learning attitude, passion-to-learning attitude, self-initiated to learning attitude, thriving to be in business attitude, and learning as a challenge attitude. The service minded attitude will equip each individual to empathize with others that needs help, as if he/she is facing the difficulty himself/herself. This attitude will encourage an individual to look for ways to solve the problem. The continuous learning mindset will encourage an individual to keep looking for ways of improvement. The passion to learning mind will give an individual the craving to look for new knowled-ge. The self- initiated to learning mind creates the discipline of learning and allows the learning to happen anywhere, anytime, and under any circumstances. The thriving to be in business mindset will guide each individual to realize that the business will be in trouble if he does not learn new things. Seeing learning as a challenge will give an individual a boost to overcome difficulty in obtaining knowledge.

4.2 NEUTRAL REINFORCEMENT

The use of monetary reward exists in several cases in this study. It was intended to be a tool to motivate staff to absorb knowledge. Some use it to reward the team performance.

Monetary reward can be seen as the negative influence when the team is underachieving the target. In this case, the reward is seen as the demotivator, especially when other useful resources necessary for absorption are not properly allocated.

4.3 NEGATIVE REINFORCEMENT

Negative reinforcement has a reverse impact on the efficacy of knowledge absorption. There are three factors in this negative category: knowledge hoarding, psychological safety, and KPI. The hoarding of knowledge results in not fully transferring knowledge from one team to another. When this happens, the company will have trouble in coordinating the work, and will end up by having the knowledge originating team held responsible for customer

support throughout the entire project phases. The company also possesses the risk of losing knowledge when some employees leave the company.

The second negative reinforcement is the fear of psychological safety. It is quite common for the Thai members of these companies to not to speak out, not to ask questions, and not to provide comment or give feedback during the transfer of knowledge. This comes from the non-fluency in using other languages as a means to communicate during the transfer.

Language becomes the barrier in term of expressing feedbacks. The size of the transfer group also has an impact on the fear to provide feedbacks. The Thai IT SMEs also has a fear of asking questions or providing comments when the transfer group is large. If the transfer occurs in a small group, especially with the same knowledge discipline, providing of feedbacks occurs freely.

5 DISCUSSION

Table 4 summarizes and compares the behavioral factors that are mentioned in the studies by many scholars and what actually appeared in the study.

Behavioral Factors extrapolated from Literature Review	References	Emerged in this research study	
		YES	NO
Intuition	Sun and Anderson (2010)		Х
Incentives that drive for absorption	Schmidt (2010)	Х	
Trust	Lane, Salk, and Lyles (2001)	Х	
Not-invented-here (NIH syndrome)	Lichtenthaler and Ernst (2009)		Х
Buy-in	Lichtenthaler and Ernst (2009)	Х	
Common interest across organization	Alin, Taylor, and Smeds (2011)	Х	
Group-level socio-psychological interpretation	Sun and Anderson (2010)	Х	
All-stored here syndrome (Knowledge generated internally is to be used inside the firm)	Lichtenthaler and Ernst (2006)		Х
Related-out syndrome (Strong reliance on external in sourcing, omit building own capabilities)	Sun and Anderson (2010)	х	
Managerial encouragement to share knowledge	Sun and Anderson (2010)	Х	
Only-used-here syndrome (Incomplete or underutilization of existing knowledge due to fear of strengthening competitors)	Lichtenthaler and Ernst (2006)		Х
Sell-out syndrome (overvaluation of external exploitation potential and undervaluation of consequences for internal knowledge exploitation)	Lichtenthaler and Ernst (2006)		Х
Behavior output controls	Li, Lee, Li and Liu (2010)	Х	
Reward and recognition	Sun and Anderson (2010)	Х	

Table 4: Comparison of behavioral factors between the reviewed from literature and the actual emergence

The behavioral factors that do not appear in this study are: intuition, not-invented-here syndrome, all-stored-here syndrome, only-used-here syndrome, and sell-out syndrome.

Intuition (Bennet & Bennet, 2008; Crossan, Lane & White, 1999; Sun & Anderson, 2010) does not involve the identification and acquisition capability. For IT SMEs, poor decision- making means capital expenditure. The selection is to be done carefully. Intuition, heavily dependent on the knowledge and past experiences of the decision-maker. This always comes with uncertainty and prediction for market responses. Using intuition does not allow any mistakes. Thus, the decision-making based on intuition did not surface.

The not-invented-here (NIH) syndrome leads to resistance in the acceptance of knowledge from the outside (Katz & Allen, 1982; Szulanski, 1996). NIH could happen with the group whose members possessed a monopoly of knowledge in the area of specialization, enough not to consider the possibilities that outsiders may produce new ideas or knowledge relevant to the group (Katz & Allen, 1982). In this study, the NIH syndrome does not appear. This is because IT SMEs do not have their own R&D. They rely on knowledge from external sources. In this environment, NIH is not a behavioral factor that has impact on the industry.

NIH syndrome is the diametrical opposition of the Buy-in syndrome (Lichtenthaler & Ernst, 2006). NIH totally depends on internal knowledge, while Buy-in focuses on external knowledge only. For IT SMEs, the NIH syndrome has negative impact and the Buy-in syndrome compliments the positive impact on knowledge absorption.

All-stored-here syndrome has negative impact on the knowledge assimilation process. The new knowledge that is acquired and integrated with existing knowledge is used by the firm for internal purposes only (Lichtenthaler & Ernst, 2006). For IT SMEs, the absorbed knowledge will be combined with the existing trait of knowledge. The combined knowledge could exploit for the firm's advantage.

The same reason applies to the Only-used-here syndrome and the Sell-out syndrome. This is because all combined and developed knowledge are to be fully utilized. Only-used-here syndrome is the behavior that are caused by over-evaluation of external exploitation potentials (Lichtenthaler & Ernst, 2006). The Sell-out syndrome is the behavior that is evolved from the under-evaluation of consequences for internal network exploitation (Lichtenthaler & Ernst, 2006). Over-evaluation and under-evaluation result in costs and mis-appreciation on return which will severely impact the financial status of IT SMEs. Careful consideration in the identification and acquisition of external knowledge must be thoroughly examined.

Additional behavioral factors that emerged from the analysis of data and that complemented the positive reinforcement of knowledge absorption is the trust (Lane et al., 2001), together with negative reinforcements such as knowledge hoarding (Elwyn et al., 2007) and psychological safety (Cauwelier et al., 2016). These additional behavioral factors manifest in the Thai context. Negative reinforcements can be overcome by knowledge enhancing activities such as the building of trust relationships and the development of a learning mindset. According to Lane, Salk, and Lyles (2001), the transfer of knowledge between two parties requires active engagement of the transferrer and the recipient, as well as the supportive cultural and cognitive preconditions. Trust is a critical part of knowledge transfer because it helps the knowledge recipient to understand the knowledge the transferrer is offering. Trust has two dimensions that are relevant to transferring and learning. First, it is the willingness to risk vulnerability, which requires openness and sharing of valuable secret (Inkpen & Beamish, 1997). Second, is the confidence that the transferred knowledge will impact the adoption and taking of actions over the new transferred knowledge (Barney & Hansen, 1994). "The greater the trust in the relationship, the more willing all parties will be to share and exchange information" (Lane et al., 2001: 1141). Trust also helps lower the costs and the need to monitor behavior when the transferred knowledge is being implemented (Edmondson, 2014). Trust is considered a relational capital (Lichtenthaler, 2008) or social capital (Macpherson & Holt, 2007). It is a socio-psychological learning factors that involves changes in cognition and behavior (Sun & Anderson, 2010). From this study, trust is found to have important influence on the efficacy of the knowledge transfer. Companies in the case studies allocate time and cost for their employees to build trust between their supporting suppliers and partners, as well as their customers.

Knowledge hoarding occurs when the source of knowledge (the transferrer) does not wish to transfer the knowledge to the recipient. According to Szulanski (1996), the two characteristics that could lead to knowledge stickiness were – (1) the transferrer lacked of motivation to transfer knowledge, and (2) the transferrer was not perceive as reliable. For the first characteristic, the lack of motivation comes from the fact that the source might be reluctant to transfer the knowledge. The transferrer fears that the transferred knowledge would result in losing ownership which in turns cause the lost of the privilege position or superiority. For the second characteristic, the transferrer was perceived as unreliable, resulting in the lack of trustworthiness. This makes the initiation of the transfer difficult.

When one of the two characteristics was present, knowledge hoarding might result (Koskinen, 2012). From the case study analysis, it was found that knowledge hoarding existed, especially in those firms that required extensive knowledge transfer from one team to another. The higher the number of inter-disciplinary knowledge transfer, the higher the likelihood of knowledge hoarding. To overcome knowledge hoarding, efficient practices of knowledge management is required (Elwyn et al., 2007).

Psychological safety is another behavioral factor that emerged in all cases. There are strong evidences indicating the presence of fear. These fears come from the concern of potentially humiliating oneself in public. Individuals are afraid of asking stupid questions, of using incorrect grammar, or of using inappropriate words when communicating in English. The fear of losing face dominates their actions and prevents these individuals from taking actions. The simplest way to overcome these fears is to use gatekeeper as the language translator when communicating for knowledge transfer. The size of the learning group can be kept small. Segregating transfer recipients and arranging them into transfer groups comprising the same knowledge discipline helps to overcome fear as well.

6 CONCLUSION

The purpose of this study is to explore the behavioral dimensions that impact the development of firm's absorptive capacity. The study looks into the internal capability elements of absorptive capacity and explores the behavioral factors that influence each element. Behaviors that are found to exist from the study are compared with the behaviors that are discussed by many scholars from the literature review. There are some factors that co-exist, some do not exist, and some surfaced only in the study.

The co-exist behaviors are common behaviors found in any business environment when developing absorptive capacity in firm.

The non-existence behaviors are the specific behaviors that only existed in high dynamic market, such as IT SMEs. This answers the RQ1, led to the following proposition.

P1: In highly dynamic market, these behaviors have no significant to the development of firm's absorptive capacity. These are intuition, not-invented-here syndrome, all- stored-here syndrome, only-used-here syndrome, and sell-out syndrome.

The behaviors that only existed in this study but not exist in the review of literature of behaviors belong to specific local culture. This gives the perspective of Thai IT SME culture and provides answer to the RQ2, which leads to the following proposition.

P2: In Thai IT SMEs, psychological safety strongly prevails and impacts the development of absorptive capacity. These behaviors are the fear of communicating in foreign language, the fear of asking questions and providing feedback in front of large crown, and fear of losing face by asking stupid questions or act of stupidity.

6.1 BUSINESS IMPLICATION

The study on the impact of behaviors to the development of absorptive capacity in highly dynamic markets revealed the guidelines for IT SMEs. First, the trust relationship is crucial to successful building of firm's absorptive capacity. Firm should focus on the process to the development of trust relationship.

Second, learning mindset is the core competitive behavior that leads the firm in highly dynamic markets to adopt to the turbulence of changes. Firm should consider implementing and embedding the learning mindset into the company culture.

Third, reward as incentive can be applied to improve the efficacy of absorptive capacity development. However, price incentive may also reveal the negative impact when the target-orientation is used as the evaluation criteria as awarding involves comparison with others.

Fourth, there are negative influencers that deteriorate the efficacy in the development of absorptive capacity.
These factors include the local fear factors that are stemmed from the psychological safety, such as fear of using foreign language in communication, fear of asking question, fear of providing feedback, fear of expressing ideas in front of large crown and fear of losing face from acting with stupidity.

Last, Knowledge hoarding may also exist when knowledge transfer involves the cross- boundary of inter-disciplinary network. Knowledge hording may be overcome by the implementing of knowledge management practices.

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SOFT SKILLS: THE HARD CORE OF THE HUMAN CENTERED KNOWLEDGE ECONOMY

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ABSTRACT

Technology is changing the world and deeply impacting economies, people and societies. Yet large segments of education and the workforce remain anchored in unwavering outdated hard disciplinary approaches that are undermining productivity and obstructing the potential of people's contribution and the need for change. Postponing attention on the paradigm shift from the hard resources and process focus to the development of human capital secured in talent discovery and cultivation may cause significant drawbacks. The paper presents a way out of this dilemma by suggesting a common denominator of new methodologies in training, coaching and deployment of soft skills: The outcome will only be beneficial if they are not taught and developed on a standalone basis, but in close junction with hard-core standards in management and performance assessment. The topic is addressed from the dimensions of education, industrial/administrative implementation and business ethics.

Keywords: Soft skills, workforce, human capital, human centered management, knowledge economy

KEY FINDING(S)

Key findings from this paper, to reinforce the importance of Soft Skills as a useful capability for practitioners in business and as background for educators. Such findings include:

- The survey conducted in this study confirms that Soft Skills are perceived as most important among corporate leaders; it also infers that in many workplace situations hard skills alone may be meaningless without soft skills.
- Soft skills are becoming recognized to be the "glue" that ties the traditional skills together.
- Soft Skills are equally critical as they can assist with the changing attitude of the workforce by finding solutions for the next generations desire for work/life balance.
- For computer programmers, Soft Skills mixed with technical skills are viewed as more critical than specific business skills by IT professionals who have programming experience.

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- Current accounting education and the skill levels of accountants are not in line with what is required in the environment of global business.
- Soft Skills has direct effect on planning and budgeting, by the effect of conceptual thinking on collecting and organizing information.
- Soft Skills provide a crucial role for engineers as technical work is becoming more and more collaborative and interdisciplinary, two Soft Skills that to been mostly ignored by educators.
- Findings show that software development has been converted from a solitary task to one that only can thrive if done in teams, which makes Soft Skills critical for team engagement.
- Findings that undergraduate students are not engaged with current attempts at teaching of employability skills as they are taught discretely and not integrated with relevant examples.

IMPLICATION(S) FOR THE PRACTICE OF SMEs

Despite these and other key findings employers continue to report that graduates are not ready for the world of work, and lack some of the most basic Soft Skills needed for successful employment.

Today many engineering education programs fail to give appropriate training in Soft Skills.

Much of the implication are connected to limited or no Soft Skills training and education. At the core of the Education challenges is the acceptance that our educational communities' preparation for our workforce and business have been focused too narrowly on the technical skills and traditional business techniques. Furthermore, what education there is tends mostly toward discrete classes on employability skills, ethics, diversity, and similar topics which are taught in a vacuum and not integrated in the relevant traditional topics such of business or the craft or professional trade environments. This is especially a problem for the new generation of workers who want relevance in their training and education; "why is this important to me?"

Schools that really wish to prepare future managers in different disciplines must close the gap between the skills acquired by its graduates and the skills required by the global markets. It is Soft Skills education that will help businesses and skilled professional institutions to cope with the changes brought about by the rapid spread and acceptance of globalization and the enormous developments in information technology.

A strategic plan is needed that recognizes the integration of Soft Skills with the hard/technical skills and relevant aspects of the workplace for education to close the gap between the acquired and required skills.

Soft Skills require more than just traditional teaching, as Soft Skills are not simply information or knowledge but are truly complex skill which require application, practice, evaluation, feedback and development over time. A program that blends students across several years of a program integrated with case studies and project based learning where the relevance of the Soft Skills and their interaction with more traditional skills can be experienced. There is some examples which have shown of value in various schools, such as previously described in the paper, e.g. Linköping University in Sweden, where they have developed a completely new course "Professionalism for Engineers" that mixes students from across different year groups over 3 year period. Such a program gives students understanding of importance of Soft Skills during the engineering education as well as during their professional career.

The challenge that faces trainers and educators today is the lack of clear, operational definition of Soft Skills, challenge of consistent methods of evaluating Soft Skills, complexity of teaching and developing Soft Skills and finally, gaining acceptance in the workplace about continuing and fostering their development by supervisors and managers. Too often an employee who has limited Soft Skills and looks for help gets limited guidance on how to improve their problem and are told they either need to try harder or they have a bad attitude. This is as a result of supervisors lacking Soft Skills or even understanding their lack of them.

INTRODUCTION

The growing significance of the soft skills topic can be demonstrated by inspecting peer-reviewed papers in management journals. Using database "SCOPUS®" by Elsevier (http://www.elsevier.com/online-tools/scopus) to search papers with "soft skills" in titles, abstracts or key-words, 15 soft skills concepts came up in a recent research (Fig. 1).



Figure 1: Evolution of main soft skills concepts in management literature (number of topics) Source: Massaro, M., Bardy, R. & Garlatti, A., 2016.

The following list (Table 1) gives a brief overview of how the concepts are used in the papers.

Table 1: Definitions "soft skills" in the literature

"Soft skills" items/field	Authors recently published	Main words/concepts used by authors			
Idea creation ability	Bailly and Léné, 2013; Bajada and Trayler, 2013; Baron and Morin, 2010; Barraquier, 2011; Bodell, 2014; Griffith and Hoppner, 2013; Kahlon, 2013; Massaro et al. 2014	Problem Solving, Creativity and Self-Confidence: Intuition, Flexibility, Imagination, Ingenuity, Inventiveness, Creativity			
Coordination ability	Barraquier, 2011; Bedwell et al., 2013; Falconer and Pettigrew, 2003 Kahlon, 2013; Parente et al., 2012; Tyagi and Tomar, 2013; Weber et al., 2009	Collaborative Skills, Ability to Communicate and Interact with Others, Interpersonal Relations and Communicati- ons, Work in Groups and Team, Collaboration, Cooperation, Help, Contribution, Communication, Dissemination, Influence, Relationship Connection, Correlation, Team Environment, Staff, Units			
Multicultural ability	Andrews and Higson, 2008; Bailly and Léné, 2013; Bajada and Trayler, 2013; Barraquier, 2011; Bodell, 2014; Griffith and Hoppner, 2013; Haro and Turgut, 2012; Massaro et al., 2014; Mirchandani, 2012; Neely and Tucker, 2013; Rao, 2013a; Nilsson, 2010; Tilley et al., 2012; Velasco, 2012	Global Expertise / Multicultural, General Culture, Networking, Global Context, Character, Complexity Skills, Languages, Interaction, Knowledge, Learning, Scholarship, Social Network, Workplace, Environment, Personality, Inclination, Mind, Mind Multiplicity, Variety, Variability, Multiplicity			
Planning ability Ashcroft, 2004; Bailly and Léné, 2013; Bodell, 2014; Falconer and Pettigrew, 2003; Griffith and Hoppner, 2013; Rao, 2013b; Tyagi and Tomar, 2013; Weber et al., 2009		Ability to cope with Uncertainty, Plan, Strategy and Strategic Planning, Change Indeterminacy, Vagueness, Indecision, Ambiguity, Organization, Planning, Design, Skills, Tactics, Cunning, Change, Change, Renewal, Innovation			
Learning ability	Bell, 2012; Bixby, 2012; Crosbie, 2005; Griffith and Hoppner, 2013; Haro and Turgut, 2012; Kahlon, 2013; Neely and Tucker, 2013	Learning to Learn, Willingness To Learn And Accept Responsibility, Acquire, Understand, Learn, Experience, Aspiration, Awareness, Maturity, Will			
Professionalism	ElShenawy, 2010; Fletcher et al., 2014; Garwood, 2012; Griffith and Hoppner, 2013; Kahlon, 2013; Rao, 2013b; Tyagi and Tomar, 2013	Professionalism, Reliability, Stress Management, Time Management, Seriousness, Commitment, Competence, Trust, Secure, Stress, Endeavors, Urgency, Indepen- dence, Run, Self-Management			
Leadership	Barraquier, 2011; Bell, 2012; El Shenawy, 2010; García-Sánchez et al., 2013; Kahlon, 2013; Rao, 2013b; Tobin, 2007; Trompeter et al., 2013	Employee Motivation, Leadership and Influence Boost, Encouragement, Management, Command, Direction, Principles-Based, Governance			
Information management ability	Walker et al., 2008	ICT Competences, Decision-Making, Information Management, Boost, Encouragement, Management, Command, Direction, Principles-Based, Governance			
Ethics	Baden, 2013; Bajada and Trayler, 2013; Barraquier, 2011; García-Sánchez et al., 2013; Kahlon, 2013; Rao, 2013b; Shadnam and Lawrence, 2011; Soltani, 2014; Su, 2013; Tilley et al., 2012; Trompeter et al., 2013	Ethics, Morality, Integrity, Customs, Norms			
Communication ability	Fletcher et al., 2014; Garwood, 2012; Kahlon, 2013; Mirchandani, 2012; Parente et al., 2012; Robles, 2012; Sullivan and Kedrowicz, 2012; Tyagi and Tomar, 2013	Written and Verbal Communication Skills, Communication, Relationships			
Social responsibility	Baden, 2013; Bailly and Léné, 2013; Bajada and Trayler, 2013; Kahlon, 2013; Walker et al., 2008	Social Responsibility, Stakeholder Integration, Sustainable, Development, Community Relations			

"Soft skills" items/field	Authors recently published	Main words/concepts used by authors		
Entrepreneur- ship develop- ment	Andersen et al., 2006	Guidance, Entrepreneurial Abilities, Creativism		
Collaborative governance	Shih et al., 2010	Participative Competences, Humanistic, Management, Bottom-Up Involvement, Alignment, Interaction		
Sustainable Development	(Baden, 2013; Clarke, 2008)	Integrative Resource Use		
Dealing with others	Bailly and Léné, 2013; Baron and Morin, 2010; Bedwell et al., 2013; ElShenawy, 2010; Falconer and Pettigrew, 2003; Kahlon, 2013; Parente et al., 2012; Robles, 2012	Rule-finding, Discourse, Dealing with Conflictive Environments, Reflection, Inquiry and Advocacy, Involvement, Interaction, Alignment		

This list of definitions reveals the width of the abilities that are needed for successfully working and leading in competitive environments. But there is an additional requirement: It is about alignment with the demands of the Knowledge Economy. The soft scores must be integrated with the hard scores of physical and social sciences to a much deeper extent. For this, it is essential to connect soft skills education and training to a broad spectrum of applications covering all sectors of the economy and society. Only then will the development of soft skills facilitate social and economic progress, because only then progress will be propelled by the empathetic people who have the capacity to seek and optimize opportunities in the global VUCA (volatile, uncertain, complex, ambiguous) environment in our fast-changing world (Ochoa, Lepeley & Essens, 2018). Moreover, studies report that today in less than a decade, students forget hard skills they learned in business schools because they become obsolete (e.g., Teichler, 2009; OECD, 2012). In contrast, soft skills are long lasting, transferable across different industries and cultures, and applicable in countries around the world.

A SOFT SKILLS FRAMEWORK FOR CONDUCIVE ALIGNMENT WITH HARD SCORE KNOWLEDGE

Aligning soft skills training and development with the demands of the Knowledge Economy requires a new rationale that corresponds with the fundamental principles of human centered management, i.e., emphasizing human relationships, placing people at the center of concern, and paying attention to issues of trust and emotion. We present a model that accentuates the urgency to integrate Soft skills along the continuous stream of education and of workforce training. The effort must span from the lowest education levels to executive suites to achieve that team building is strengthened, organizations are becoming agile and that engagement and work satisfaction are enhanced. This will boost individual and organizational performance and productivity in countries around the world. One example that this foundation reaches beyond the Western world is the accent which Chinese business literature has laid on the human centered paradigm early on (see, e.g., Sheng, 1979; Menkhoff, 1993).

The framework we propose is based on a research continuum of soft skills using multi-dimensional projections and multidisciplinary approaches on how to complement soft skills with deployment of hard skills for improving outcome and results of work in any discipline. We believe that research on soft skills, placing them as central elements of management in the 21st century have not received necessary attention (see Murti, 2014; Cinque, 2016),

and this is largely so because soft skills involve more complex human behavior and are more difficult to teach, transmit and measure than hard skills. Yet it is increasingly evident that without soft skills the performance of people in the Knowledge Economy is curtailed as is organizational competitive level. Moreover, since the "hype" towards Artificial Intelligence suggests that this can substitute hard human skills to a significantly higher extent than soft skills, there is again a tendency to neglect the topic (Brundage et al., 2018). But soft skills will remain strengthening human participation in production processes.

Multidisciplinary literature confirms a fast increase in the exploration of soft skills (as elucidated through Table 1), but practical research is lacking (Adams, 2014; Cerezo-Narváez et al., 2017), and it is necessary to bridge deep gaps between disciplines, sectors and industries. Therefore, we concentrate on applicability in business, the workforce in general and in government/public service institutions. The main concern is that soft skills, like other cognitive skills, cannot be merely memorized but must be developed, practiced and strengthened over time. And we wish to point out that the impact of soft skills can only be properly demonstrated if including results of effective integration with hard skills. This comprises assessment of individual and organizational indicators and performance standards, output/outcome, decentralization, and constructive competition. Our argumentation is going along the following lines:

Performance standards – Introducing collaborative methods to collectively develop and implement objective performance measures identifying clear goals, targets and indicators for improvement. Criteria for performance assessment leading to output / outcome assigning increased individual responsibility through decentralization and internal collaborative competition.

Output/outcome – Targeting and engaging all stakeholders concerned with assessment to develop and implement processes and standards to measure output and outcome. Assessment criteria must be based on a balanced mix of qualitative and quantitative performance indicators.

Decentralization – As staff members become empowered and encouraged to use their Softs Skills, the expectations are set for a shift from a hierarchical management system to a decentralized system in which managers are increasingly responsible for output/outcome to make the organization agile expediting change the workforce needs to optimize benefits and minimize costs of unavoidable disruptions.

Constructive competition – Enhancing professionalism, increased reliability, learning to cope with uncertainty and work under pressure, upgrading long-term planning competencies and communication skills, benchmarking and constructive competition between departments or agencies with high potential to be effective incentives for improvement aiming to lower cost of production, eliminate waste and achieve quality standards of work performance and service delivery.

Tangible results like those listed above will also depend on the appropriate instrumentation of communication skills. They need to obey an ethical principle, which is universal moral respect. This implies recognizing the right

of all human beings to speech and actions to participate in any conversation. The principle of egalitarian reciprocity in conversations is about providing symmetrical responsibilities and rights to all speakers; to give everyone a chance to initiate new topics and reflections about conversations (Benhabib, 1993). These "rules of the game" are to be embedded in soft skill- and communicative abilities in the workforce and society.

In order to analyze how both the soft and the hard core-sides of soft Skills implicate, a survey was undertaken with participants of an executive education course. "Performance" was measured proxy by assessment of tangible and intangible outcomes of business processes and stakeholder relations that were drawn on human centered management.

A SURVEY ON SOFT SKILLS OUTCOMES

The survey set out from the question of whether soft skills connect to business processes and to stakeholder relations and how they are built and managed in a firm. There should be impacts on corporate performance as, per minimum, soft skills are likely to encourage open communication, problem solving, knowledge sharing and creativity among employees (the organizational capital); enhance interactions and relationships with suppliers, customers and other stakeholders (the relational capital); and retain talent (the human capital).

Another input into the survey was the issue of how knowledge on ethics transcends into business behavior and business processes. The knowledge built up from business ethics can help to improve human centered decision-making by providing managers with the appropriate knowledge and tools that enable them to correctly identify, diagnose and analyze human relation problems and dilemmas. An ethical concept of how to deal with knowledge needs to depart from defining knowledge as *justified true belief* (Goldman, 1979) and knowledge creation as the "dynamic human process of justifying personal beliefs as part of an aspiration for the truth" (Nonaka, 1994: 15).

The ethical concept of knowledge management transforms into a practical panorama through five fundamental effects (McElroy, 2003):

Overcoming tacitness and complexity within and between corporations – individuals must be guided in their various roles to fundamentally rethink their work patterns, relationships and cognitive frameworks.

Extending enterprise and networks – be it "knowledge communities", "knowledge chains", "knowledge suppliers," or "knowledge markets" (Gilsing, 2006), the foremost requirement is that their participants interact free from affectation or disguise; without this, all modern networking techniques will not produce the desired outcomes.

Practicing a "learning organization" (Senge, 1994) – each person dealing with others must command personal mastery, mental models, shared vision, team learning, and systems thinking.

Working with multi-faceted and parallel approaches ("ambidextrous learning"; Kang & Snell, 2009) – progress can be achieved only by simultaneously exploring new knowledge domains while exploiting current ones (Kang & Snell, 2009).

Maintaining continuous connectivity and communication – beyond state-of the art technology, a methodical approach is required for updates, feedbacks, inclusion in surveys, etc.

All five aspects delineate essentials of business ethics and will level up human capabilities in a firm and its organizational structure. It will thus alter a firm's intellectual capital of which human capital and structural capital are the two major categories, with relational capital as a third category of its own (see, e.g., Sullivan, 2000; Firer & Williams, 2003). Structural capital has been divided into the two subcategories of organizational capital and customer capital (Edvinsson & Malone, 1997; Bontis, 1998); however, this composition is mainly applied to serve the purpose of attempting a valuation of intellectual capital (Ariely, 2005). When using a categorization that places relational capital at the side of structural and human capital, we get closer to corporate strategizing: The role of all stakeholders is taken into account explicitly (beyond just "customer capital"), and when corporations earnestly consider stakeholder interests, we arrive at a view on stakeholder relations that has been called a "synthesis of ethics and economics" (Jones, 1995). This instrumental approach, rather than a descriptive or a normative approach, is based on the connections between stakeholder management and the achievement of corporate goals, most commonly profitability and efficiency goals but ethical goals as well (Donaldson & Preston, 1995). The argument is for stakeholder management to be both a means to an end, contingent on the value of stakeholder relationships to corporate success, and a means to deploy instrumental ethics as an addendum to the rule of creating wealth. This makes ethics a business case: managers perceive that "good ethics" is "good business" and that employing ethics in stakeholder relations increases firm value (Solomon, 2007; Quinn & Jones, 1995).

Making the participants aware of the issues and interrelations laid out in the preceding paragraphs was one fundamental step before conducting the survey. The other fundament was a model that depicts the interaction between ethical/moral reasoning and outcomes of business activities.

The ingredients of human centered enablers of corporate performance: A model of interaction

The model that was presented for the participants of the survey had been solely conceived for surveying the views of high-level managers attending the executive education course. It may be valid in a European and perhaps in a North American context, but not in others – even though, as said in the Introduction, human centered management is a distinctive feature, for example, in Chinese businesses. Another disclaimer would be that the proof of the model's validity may have been influenced by the setting of the survey: it was a course on ethical leadership, and this certainly influenced the answers to the questionnaire.

The model endeavors to measure the effect of human centered management in a firm by gauging the impact of an awareness of soft skills deployment on business processes and stakeholder relations.

Four ingredients to corporate performance are shown in the model:

(1) A code of ethics that serves to guide employees', managers' and executives' behavior, (2) conscientious management of stakeholder relations, (3) knowledge management procedures that are enhanced by the mutual respect, and (4) business processes that are conducted along the same lines. The four interact with each other and with corporate performance.

The term "corporate performance" is not defined in the model – it may represent financial performance or market share or share-value. This ambiguity allows a flexible application, above all, when used for a qualitative investigation. The model is shown in Figure 2:



Figure 2: Direct and indirect effects of soft skills elements on corporate performance Source: Authors

From there, the first four questions were drawn:

- Q1: How do code of ethics statements affect business process performance?
- Q2: How do code of ethics statements affect stakeholder relations?
- Q3: Is there a relationship between code of ethics, soft skills like communication, creativity enhancement, etc. and knowledge management?
- Q4: How do code of ethics statements affect overall corporate performance?

Likewise, it is assumed that knowledge management procedures which are enhanced by soft skills will improve business process performance and also have a direct effect on overall corporate performance.

This produces three more questions:

Q5: How does soft skills-enhanced knowledge management affect business process performance?
 Q6.1: How does soft skills-enhanced knowledge management affect overall corporate performance?
 Q6.2: How does soft skills-enhanced knowledge management affect stakeholder relations?

It is also assumed that conscientious stakeholder management has an effect on business processes and that, vice versa, business processes that are enhanced by soft skills affect stakeholder relations. Similarly, conscientious stakeholder management has a direct effect on corporate performance.

The corresponding questions are:

- Q7: How do soft skills-enhanced stakeholder relations affect business process performance (Q7.1)? Is there a reverse effect as well (Q 7.2)?
- Q8: How do soft skills-enhanced stakeholder relations affect overall corporate performance?

An unmediated effect is assumed for business processes: if they are conducted in alignment with corporate ethical standards, corporate performance is affected directly:

Q9: How do soft skills-enhanced business processes affect overall corporate performance?

The questions were submitted to several groups of executives attending an ethical leadership course in Switzerland by way of a questionnaire they received at the end of the course. The survey followed a self-assessment approach based on a scale of 1 to 5, where respondents were asked to assess their opinion on the effects of the ethics code in their firms (all respondents' firms have a written ethics code), of their knowledge management procedures, of their stakeholder management and of their business processes.

The main result of the survey is reproduced in Tables 2 and 3. Quantitative statistics are not given here – for a detailed discussion of the results see Bardy, 2015. But the tables delineate quite distinctly to where ethical leadership and knowledge management that is enhanced through soft skills can lead with regard to process performance, overall performance and stakeholder relations.

Table 2: Soft Skills Effects (I) on Business Processes (Source: Bardy, 2015)

Description
Business Process Performance
Effects in terms of less friction at process interfaces
Effects in terms of increased speed of business processes
Effects in terms of improved output quality
Effects in terms of increased process re-engineering efforts
Effects in terms of less costly processes
Effects in terms of higher transparency of business processes
Stakeholder Relations
Effects in terms of more dialogues with stakeholders
Effects in terms of stakeholder groups reporting more issues of affectedness
Effects in terms of more social networks connecting with the corporation
Effects in terms of customer management processes becoming more transparent
Effects in terms of supplier management processes becoming more transparent
Effects in terms of industrial relationship processes becoming more flexible

Table 3: Soft Skills Effects (II) on Knowledge Management and Corporate Performance (Source: Bardy, 2015)

Description
Effects in terms of
having knowledge management procedures implemented that are clearly connected to what is said in the ethics code about how to apply communicative skills and respect for others;
clearly relating that implementing a code that spells out how to apply communicative skills and respect for others has improved overall corporate performance directly;
the statements how to apply communicative skills and respect for others on producing an indirect effect on corporate performance through realizing improved knowledge and business process management.

In summarizing the results with regard to business processes, the survey reveals that there are effects in terms of higher transparency, of less friction at process interfaces, of increased speed of business processes, of improved output quality and of less costly processes and in terms of increased process re-engineering efforts. As far as stakeholder relations are concerned, effects were found in terms of more dialogues with stakeholder groups, of stakeholder groups reporting more issues of affectedness and effects in terms of more social networks connecting with the corporation. Combining processes and stakeholder relations, there are effects in terms of customer and supplier management processes becoming more transparent and effects in terms of supplier management processes becoming more transparent as well as effects in terms of industrial relationship processes becoming more flexible. The use of this can be threefold: (1) for the theoretical discussion, (2) for the teaching of business ethics, and (3) for practical consequences within corporations.

WIDENING THE PERSPECTIVE

In the survey that was exhibited above, implicit relations between soft-core and hard-core knowledge were displayed. But there are very explicit relations as well. The effects of soft skills on mastering hard-core knowledge are often emphasized in studies that exhibit the perception of business executives. An example is Robles (2012). The survey conducted in this study not only confirms our own findings that integrity, communication, courtesy, responsibility, social skills, positive attitude, conceptual thinking, flexibility, teamwork, and work ethic are perceived the most important among corporate leaders; it also infers that in many workplace situations hard skills alone may be meaningless without soft skills. This relates, e.g., to the effect which conceptual thinking has on collecting and organizing information for planning and budgeting, or to the routines of software testing that need positive attitude skills towards the software developers (Robles, 2012: 460). All of this, though, is connected to soft skills training, which takes us to the broader aspect of education.

It is soft skills education that will help businesses and other institutions to cope with the changes brought about by the rapid spread and acceptance of globalization and the enormous developments in information technology. Education, here meets must challenges which are similar to those encountered by business. At the core of these challenges is the grudging acceptance that education, training and in general the focus of our educational communities preparation for our workforce and business focus of in service training have been focused too narrowly on the technical skills and traditional business techniques. As soft skills are becoming recognized to be missing in workers across all disciplines and communities, they are as well recognized to be the "glue" that ties the traditional skills together. And they are indispensable as they can help with the mobile and changing attitude of the workforce by assisting with changing jobs, evolving processes and finding solutions for the new desire for work/life balance. Business schools that really wish to prepare future managers in different disciplines must close the gap between the skills acquired by its graduates and the skills required by the global markets. For academia to respond to these external stakeholder needs curricula must be reexamining in light of how degree programs, particularly in management, are preparing students for new demands of the workplace. One example of the issues to be encountered across several disciplines is Mohamed and Lashine's (2003) description of the accounting education providing students with the knowledge and skills that raise their competency level. Current accounting education and the skill levels of accountants are not in line with what is required in the environment of global business where, e.g., cultural differences have a strong influence on the application of what is deemed to be uniform standards. This has been a long-standing issue (see Beechy, 1999), but it has taken several years to come up with answers that include the soft skills side as well (see, e.g., Cole, Branson & Breesch, 2012; Haller & Wehrfritz, 2013).

A strategic plan, in general, is needed for education of whichever kind to close the gap between the acquired and required skills. Many higher education institutions include what is called elements of employability skills within their curricula. However, employers continue to report that graduates are not ready for the world of work, and lack some of the most basic skills needed for successful employment. Research into why this might be abounds from the perspectives of multiple stakeholders, made up of government, employers, higher education institutions and graduates. One researcher, Tymon (2013), reports the views of over 400 business studies, marketing

and human resource management undergraduate students about employability. Findings suggest there is only limited alignment between the views of students and other stakeholder groups. So the question is raised as to whether undergraduate students are engaged with employability skills development. This could be an important clue, because learning theory tells us that motivation and commitment of learners is an essential prerequisite for effective outcomes. They report differences between first, second and final year students, which could explain an observed lack of engagement with employability-related development.

In the "hard-skills world" of computer programming, as the competition increases, the development of skills leading to increased job performance becomes more important for these employees. Research by Bailey and Mitchell (2006) has identified a combined skill set of technical, business, and soft skills needed by computer programmers. Two hundred twenty-seven IT professionals evaluated the knowledge, skills, and abilities needed by computer programmers via a web-based survey. Findings indicated that although an eclectic mix of skills is needed for computer programmers, technical and soft skills are viewed as more critical than specific business skills by IT professionals who have programming experience. In addition, the more broad-based skills, which cut across languages, platforms, and tools, are viewed as most important. The identified skill set can be used as the foundation for designing information systems curricula. The topic was picked up again Ahmed et al. (2013) who highly corroborate the earlier findings because by then software development had been converted from a solitary task to one that only can thrive if done in teams.

In another study from the field of technology, the crucial role of soft skills for engineers has been recognized as technical work is becoming more and more collaborative and interdisciplinary (Kumar & Hsiao, 2007). Today many engineering education programs fail to give appropriate training in soft skills. One program at Linköping University has developed a completely new course "Professionalism for Engineers" that stretches over the first 3 years with students from across different year groups taking it together. The purpose of the program is to give engineering students training in soft skills that are of importance during the engineering education as well as during their professional career. The organization of the course is innovative in many ways, such as having mixed groups with students from year 1, 2, and 3, with each group having a teacher mentor and an examination process based on the Dialogue Seminar Method which was developed for learning from experience and through reflection (Berglund & Heintz, 2014).

CONCLUSION

This paper discusses the soft skills potential to increase effectiveness of human interaction within and beyond organizational strengthening ethical foundations of moral respect and egalitarian reciprocity. It substantiates the relation between soft skills and organizational goals aimed to facilitate assessment of high-level managers across sectors and organizations to integrate productive processes and service chains within and beyond organizations. Highlighting the study that was performed for this paper is the proof that the hard core of soft skills and their multiplier effects have a substantial impact on professionalism, reliability, ability to cope with uncertainty, work under pressure, plan and think long-term, communicate effectively, interact with others assertively in written and verbal communication. This comes by using soft skills to augment personal talents, creativity,

self-confidence, self-management, engagement with work, and willingness to deploy quality standards, and it will work best when in synch with optimal selection and application of information technology. It is hoped that this study contributes to the increasing testimony that, by soft skills deployment, organizations can optimize employees' engagement leading to organizational agility, effectiveness, improvement in risk management and the digital dimension.

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INDEPENDENT PROFESSIONALS: KNOWLEDGE-INTENSIVE WORK BETWEEN THE PROFESSIONS AND NEW EXPERT OCCUPATIONS

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ABSTRACT

Independent professionals (iPros) constitute a growing portion of the labour market in knowledgebased (business) services (KBS) and professional occupations. They work as self-employed workers without employees, sell specific knowledge-intensive (intellectual) services in external labour markets outside of standard employment relationships and contribute, among other things, to the innovative capacity of other companies. As part of the self-employed workforce they practice traditional 'liberal' professions (lawyers, doctors, journalists etc.) as well as new expert occupations (consulter, software developer etc.). By drawing on time series data from the Austrian labour force survey (LFS) this paper presents growth trends for iPros in knowledge-based service sectors and professional occupations in Austria for the time period 2004 to 2017. The results show that iPros are the fastest growing group on the Austrian labour market.

Keywords: independent professionals (iPros), freelancer, solo self-employment, knowledge-based services, entrepreneurship

KEY FINDING(S)

- (Solo-) Self-employment in knowledge-based service (KBS) or knowledge-intensive (business) service (KIBS) sectors is growing faster than in other (service) sectors in the Austrian economy. The number of self-employ-ed people without employees ("solo self-employed") in these sectors has increased on average by 3% annually between 2004 and 2017 compared to -1.7% in the industry/commerce sectors and 2% in other service sectors.
- These solo self-employed people are highly skilled and educated individuals who work in knowledgebased/professional occupations. According to occupational classification system (ISCO-88 and ISCO-08) we have shown that the number of solo self-employed people in academic occupations or professions has also increased considerably in the time period from 2004-2010 (4.8%) and from 2011-2017 (3.1%) in Austria.

1) Department of Sociology, Alpen-Adria University Klagenfurt, Austria This knowledge-intensive segment of the workforce (Independent Professionals – IPros) is not homogenous, but consists of different occupational groups and forms of service provision. They include new expert occupations as well as traditional (liberal) professions that are pursued in the form of a solo self-employed practitioner.

IMPLICATION(S) FOR THE PRACTICE OF SMEs

A highly skilled and creative workforce is seen as a main driving factor for innovativeness in the knowledge economy, where ideas and knowledge are the engines of economic growth and prosperity. As self-employed workers without employees Independent Professionals (IPros) sell their specific knowledge-intensive (intellectual) services in external labour markets outside of standard employment relationships and mostly outside of or in-between organizational boundaries. They can contribute to the competiveness and innovativeness of the SME sector in Austria by providing their services to SMEs in different knowledge-intensive fields (e.g. software, advertising, consulting).

Independent professionals as solo self-employed people working in knowledge-intensive service sectors can be seen as a facilitator for the digital transformation of SMEs. With their expert knowledge they can provide specific knowledge inputs for digitalization projects carried out by companies without having to build it up internally first. For example the production of a digital product or service often requires specialized knowledge in software programming or marketing know-how that is not immediately available in the company. Independent professionals make it possible to access this needed knowledge quickly through the market without having to develop this expertise in the organization first. Thus, they liberate SMEs from internal limits and enable them to draw on diverse skills and knowledge available in the market. In a fast changing business environment they enable SMEs to use expert knowledge for specific projects without having the costs associated with employing these people long-term.

1 INTRODUCTION

The nature of work and the institutional structure in which work is performed have changed multiple times throughout history. With the evolution of digital technologies and the Internet, many of today's jobs did not exist a few years ago and routine work is likely to be automated in near future (Frey & Osborne, 2013). In this disruptive economic environment specific personal skills become important for people to secure their jobs (EPSC, 2016). A highly skilled and creative workforce is seen as a main driving factor for competitive advantage in the knowledge economy or "informational economy" (Castells, 2010) where ideas and knowledge are the engines of economic growth and prosperity (Audretsch, 2009).

Currently, the majority of workers in Europe still hold permanent contracts however, with those enormous changes in the digital economy we recognise shifts away from permanent employment relationships to alternative work arrangements such as short-term contracts, part-time work or teleworking (Spreitzer, Cameron & Garrett, 2017).

Independent professionals (iPros), mostly called freelancers in the creative industries, are at the core of these developments in workforce (Leighton & Brown, 2013). They are mobile, independent workers who provide their specific services to clients (e.g. in the areas of design, software, video, advertising, consulting) personally, independently and professionally. They offer their workforce on the external labor market outside of standard employment relationships and mostly outside of or in-between established organizational boundaries (Osnowitz, 2013). As such, they are generally classified under the statistical category of solo self-employed workers in the service sector, differing from other (solo) self-employed workers in the agricultural, commercial or trade sectors (Bögenhold, Heinonen & Akola, 2014).

2 INDEPENDENT PROFESSIONALS AS A CATEGORY OF SELF-EMPLOYED WORKERS WITHOUT EMPLOYEES

Although self-employment can be regarded as universal with regard to its employment classification, the "group" of self-employed workers is not homogenous (Bögenhold, 2019). The statistical category of self-employment contains different socio-economic groups, which are only partially covered by the distinction between the self-employed with employees ('employers') and the self-employed without employees ('own-account workers') (Dvouletý, 2018). In order to capture the different working and living situations of these types of self-employed workers properly additional or other criteria might be necessary.

A recent study conducted by the Eurofound (2017) on self-employment in Europe has shown that the self-employment workers in Europe (32.0 million) are heterogeneous in terms of economical sustainability, operational autonomy and entrepreneurialism and that they could accordingly be clustered in 5 different "groups". In two of the five clusters (employers: 7.4 million and stable own-account workers: 8.3 million) self-employed workers face favorable economic conditions, have more autonomy in their working lives and are more likely to be self-employed out of choice than of necessity. On the other hand there are two clusters (vulnerable: 5.4 million and concealed: 2.6) were the self-employed people are generally more dependent, have less autonomy over their work, lower levels of income and less job security (Eurofound, 2017: 17-20). The self-employed workers without employees are represented across all five clusters, which indicates that the diversity in this group is even more pronounced than in the group of employers.

With regard to economic sectors and occupations the report furthermore suggests that most self-employed workers in knowledge-based service sectors and professional occupations are distinctive from self-employed workers in the industry, construction or other service-based sectors and occupations (Eurofound, 2017: 21). Highly skilled and educated individuals who work on their own without any employees in knowledge-based service sectors and professional occupations are not examined in detail in the report, although the constitute a growing part of the self-employed workforce in Europe (Leighton & Brown, 2013).

One of the first studies carried out explicitly on independent professionals (iPros) in Europe defines them as "independent workers without employees engaging in a service activity and/or intellectual service not farming, craft or retail sectors (Rapelli, 2012: 11)". According to this definition of iPros, there were approximately

8.6 million people in the year 2011 that worked as micro businesses in specific professional service sectors in Europe. In terms of the total European working population this is less than 4%, but if you look at this number as a proportion of all self-employed people (employers and independent workers without employees in all sectors combined) or as a proportion of all solo self-employed, then iPros account for 26% or 37% (Rapelli, 2012: 12).

The definition proposed by Rapelli (2012) discerns iPros from other self-employed workers by classifying them according to the economic sectors in which they operate. By relying on Eurostat's NACE classification, which is a statistical classification of different economic activities, iPros can be defined in terms of particular service sectors. Therefore, iPros are all solo self-employed persons who work in knowledge-based service sectors (tertiary sector) without the retail, transportation, accommodation & food services and public administration sectors (Rapelli, 2012: 9). Such a broad definition makes it possible to statistically capture a large number of micro-self-employment in knowledge-based sectors, but does not do justice to the heterogeneity of this sector. In particular, the distinction between knowledge-intensive work that requires highly specific skills and long training periods and other personal services is not adequately shown here.

Another way of defining and estimating iPros or freelancers as they are also called is by using occupational classifications systems like the International Standard Classification of Occupations (ISCO) or the Standard Occupational Classification (SOC) System. Kitching (2015) for example defines freelancers according to the SOC major groups 1 to 3, which refer to 'managers, directors and senior officials', 'professional occupations' and 'associate professional occupations'. Occupations in these three groups correspond with knowledge-intensive non-manual work and therefore provide a criterion to demarcate iPros from other types of own-account working (Kitching, 2015: 17).

Both approaches to define iPros and empirically estimate their numbers in the current workforce are possible and have their advantages and disadvantages. In this paper we will apply first a sector-related and then an occupation-related characterization of own-account workers in knowledge-based services (Mason, 2018). This approach allows us to compare the estimates made by both definitions.

2.1 KNOWLEDGE-BASED AND KNOWLEDGE-INTENSIVE (BUSINESS) SERVICES

Knowledge-based services (KBS) or knowledge-intensive (business) services (KIBS) are central elements of the so-called "informational economy" (Castells, 2010), in which knowledge production, information processing and symbolic communication became the main source of economic productivity, growth and prosperity (Audretsch, 2009). The creation of value in this type of economy is based on (new) information technologies, which in turn depend on the capabilities for development of such technologies and their applicability in different sectors (Castells, 2010: 258).

The need for KBS arises from the unequal distribution of knowledge and information in society (Hayek, 1945). It is often the case that knowledge needed to solve certain tasks or problems is not immediately accessible. Actors possess only 'limited stocks of knowledge', whose contents and forms depend on prior individual or

organisational resources, particular development paths and social embedding in groups of individuals or organisations. In order to carry out particular tasks, actors are therefore dependent on knowledge that other actors might have at their disposal and to which one has no direct access. For example the production of a mobile application often requires specialized knowledge inputs that could not be immediately available in the company. KBS make it possible to access this knowledge relatively quickly through the market without having to build it up in one's own company.

The services supplied by KBS firms thus rely on professional knowledge or expertise relating to specific technical or functional domains, which can either be a source of information or form intermediate inputs in the products, services or production processes of other businesses (Windrum & Tomlinson, 1999: 392). Accordingly, KBS can play an important role for the innovativeness of companies in other sectors and for the innovation systems as a whole (Muller & Doloreux, 2009). K(I)BS can generally be defined as services *"that provide knowledge-intensive inputs to business processes of other organisations such as Computer services, R&D services, Legal, Accountancy and Management services, Architecture, Engineering and Technical Services, Advertising and Market Research"* (Miles, Belousova & Chichkanov, 2018: 5).

The provision of KBS to organisations can, in principle, take place in several ways. Different institutional or organisational forms of the provision of professional services have developed historically under different economic and social conditions (Barley & Kunda, 2006). Today the majority of KBS are being provided either externally by Professional Service Firms or internally by so-called corporate or organisational professionals (Muzio, Ackroyd & Chanlat, 2008). In both ways the people who provide these KBS are mainly employed and are part of an organisational hierarchy.

The traditional form in the provision of professional services although, has been the 'solo practitioner' who is self-employed and works either alone (sometimes with a small number of employees and/or family members) or with a limited number of associated partners in a partnership agreement (Pedersini & Coletto, 2010: 15). This way of providing professional services represents, so to speak, the 'prototype' of professional practice and has shaped the self-image of traditional liberal professions. To put it in the words of Hughes (1963): *"The true professional, according to the traditional ideology of professions, is never hired. He is retained, engaged, consulted, etc., by some one who has need of his services. He, the professional, has or should have almost complete control over what he does for the client"* (Hughes, 1963: 663).

Whether this ideal ever coincided with the actual reality of professional work remains to be seen. It should be noted however, that with the rapid growth of professional services and occupations during the 20th century organisational employment became the dominant form of professional practice. But with the rise of the digital economy we now see sort of a 'revival' of self-employment without employees in KBS sectors. In order to point out that iPros do not represent a completely new phenomenon they are also called sometimes "second-generation independent workers" (Bologna, 2018). They offer specific intellectual services in the KBS sectors on a freelancer basis and often collaborate with other individuals or organisations, but do not employ their own staff.

Through their specific knowledge and skills, iPros contribute significantly to generate value for businesses by helping in the development and implementation of innovative products and services based on modern information technologies (Burke & Cowling, 2015).

2.2 THE LIBERAL PROFESSIONS AND NEW EXPERT OCCUPATIONS

The provision of KIBS is dependent on people who have the necessary expertise in specific knowledge fields. Traditionally, the (liberal) professions represented the social form in which "expert knowledge" (in form of specific services) could be made available to the economy and society in general (Susskind & Susskind, 2015). A definition laid out by the Court of Justice of the European Union defines liberal professions according to activities ...

"Which, inter alia, are of a marked intellectual character, require a high-level qualification and are usually subject to clear and strict professional regulation. In the exercise of such an activity, the personal element is of special importance and such exercise always involves a large measure of independence in the accomplishment of the professional activities." (Henssler & Wambach, 2014: 8)

This definition makes it clear that the liberal professions provide knowledge-based or 'intellectual' services, which have a strong personal character and require a high degree of independence or autonomy in the performance of these tasks. Historically, the exercise of a liberal profession has meant that one was self-employed and had to sell his or her service on the market and earn income from remuneration for their personal intellectual work (Hughes, 1960: 59). Independence and personal autonomy was regarded as a prerequisite for the personal provision of services for example in the medical or legal professions. This independence in the exercise of one's profession was accompanied by a large number of legal regulations and restrictions, in particular with regard to access to the professions, professional organisation, supervision and obligations (Henssler & Wambach, 2014).

The development towards an informational economy, in which technological competence and knowledge have become central competitive factors, is closely linked to the emergence and spread of new knowledge-based or 'informational' occupations. In the second half of the 20th century or so we have seen new "expert occupations" (e.g. software developer, project managers, consulters) arise (Wyatt & Hecker, 2006). These new knowledge-based occupations were quite different from traditional "liberal professions" in their patterns of organization and delivery of expertise (Muzio et al., 2008).

Professional regulation, which is a classic characteristic of liberal professions, exists among the 'new experts', if at all only to a limited extent. Access to these new professional occupations is also hardly limited. Furthermore, the practice of new expert occupations usually does not require any predefined academic pathways and does not build on established knowledge stocks that are defined and prescribed by vocational organisations. The practice of these occupations depends rather on the individual abilities and relationships of the individual, which are sold in the form of a service either on the labour market or in the markets for goods and services.

Although, new expert occupations lack characteristic patterns of organisational or collegiate professions there are obvious similarities between traditional forms of professional work and new patterns of 'expert work' (Alvesson, 2001). Both can be categorized as 'knowledge workers' because they are involved in the production and dissemination of knowledge and information. In the traditional (liberal) professions as well as in new expert occupations people apply their "practical expertise" as a service to help their clients to cope better with specific problems or challenges (Susskind & Susskind, 2015).

This expertise comes in terms of advice or other symbolic actions and is grounded in a more or less systematic field of specialised knowledge (Hughes, 1963). Expertise in a specific field requires extensive training and substantial effort and devotion to the subject and is closely connected to the work of peers. Different aspects of knowledge (e.g. technical, procedural, tacit) relate in complex ways to produce what is called "practical expertise" and which can be seen as the core of professional work (Susskind & Susskind, 2015).

The new expert occupations do not differ from the "traditional" liberal professions in the fundamental importance of knowledge or in the relevance of "practical expertise", but rather in the way in which KBS are being provided. Thus, the difference is not in the professional specialisation or occupational organisation per se, but rather in the way in which KBS are being produced and made available to private or organisational customers. It is the "social form of professional practice" (Bologna, 2018: 199) that makes the difference between the traditional liberal professions and the new expert occupations. If the exercise of a traditional liberal profession takes place in a market environment, which is substantially different from the original professional context (e.g. the intellectual work is performed via an online platform), then the traditional professions can also be counted among the new expert occupations (Bologna, 2018: 199).

3 INDEPENDENT PROFESSIONALS (iPros) IN AUSTRIA: TRENDS BETWEEN 2004 AND 2017

Solo self-employed persons working in KBS sectors and/or professional occupations are a growing part of the economy and the workforce around the globe. The following analysis is a first attempt to explore this group of self-employed workers in Austria and thus to see whether this group is growing here as well. To analyse the number of iPros in Austria over time and to see whether iPros are increasing numerically we draw on annual time series data from the Austrian Labour Force Survey (LFS). A continuous time series from the year 2004 to 2017 is thus available and forms the basis for the following analysis.

We estimate the number of iPros in Austria in two ways. We will first apply a sector-related characterization of own-account workers in KBS sectors (Mason, 2018) and then depict the numbers of own-account workers in skilled non-manual occupations (Kitching, 2015). This approach allows us to compare the estimates made by both definitions and helps to include a wide range of different iPros.

3.1 METHODOLOGY AND DATA

The following analysis is based on data from the microcensus of the LFS, which is a quarterly sample survey collected by the Statistik Austria. The microcensus provides estimates of workforce numbers of the Austrian resident population. Around 22,500 households throughout Austria are surveyed each quarter. The microcensus is a sample with fifth rotation, which means that one fifth of households finishes the survey cycle every quarter and one fifth of new households begin it. Since the data is extrapolated, values with less than 6,000 persons are highly random and values with less than 3,000 persons are not statistically interpretable. This means that a reasonable analysis of self-employed workers at economic sectors (Ö-NACE) and occupational categorization (Ö-ISCO) is only possible at level 1 and in the occupational sub-major groups.

3.2 (SOLO) SELF-EMPLOYMENT IN AUSTRIA BY ECONOMIC SECTORS

The proportion of self-employed workers in the Austrian workforce has been relatively stable since the beginning of the 21st century. According to data from the LFS, the proportion of all self-employed workers in Austria was 11.4% in 2004 and has slightly shrunk to 10.9% in 2017. This is generally below the average of all 28 EU countries, which was 14.9% in the year 2015 (Eurofound, 2017: 7–8).

Between 2004 and 2017, the number of self-employed people with employees ('employer') in Austria has risen by 37.300 (23,2%) while the number of self-employed people without employees ('own-account workers') has increased only by 10.000 (3.9%). That means that the proportion of the solo self-employed among all self-employed persons declined slightly from 61.5% in 2004 to 57.4% in 2017. The proportion of the solo self-employed in the total employed labour force in Austria has also dropped slightly from 7% in 2004 to 6.3% in 2017.

This slow growth in the numbers of self-employed without employees within the period under consideration gives the impression that solo self-employment is a relative stable employment category. But a closer look at the three economic sectors reveals that behind the aggregate numbers divergent trends are taking place. As Figure 1 shows, own-account workers have developed differently in the three economic sectors in Austria. While the number of own-account workers in agriculture and forestry has declined sharply since 2004 and the number of solo self-employed workers in the industry is also slightly shrinking, the number of self-employed workers without employees in the services has grown markedly.



Figure 1: Change in the numbers of types of self-employment in Austria, 2004–2017

A comparison of the self-employed without employees in the service sectors with their salaried counterparts (employees) in Table 1 shows that the solo self-employed persons in the service sectors is one of the fastest growing employment categories in the Austrian labour market. While salaried employment in the services is growing on average 1.5% per year, growth in own-account workers in services is on average over 2.5% per year.

Table 1:	Employed	persons b	by econom	c sector in	Austria,	2004-2017
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	Services			Industry and Commerce			Agriculture and forestry		
	2004	2017	avg- growth %	2004	2017	avg- growth %	2004	2017	avg- growth %
Employees	2230.6	2704.1	1.49	961.9	999.9	0.30	28.8	29.1	0.08
Own-account workers	127.9	177.3	2.54	27.5	22.0	-1.70	101.5	67.6	-3.08
Employers	112.6	138.6	1.61	34.4	38.7	0.91	13.9	20.9	3.19

This rapid growth of solo self-employment in the service sector since 2004 is an indication of an on-going transformation to a service economy. However, from this figure it is not clear which service sectors are driving the growth. Therefore, a distinction must be made between KBS and other service sectors to see if the growth comes primarily from knowledge-based or other services.

3.3 (SOLO) SELF-EMPLOYMENT IN KNOWLEDGE-BASED SERVICE SECTORS

Self-employed workers in K(I)BS sectors can be specified and delimited in different ways. We define them according to an adopted list of knowledge-intensive service sectors provided by Eurostat (2016). This list has been crosschecked with other existing classifications of knowledge-based service sectors by Rapelli (2012) and Mason (2018). By using the (Ö-) NACE classification it is thus possible to estimate the numbers of the self-employed in different 'intellectual' service sectors. The following table lists those service sectors that fall under knowledge-based/intensive services and are referred here as knowledge-based service (KBS) sectors:

(Ö-) NACE code	Business Type	
<j> (58-63)</j>	Information and Communication	
<k> (64-66)</k>	Financial and Insurance Activities	
<m> (69-75)</m>	Professional, Scientific and Technical Activities	
<p> (85)</p>	Education	
<q> (86-88)</q>	Human Health and Social Work Activities	
<r> (90-93)</r>	Arts, Entertainment and Recreation	

Table 2: KBS sectors by (Ö-) NACE code

In comparison to Rapelli's definition of iPros sectors, we slightly narrow down the scope of service sectors included and thereby limit them to business types proposed by Mason in his paper on Entrepreneurship in know-ledge-based services. We have therefore excluded the sectors "Real Estate Activities (<L>)", "Administrative and Support Service Activities (<N>)" and "Other Service Activities (<S>)" from our delimitation of KBS sectors. In order to make a distinction between KBS and other service sectors, these sectors just mentioned, together with the sectors "Wholesale and Retail Trade (<G>)", "Transportation and Storage (<H>)", Accommodation and Food Service Activities (<I>)" are here referred to as "Non-KBS" sectors.

The following figure (Figure 2) shows that the number of (solo) self-employed workers (own-account workers) in both KBS and NonKBS sectors in Austria has increased significantly since 2004, but to varying degrees. The number of solo self-employed workers in KBS sectors (iPros) has increased considerably during the period under review. In 2004 the number of iPros in Austria was 72.200 and has increased to over 100.000 people in 2013. Since then the number has never dropped under this limit. With an average annual growth rate of 3% this group has shown a remarkable growth trend over the period under review (see Table 3). The proportion of iPros among



all solo self-employed people in all services grew also from 56% in 2004 to 60% in 2017. This means that iPros working in KBS sectors represent the majority of solo self-employed in the service sectors.

Figure 2: Change in the numbers of (solo-) self-employment in KBS and NonKBSs sectors, 2004–2017

The self-employed with employees (employers) are generally more strongly represented in the 'NonKBS' than in the KBS sectors. However, employers in KBS sectors show a stronger growth pattern over the entire period of observation. Employers in these sectors grew with an average annual growth rate of about 2% faster than employers in other service sectors (NonKBS), which grew only 1.4% per year on average (see Table 3). The share of employers in KBS sectors to all employers in the service sectors has thus increased also from 36% in 2004 to 38% in 2017.

	Knowle	edge-based Services	s (KBS)	Other Services (NonKBS)			
	2004 2017 avg-growth %		2004	2017	avg-growth %		
Employers	40.5	52.2	1.97	72.1	86.4	1.40	
Own-account workers	72.2	106.0	3.00	55.7	71.3	1.92	

Table 3: Average Growth (Solo) Self employment in KBS and NonKBS sectors

From this preliminarily results it becomes clear that since the beginning of the 21st century Austria has seen a substantial increase of self-employed professionals (in particular iPros) at the sectoral level. A more detailed analysis of sectoral differences should not be carried out here due to limited space. In the next section we will look at iPros through an occupational lens and will define them according to knowledge-based occupations.

3.4 (SOLO) SELF-EMPLOYMENT IN KNOWLEDGE-BASED OCCUPATIONS

Knowledge-based occupations include those occupations that require specific personal skills and expert knowledge to perform the related tasks and duties. The (Ö-) ISCO-08 (International Standard Classification of Occupations) provides a standardized classification structure to group specific occupations according to skill level and specializations. It distinguishes 10 major occupational groups that are associated with different skill levels in terms of nature and duration of qualifications, training and work experience. The ISCO major groups 1 to 3 refer to 'Managers', 'Professionals' and 'Technicians and associate professionals'.

Kitching (2015) argues, that these three groups correspond broadly with skilled non-manual occupations and are therefore a possible criterion to demarcate 'freelance work' or knowledge-based work from other types of own-account working (Kitching, 2015: 17). Although managerial occupations (major group 1) could in the light of changing employment relationships (Wynn, 2016) be practiced in the form of solo self-employment, this is presumably the exception rather than the rule.

Since the change from the old occupational classification ISCO-88 to the new ISCO-08 the numbers for ownaccount workers in major group 1 ('Managers') are no longer recorded in the Austrian LFS, we will focus here on the ISCO major groups 2 and 3 and define (solo) self-employment in knowledge-based occupations according to the 'sub-major' groups in these two groups. The following table lists those occupations, which should be named here as KBS occupations. This classification corresponds to that of Mason (2018), who defines KBS occupational groups according to occupation codes from the US Bureau of Labour Statistics (BLS).

Major Group	Sub Major	Occupation	
	<21>	Science and engineering professionals	
	<22>	Health professionals	
(2)	<23>	Teaching professionals	
<2>	<24>	Business and administration professionals	
	<25>	ICT professionals	
	<26>	Legal, social and cultural professionals	
	<31>	Science and engineering associate professionals	
	<32>	Health associate professionals	
<3>	<33>	Business and administration associate professionals	
	<34>	Legal, social, cultural and related associate professionals	
	<35>	Information and communications technicians	

Table 4: Knowledge-based	occupations	by	ISCO-08 code
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The change in the occupational classification system from ISCO-88 to ISCO-08 makes it necessary to draw separate time series for the years 2004 to 2010 and for 2011 to 2017. Because of regroupings in occupational groups the major groups are not directly comparable, but they show the change of numbers in these groups in the two time periods.

As shown in Figure 3 the number of solo self-employed professionals in academic occupations (ISCO-Class <2>) has risen considerably from 2005 to 2010 and from 2011 to 2013. After reaching peak in the year 2013 the number of iPros working in highly skilled jobs has remained constantly over 70.000. The number of solo self-employed professionals working in associated professional jobs (ISCO-Class <3>) has also increased from 2004 to 2010. After the changeover from ISCO-88 to ISCO-08 the number dropped from nearly 68.200 to 46.200 because of regroupings.



Figure 3: Change in the numbers of (solo-) self-employment in KBS occupations, 2004–2017

Accordingly, there has been a significant growth trend for iPros in both ISCO-classes over the two observed time periods. Although, with an average growth rate of 4.8% per year for the period between 2004 and 2010 and an growth rate of 3.1% for the period between 2011 and 2017 solo-self employed professionals in the academic professions are growing slightly faster than professionals in associated occupations, which grew by an average of 4.1% and 2.1% accordingly.

Type / ISCO-Class	<2>			<3>		
	2004	2010	avg-growth %	2004	2010	avg-growth %
Employers	27.7	33.6	3.27	19.4	30.7	7.95
Own-account workers	37.8	50.2	4.84	53.9	68.6	4.10
	2011	2017	avg-growth %	2011	2017	avg-growth %
Employers	39.2	42.1	1.20	20	26.3	4.67
Own-account workers	61.8	74.4	3.14	46.2	52.2	2.06

 Table 5: Average Growth (Solo) Self employment in professional occupations

4 CONCLUSION

Highly skilled and educated individuals who work in KBS sectors and professional occupations are a major component of the economy in digital societies. They now constitute also a growing part of the self-employed workforce in Austria. Since the year 2004 the proportion of own-account workers in total Austrian labour force has been relatively unchanged. But this aggregated number conceals various changes in the sectoral composition of the self-employed workforce. While the number of own-account workers in farming and forestry has shrunk dramatically the number of solo self-employed in the service sectors has increased at the same time. To further explore these developments in the service sectors and to see whether this changes can be attributed to knowledge intensive sectors and occupations we analyzed the number of (solo) self-employment in KBS sectors and occupations over time.

As we have shown here self-employment in KBS sectors is growing faster than in other service sectors in Austria. Especially, the number of self-employed people without employees in KBS sectors has increased on average by 3% annually between 2004 and 2017, compared to 1.9% in other services. With regard to occupational classification we have also seen that the number of solo self-employed people in professional occupations has increased considerably since the beginning of the 21st century. These developments suggest that iPros or freelancers who work as solo self-employed experts are becoming an integral part of an informational or entrepreneurial economy and society (Audretsch, 2009). They work as "mobile, independent workers, selling specific services in external labor markets outside standard, organization-based employment" (Osnowitz, 2013: 1).

Although professional and knowledge-intensive (business) services (K(I)BS) have been identified as an essential part of competitiveness in knowledge driven economies (Ferreira, Raposo, Fernandes & Dejardin, 2016) research in entrepreneurship on the specifics of these firms and their diverse forms of organizations is still limited (Landström, 2008). Recent research has shown that KBS businesses are different from other service providers and production companies in their entrepreneurial development and financial performance and thus need special consideration from educational system and policy (Mason, 2018).

In this paper we have taken both an economic sector-related and an occupational-related approach to trace the trends in the number of (solo) self-employed people in Austria over time. This approach has the advantage of inclusion of a wide range of different knowledge-intensive service sectors and also provides information of the skill and qualification level of self-employed service professionals. The findings in this paper can be seen as a first explorative approach to the further analysis of this emerging group in the labour force.

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THE NET OF COMPETENCES: AN INNOVATIVE FRAMEWORK FOR PRIOR LEARNING ASSESSMENT*

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This paper is based on Fahrenbach, Florian, Kaiser, Alexander, Schnider, Andreas. 2019. A Competency Perspective on the Occupational Network (0 Net). In Proceedings of the 52nd Hawaii International Conference on System Sciences (HICSS-52), Hrsg. Tung Bui, 5651-5660. Honolulu: ScholarSpace University of Hawaii at Manoa and on Fahrenbach, Florian, Kaiser, Alexander, Schnider, Andreas. 2020. Introducing an Artifact for the Assessment of Transversal Professional Competences In Proceedings of the 52nd Hawaii International Conference on System Sciences (HICSS-52), Hrsg. Tung Bui, 5651-5660. Honolulu: ScholarSpace University of Hawaii at Manoa and summarizes these two works.

ABSTRACT

This paper departs from a project conducted with the Trade and Craft sector of the Austrian Federal Chamber of Economics. A design science perspective scaffolds the development of an artifact, the net of competences, to support the assessment of transversal professional competences in the validation of prior formal, non-formal and informal learning. This paper contributes to theory by arguing for a structural functional equivalence between a real spider-web and the structure of the net of competences. A process perspective shows how different stakeholders interact in the net of competences. Specifically, we pose the research question "How to assess transversal professional competences?". To answer this question, we describe the design of a self-assessment by outlining item generation, generation of verb levels and the triangulation of items and verbs to create nodes in the net of competences. Abstracting from the previous, we present the algorithm on which the net of competences is based.

Keywords: assessment of competences; professional competences; validation of prior learning, Knowledge Innovation and Entrepreneurial Systems; European Qualifications Framework

KEY FINDING(S)

- To develop the content model of the net of competences we depart from a competence perspective (European approach – EQF) and subsume the relevant descriptors of the O*Net (American approach) into this perspective.
- As the model integrates the relevant descriptors from the O*Net, it allows to directly translate defined competences into measurable constructs. We show that these perspectives are not mutually exclusive but rather complement each other in a meaningful way.
- We introduce an algorithm that connects each component and shows how qualitative documentation of
 professional competences can be transformed into a quantitative judgment. In so doing, we contribute to the
 integration of approaches describing the content of knowledge, skills and competences (KSC) with approaches
 describing the level of proficiency and development of KSC.

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IMPLICATION(S) FOR THE PRACTICE OF SMEs

One of the key aims within Europe is to foster labor-market mobility, this holds especially for SMEs. Practically, the outcome of this research endeavour targets the scarcity of ICT-based assessment methods within the validation of prior learning in the European context. The structural components of the net of competences play together in four phases of the validation of prior learning: the identification, documentation, assessment and recognition of professional competences. The identification of professional competences aims at making explicit often tacit competences from learning that took place in a setting of formal, non-formal and informal learning.

The net of competences relies primarily on creating a portfolio, an organized collection of (written) materials (either on paper and/or digital) that presents and verifies learning outcomes acquired through experience. It can include resumes, documentation of formal learning (e.g. school or university degrees), non-formal learning (e.g. certifications of community colleges or massive open online courses) and informal learning (e.g. letters of reference from former workplaces, testimonials from the workplace/voluntary work). Also photographs of work samples, presentations, or videos showing behavior in social interaction may be appropriate.

Together with the algorithm that we present in this paper, the competence network can help SMEs in particular to assess existing competences and to decide whether there is an appropriate match between the competences of individuals and future employees and the requirements of the respective SME.

1 INTRODUCTION

One of the key aims within Europe is to foster labor-market mobility and social cohesion, i.e. the "social europe" (Jarvis, 2007; Jackson, 2011; Harris, Guthrie, Hobart & Lundberg, 1995). The validation of prior learning, the process of "assessing and recognizing a wide range of skills and competences which people develop through their lives and in different contexts, for example through education, work and leisure activities" (Bjørnåvold, 2000: 216) plays an important role in these efforts. It is supported in the European Union (EU) through policies by fostering lifelong learning, the European Qualifications Framework (EQF) to ensure comparability between member states, the National Qualification Frameworks (NQF) (Council of the European Union, 2006) and the recommendation on the validation of prior learning to outline the process (Council of the European Union, 2012).

While member states of the EU agreed on the legislative part, it is currently important to design innovative artifacts to support the assessment of professional competences in the validation of prior learning (European Commission, Cedefop & ICF International). The design of standardized and information and communication technology (ICT) based artifacts is necessary as these artifacts can "mainstream processes and increase awareness of validation" (Cedefop, 2017: 75). Within standardized ICT-artifacts, different methods of assessment are supported, which currently holds as the "gold standard" in assessment procedures. This multi-method assessment is "based on the triangulation of results from different assessment methods [...] frequently used in validation" (Cedefop, 2017: 74). However, even though the advantages and opportunities of standardized assessments are
known, policy-makers recently concluded that "more can be done in the standardization of tools and the use of ICT" (Cedefop, 2017: 20) to support the assessment of professional competences in the validation of prior learning.

One reason why the development of ICT-artifacts to support the assessment of professional competences proves a challenge for research and policy making is the lack of integrated and comprehensive approaches. On the one hand, there are many approaches that describe classifications of qualifications (e.g. ISCO or ISCED (Markowitsch & Plaimauer, 2009; Unesco, 2011)), the content of occupational and individual requirements (e.g. the 0*Net (Peterson et al., 2001) or DISCO (Markowitsch & Plaimauer, 2009) while integrative approaches are currently under development (e.g. ESCO, a recent project of the European Union (Cedefop, 2017)). On the other hand, we witness many approaches that describe levels of professional competences and competence development (e.g. (Anderson, 2001; Krathwohl, 2002; Bloom, Krathwohl & Masia, 1956; Dreyfus & Dreyfus, 1986). However, in order to facilitate the assessment of professional competences within an ICT-environment, we are currently lacking a comprehensive model that integrates both.

From a practical perspective, human resource development (Salas et al., 2012). However, trainings in organizations are often not perceived as very useful and a waste of time (Benabid & Mikhaeil, 2019). Some even speak of the great training robbery (Beer, Finnstrom & Schrader, 2016) as most of the trainings do not provide the return of investment organizations expected (Laker & Powell, 2011). This is the second reason why the development of an ICT-artifact to assess the content *and* level of professional competences is important, as it may provide a very detailed profile of training needs in regard to a specific profession.

Research question and research method

While domain-specific competences are of great importance for each single profession, the Austrian Trade and Craft sector puts great emphasis on transversal professional competences (i.e. competences that are viable across domains such as language skills or learning to learn) (Le Deist & Winterton, 2005: 38). Practically speaking, if a person has acquired transversal professional competences, they can be applied in several contexts – thus increasing the person's capacity to act.

In this paper, we report a research project with the Austrian Federal Chamber of Economics. Its goal is to design an ICT-artifact to support the assessment of transversal professional competences within the Austrian Trade and Craft sector. The main purpose of the artifact is to standardize the award of trading licences, which is the legal precondition to open a business in Austria. Applicants are awarded with a trading licence if they can prove the necessary knowledge, skills and competences (KSC). The ICT-artifact should support the whole process of the validation of prior learning. Consequently, we pose the research question *"How to assess transversal professional competences?"* To answer this research question we will describe the development of the *net of competences.*

The purpose of this paper is twofold. First we introduce a conceptual model to integrate *learning outcomes* that are formulated in the European Qualification Framework (EQF), an attempt to standardize European professional

education, with *descriptors* from the O*Net, a large database that offers a taxonomy for all occupations established in the US. It is not our intent to place one approach over the other, rather we aim at investigating how they enrich each other. While the European competency perspective is action oriented and thus normative (Cheetham & Chivers, 1996; Mulder, Weigel & Collins, 2007), the O*Net taxonomy is rather descriptive. While the competency perspective provides a view on what *people who perform a certain job should be able to do*, and thus emphasizes quality requirements, the O*Net offers a comprehensive list of relevant occupational descriptions. This paper integrates these perspectives to gain the advantages of both approaches. By integrating a normative competence model and the descriptive O*Net taxonomy into a coherent framework that translates competencies into measurable indicators from industrial and organizational psychology, we aim at providing a framework to assess competencies.

Second, a theoretical model that builds a bridge between the Occupational Information Network (O*Net) and the European competence perspective allows us to contribute to theory by describing the development of a self-assessment procedure of transversal professional competences.

Methodologically, the development of the *net of competences* rests on a design science paradigm (Stoof et al., 2002; Cedefop, 2017; Anderson, 2001). Whereas natural sciences and social sciences try to understand reality, "design science attempts to create things that serve human purposes" (VandenBos, 2015: 55). It may be described as the "creation and evaluation of an innovative, purposeful artifact for a specified, currently unresolved problem domain" (Cedefop, 2017: 82). With utility as its ultimate goal in mind - it addresses problem-driven research question through *"building and evaluation* of artifacts designed to meet the identified [...] need" (Cedefop, 2017: 79–80). In this paradigm, an artifact refers to "a thing that has, or can be transformed into, a material existence as an artificially made object (e.g., model, instantiation) or process (e.g., method, software)" (Stoof et al., 2002). Usually, the design science process includes six steps: "problem identification and motivation, definition of the objectives for a solution, design and development, demonstration, evaluation, and communication" (Anderson, 2001: 46). Methodological rigor is achieved by "appropriately applying existing foundations and methodologies" (Cedefop, 2017: 80) in design science research. Design science has been used as an approach to assess competences via comparative judgement (Coenen et al., 2018).

Methodically, we construct theory using qualitative research. Constructing theory means "engaging in creative attempts to generalize mechanisms, particular cases, or links between causal statements" (Cedefop, 2017:167). When linking competencies and descriptors of the O*Net, we rely on abductive reasoning (Peirce, 1934) within a community of inquiry which is formed by the authors (Cedefop, 2017: 180). By going back and forth between data from the O*Net and competencies, categories emerge for different concepts. This is due to the circumstance that abductive processes are less secure but provide a greater innovative potential.

2 THEORETICAL BACKGROUND

Competence is a fuzzy concept with no agreed definition (Le Deist & Winterton, 2005). In psychology, competence describes the "ability to exert control over one's life, to cope with specific problems effectively, and to make changes to one's behavior and one's environment, as opposed to the mere ability to adjust or adapt to circumstances as they are" (VandenBos, 2015). The competence movement in psychology took of after the claim to test for competence rather than intelligence in educational and occupations situations (McClelland, 1973), as cognitive intelligence was seen to be a poor predictor for job performance. In the field of business and management, (Hamel & Prahalad, 2000: 202) define competence as a "bundle of skills and technologies rather than a single discrete skill or technology". The competency based view of the firm (Freiling, 2004) asserts that firms have to make use of their resources but also need to use them in an efficient way in order to gain a competitive advantage. In this regard, competencies also play a major role in organizational learning, which can be defined as "a change in the organization that occurs as the organization acquires experience. [...] [it is] a change in the organization's knowledge that occurs as a function of experience" (Jackson, 2011).

Competencies are defined as "collections of knowledge, skills, abilities, and other characteristics (KSAOs) that are needed for effective performance in the jobs in question" (European Commission, Cedefop, & ICF International: 226). In this regard, knowledge refers to the "possession of a body of information (both factual and procedural) that is related to the performance of a task" (Peterson et al., 2001: 463). Skills are defined as "a person's level of proficiency [...] to perform a task. Skills usually improve with training or experience on the task." (Peterson et al., 2001: 464). Abilities are relatively "enduring basic capacities for performing a wide range of different tasks" (Peterson et al., 2001: 458).

As outlined above, there is no agreed definition on competency, that is why we decided to follow the argument that competency may be used based on a constructivist approach of viability (Stoof et al., 2002). In this regard, we follow the definition of the European Union, in which 'competence' means the "proven ability to use knowled-ge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development" (EQF Recommendation).

2.1 THE OCCUPATIONAL INFORMATION NETWORK (0*NET)

The Occupational Information Network (Peterson et al., 2001) is a large job analysis database operated and maintained by the U.S. Department of Labor. It resulted in 1999 from the dictionary of occupational titles in which finally over 12000 occupations were listed. As this was not to handle anymore, psychologists began to develop the 0*NET and drastically reduced the number of jobs by extracting the relevant psychological parameters that are relevant to pursue most of the jobs. In this regard, the 0*Net stands in the tradition of taylorism and fordism. Nowadays, 0*NET is organized as a comprehensive database of worker and occupational characteristics that is continually updated through surveying a broad range of workers and job analysts. The database, available to the public free of cost, contains descriptions of the knowledge, skills, abilities, interests, and general work activities associated with each of around 1,000 different US occupations (Council of the European Union, 2012; Dickerson et al., 2012). The key organizing framework of O*NET is a taxonomy of occupational descriptors known as the O*NET content model (Tippins & Hilton, 2010). The main motivation for the development of the O*NET model has been to address three needs: the ability to describe occupations in many ways, a common language of work descriptors that can be applied across all occupations, and a taxonomic classification system.

The model contains almost 250 measures of knowledge, skills, abilities, work activities, training, work context and job characteristics, which are either worker-oriented or job-oriented. For the four domains of knowledge, skills, abilities and work activities, both the 'importance' and 'level' of each skill or characteristic being measured is recorded (Dickerson et al., 2012). A detailed description of the 0*NET and all the data can be found at the website of this project *https://www.onetonline.org/*.

2.2 THE EUROPEAN QUALIFICATION FRAMEWORK EQF

Hunnius and Schuppan point out that because of the increasing importance of lifelong learning, the competency approach is enjoying larger recognition worldwide, as it focuses on the results of learning processes (Hunnius & Schuppan, 2013). In Europe in particular, the competency concept has become important in establishing comparability between educational degrees issued in different countries. When applied in professional life, the competency concept takes into account what a person is able to do in a working context, regardless of how this knowledge has been acquired. Instead of formal qualifications and degrees, which differ throughout Europe, skills, techniques, expertise, and know-how become more important.

Addressing this claim the European Qualification Network (EQF) has been developed in the last decade. The EQF is described as a 'meta-framework' or 'translation device' which allows for the comparison of one or more qualifications from one or more countries (Méhaut & Winch, 2012). A central principle of the EQF is that its levels are based on learning outcomes rather than either the type of a program that leads to the qualification, or the institution in which it is taken.

Three main reasons have been given for the creation of the EQF: international transparency (among all the members and looking outwards); the possibility of international recognition of professional qualifications obtained in different countries; and student mobility. The aim has been to create a meta-framework that encompasses and connects the national frameworks, to make them compatible. These frameworks should be based on a common concept of professional qualifications. The meta-framework should include a systematic description of qualification levels, with coherent relations and conditions for it to be understood internationally (Guillén, Fontrodona & Rodríguez-Sedano, 2007).

The EQF is organized into eight levels, from primary education to doctoral level equivalents and for any qualification, a level of achievement is assigned. Each level consists of three components of, respectively, know-ledge, skill and competence, the latter being concerned with the qualification holder's exercise of autonomy and responsibility in work situations (Brockmann, Clarke & Winch, 2009).

3 THE RESULTING NET OF COMPETENCIES

In this section, we report the development of the conceptual model in which we integrated the O*Net descriptors in the competence dimensions (personal competence, social competence, method competence and domain competence). More specifically, we used the database *Content Model Reference*, which includes the whole content model according to which all occupations within the O*Net are structured (see Figure 1 for an overview of the process).

Figure 1: Development and validation of the model of competencies (data preparation: 1; data analysis: 2; data refinement and validation:3)

• Access "Content Model Reference" · Translation of descriptors 1 • Haptic clustering of descriptors through a group of researchers · Application of inclusion and exclusion criteria "relevance" to descriptors 2 · Clustering of double entries of descriptors · Integration of remaining descriptors in four broad competence dimensions · Creation of subdimensions based on descriptors • Reformulation of descriptors in the competence terminology 3 · Validation with five occupational specific learning outcomes

In the following, we outline the process how we developed the net of competencies, introduce the net of competencies and show how we validated it using data from an ongoing project. The respective excel sheet is accessible at *https://www.onetcenter.org/db_releases.html* and includes 548 descriptors.

3.1 DEVELOPMENT AND VALIDATION OF THE MODEL

In the data preparation phase (Figure 1: 1), we gathered the datafile, translated it and prepared it for haptic clustering. The source data from O*Net was gathered on 05.05.2018. The respective datafile consists of three columns. *Element ID* provides an unmistakable letter and number combination for the content element, *Element Name* provides a brief name for the corresponding content element and *Description* provides a brief description and definition of the respective content element. The overall content model is theoretically described in Peterson et al. (2001). As this model is intended to be applied in the german speaking region, we translated the "Content Model Reference" into German, while keeping the reference to the original source in the O*Net. After translating, we printed each of the translated descriptors from the O*Net on a label and placed them hierarchically mirroring the O*Net structure.

Element ID	Element Name	Description	
1	Worker Characteristics	Worker Characteristics	
1.A	Abilities	Enduring attributes of the	
		individual that influence	
1.A.1	Cognitive Abilities	Abilities that influence the	
		acquisition and application of	
		knowledge in problem solving	

Figure 2: Example descriptors of the 0*Net Content Model Reference

In the data analysis phase (Figure 1: 2), we applied the inclusion and exclusion criteria relevance, we clustered semantically double descriptors and integrated the remaining descriptors into four broad dimensions of competencies.

More specifically, we first went manually through all descriptors of the O*Net (see Figure 3 for an example) and decided whether the respective descriptor is relevant to develop a model of competencies or not. We considered everything relevant that describes a measurable human variable or job variable. We excluded the ones that did not elicit information regarding measurability of a construct or the possibility to connect the respective category with one of the competencies. We for example excluded information regarding the outlook of an occupation, or information about certifications necessary to perform a certain occupation. In this regard, we separated information, which is relevant to build a conceptual model from information that is necessary to organize the O*Net taxonomy.

We then we combined categories, which did not provide additional information. Within the O*Net, certain descriptors are formulated semantically similar as worker requirements and entry requirements for a certain occupation. We combined these cluster which have been shown as semantically similar. For example, the category *Basic Skills* is coded with the same definition as worker requirement and entry requirement for a certain occupation.

After we excluded irrelevant categories and removed semantically double entries, we matched the remaining O*Net categories with the four broad dimensions of competencies.



Figure 3: Examples of the hierarchically clustered descriptors of the O*Net Content Model Reference (Clustering was done with translated data)

In the data refinement and validation phase (see Figure 1: 3), we created terms to name the O*Net descriptors, we reformulated the O*Net descriptors in a competence terminology and validated the model with five occupational specific learning outcomes (see chapter 4.3).

As this model is intended to be used by all labour market participants (also non-native speakers) in german speaking regions, we made sure to use a wording for the subdimensions which is easy to understand. After we sorted the descriptors to the four competence dimensions, we searched for terms that best name the descriptors from a perspective of competencies.

3.2 DESCRIPTION OF THE MODEL

The resulting net of competencies is comprised by four different dimensions (see Figure 4) and 32 subdimensions, which are described in the following. We use the phrase *The person is able to...* to underline a competence perspective. This is because the phrase *The person is able to* is used to describe the learning outcomes within the EQF. Within the EQF learning outcomes are depicted strongly oriented towards individual competence.



Figure 4: The net of competencies consists of four different dimensions

3.2.1 PERSONAL COMPETENCE

Personal competence describes the "willingness and ability, as an individual personality, to understand, analyse and judge the development chances, requirements and limitations in the family, job and public life, to develop one's own skills as well as to decide on and develop life plans. It includes personal characteristics like independence, critical abilities, self-confidence, reliability, responsibility and awareness of duty, as well as professional and ethical values." (Le Deist & Winterton, 2005: 38). Within the field of personal competence, we defined seven subdimensions derived from the data in the O*Net content reference (see Table 1).

ID	Name	Description	
PC1	Socialisation through education or culture	The person is able to use his/her education and cultural background to perform appropriate at his/her workplace	
PC2	Suitability based on personality characteristics	The person is able to perform at his/her workplace based on his/her personality characteristics	
PC3	Suitability based on interests	The person is able to reflect on his/her professional interests and match these to the demands at the workplace	
PC4	Achievement motivation	The person is able to reflect on his/her key strengths and use them at the workplace	
PC5	Management of values	The person is able to reflect on his/her values and on organizational values	
PC6	Setting and pursuing goals	The person is able to set goals and pursue them at the workplace	
PC7	Act practically intelligent	The person is able to use his/her common sense at the workplace	

Table 1: Subdimensions of personal competence

We are aware that PC3, PC4, PC5 are described using the term *reflection*. We do so in accordance with Cheetham and Chivers (1996) who state that reflection is a meta-competence and plays an important role in the enactment of competencies (Schön, 1983).

3.2.2 SOCIAL COMPETENCE

Social competence describes the "willingness and ability to experience and shape relationships, to identify and understand benefits and tensions, and to interact with others in a rational and conscientious way, including the development of social responsibility and solidarity" (Le Deist & Winterton, 2005: 38). Within the field of personal competence, we defined nine subdimensions derived from the data in the O*Net content reference (see Table 2).

Table 2: Subdimensions of social competence

ID	Name Description		
SC1	Sense of social appropriateness	The person is able to act in a social appropriate way at the workplace	
SC2	Communication and interaction	The person is able to communicate and interact with others in a goal oriented and appropriate way at the workplace	
SC3	Active and passive feedback The person is able to give feedback to others and receive feedback others at the workplace		
SC4	Empathy	The person is able to act in a friendly, cooperative and empathic way with others at the workplace.	
SC5	Ability to form and maintain relationships	The person is able to support others and to build strong relationships with others at the workplace	
SC6	Occupational roles	The person is able to negotiate about the own role in the occupation at the workplace	
SC7	Leadership and social influence	The person is able to exert influence in social systems and to lead others at the workplace	
SC8	Conflict management	The person is able to solve conflicts constructively at the workplace	
SC9	Advice and development	The person is able to advice others and be responsible for their professional development at the workplace	

3.2.3 METHOD COMPETENCE

Method competence arises "from the implementation of transversal strategies and processes of invention and problem-solving" (Le Deist & Winterton, 2005: 36). Here, transversal strategies are cross-functional and span a variety of occupations. Within the field of method competence, we defined ten subdimensions derived from the data in the 0*Net content reference (see Table 3).

Table 3: Subdimensions of methodical competence

ID	Name	Description	
MC1	Socio technical systems	The person is able to understand, monitor and improve socio-technical systems at the workplace	
MC2	Resource management	The person is able to manage his/her and organizational time and finances	
мсз	Human resources systems and practices	The person is able to ensure that an organization has fitting employees to meet their organizational goals	
MC4	Solving complex problems	The person is able to solve new, ill-defined and complex problems in the real world	
MC5	Performing complex technical activites	The person is able to perform skilled activities using coordinated movements	
MC6	Operate and use machines and technical systems	The person is able to use his/her developed capacities to design, set-up, operate and correct malfunctions in machines and technical systems	
MC7	Digital communication	The person is able to appropriately use different methods and ways of digital communication	
MC8	Manage knowledge and information	The person is able to identify and manage knowledge and information at the workplace	
MC9	Business management	The person is able to apply knowledge of principles and facts related to business management at the workplace	
MC10	Administrative work	Persons are able to perform routine operations like administration, staffing or controlling at the workplace	

3.2.4 DOMAIN COMPETENCE

Domain competence describes the "willingness and ability, on the basis of subject-specific knowledge and skills, to carry out tasks and solve problems and to judge the results in a way that is goal-oriented, appropriate, methodological and independent. General cognitive competence [...] the ability to think and act in an insightful and problem-solving way" (Le Deist & Winterton, 2005: 38). Within the field of personal competence, we defined six subdimensions derived from the data in the O*Net content reference (see Table 4).

Table 4:	Subdimensions	of	domain	competence
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ID	Name	Description	
DC1	Domain Knowledge	The person is able to use domain specific knowledge to perform at the workplace	
DC2	Work settings	The person is able to work in different physical environments	
DC3	Environmental conditions	The person is able to withstand extreme environmental conditions at the workplace	
DC4	Handling of dangerous conditions	The person is able to handle different dangerous or hazardous conditions at the workplace	
DC5	Physical and cognitive requirements	The person is able to handle the physical and cognitive requirements at the workplace	
DC6	Work conditions	The person is able to work under different and changing conditions	

3.3 VALIDATION OF THE NET OF COMPETENCIES

The conceptual development of the net of competencies was part of a larger ongoing project we conduct with the Austrian Federal Economic Chamber (WKO). The project's objective is to develop a model for the industry sector 'Crafts and Trades' which helps to decide whether a person has the developed competencies to lead a company within a specific occupation. Such a trading licence is given to a person only if his or her competencies ensure an outcome of high quality. Therefore, the competencies of a person have to match with the requirements of a specific occupation. Within Austria, there exist almost 180 different occupations with very different demands. In this regard, the aim of our project is to develop a competency based model which can be applied to all non-academic occupations. A large part of the project is thus to maintain the qualitative high performance of persons obtaining trading licenses.

In the meta-framework of the EQF, it is necessary that each participating country develops a national quality framework (NQF), which fits to the EQF. In the Austrian context, the NQF requires representatives of the respective occupation to formulate learning outcomes for the highest non-academic qualification (Meister).

In the project, we obtained data from five different occupations with around 50 learning outcomes each. For example the term *"He/she is able to set goals for the organization and pursue them"* is an exemplary learning outcome from the occupation of plumbers.

Within the validation phase, we investigated in a group of scientists, whether each of these learning outcomes from the five occupations can be associated to at least one of the 32 subdimension in the net of competencies described above. To describe the process of matching in detail, is out of scope for this paper. However, during the validation, we came to the conclusion, that not only each learning outcome could be associated with at least one subdimension in the net of competencies, rather we also concluded that roughly 66% of the learning outcomes from very different disciplines semantically overlap.

4 THE ASSESSMENT OF COMPETENCIES

In this section, we give a short overview about the development of the assessment tool within the net of competencies. The assessment part consists of items, verbs and verb levels and an assessment algorithm.

4.1 ITEM GENERATION

The *net of competences* consists of 32 theoretical constructs that are described by at least three items per construct. We generated items to assess the theoretical constructs based on five qualification standards of different Austrian professions. A qualification standard is a document, that comprehensively lists learning outcomes of a profession on a specific NQF level. Learning outcomes are "statements of what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and competence" (Council of the European Union, 2008). Each of these five qualification standard lists roughly 50 learning outcomes which have to be reached to receive a trading license. To develop candidate items for the assessment of professional competences in the validation of prior learning, we followed a common procedure of instrument development in Information Systems (Unesco, 2011: 73). While each professional competences – which are competences that are not specific to a certain profession.

First, we conducted a content analysis, a qualitative research method that allows to capture and structure the content of large bodies of text (Schön, 1983; Peterson et al., 2001) – of five qualification standards of different Austrian professions (Plumbers, Butchers, Hair-cutters, Orthopedic shoemakers and Motor vehicle technicians). The content analysis revealed that roughly 2/3 of all learning outcomes of arguably very different professions are similar enough to be grouped together – and thus qualify as transversal professional competences (Mulder, Weigel & Collins, 2007). Second, based on the content analysis of five qualification standards, we generated 160 candidate items (Unesco, 2011: 73) within the research group. While one member of the group conducted the content analysis and generated candidate items, other members assessed these items and provided feedback on them (i.e. accounting for an expert panel) (Unesco, 2011: 73). During several iterations, all 160 items were reformulated (shortened and improved in clarity). Where necessary, we relocated the item to a better fitting theoretical construct (i.e. sub-competence). A second expert panel, consisting of members of the Austrian Federal Chamber of Economics reviewed all 160 candidate items again and adapted them where deemed necessary.

4.2 DEVELOPMENT OF VERB LEVELS

To describe the level of professional competences from novice to the expert – independent of the specific profession – we relied on relevant scientific literature (Freiling, 2004; Hamel & Prahalad, 2000; Dreyfus, 1985).

There are several taxonomies available, which are widely used around the world that describe six levels of professional competences (e.g. Freiling, 2004; Hamel & Prahalad, 2000). In line with the most widely used taxonomies describing levels of professional competences, the research team decided to develop the *net of competences* distinguishing these six levels. To distinguish these six levels of professional competences, practitioner/policy-making literature offers guidelines containing lists of verbs (e.g. for the European context: European Commission, Cedefop & ICF International: 34, 51-52; or for Austria: Fritz, 2015: 25–27). These guidelines offer – almost endless – lists of verbs to describe learning outcomes and professional competences on specific levels. Table 5 gives an example list of verbs for each of the six levels.

Table 5: Example list of verbs used in the net of competences to describe the levels of competence (Hamel & Prahalad, 2000; Freiling, 2004; Guillén, Fontrodona & Rodríguez-Sedano, 2007)

Level: Name	German translation	English verbs
Level 1:	(zu) nennen,	to name,
Remember	(zu) benennen	to recognize
Level 2:	(zu) erklären,	to describe,
Understand	(zu) beschreiben	to explain
Level 3:	an(zu)wenden,	to apply,
Apply	durch(zu)führen	to perform
Level 4:	(zu) prüfen,	to test,
Analyze	(zu) analysieren	to analyze
Level 5:	(zu) beurteilen,	to assess,
Evaluate	(zu) begründen	to justify
Level 6:	weiter(zu)entwickeln,	to develop,
Create	(zu) optimieren	to refine

4.3 TRIANGULATION OF ITEMS AND VERB LEVELS

In order to determine whether a verb from the relevant literature described above fits to a specific item, there are certain requirements the verb has to fulfill (e.g. European Commission, Cedefop & ICF International: 46–48): it must linguistically fit to the item; it must be comprehensive for the target audience; it must describe a specific level of professional competence in regard to the item.

To determine which verbs fit for a specific verb level and is viable in combination with the item, we conducted 15 practitioner panels in six Austrian cities with 73 participants in total. Each practitioner panel lasted about three hours and was usually moderated by the first author. In each panel, we went through 10 candidate items and proposed up to four verbs per level that indicate the level of competence for each candidate item. We aimed to find 12 fitting verbs (two on each level) for each of the 160 candidate items.

During the practitioner panels, we asked the following questions for each candidate item: First, *Do you understand the candidate item*?. If at least two practitioners did not understand the item or deemed it was too complicated, the group reformulated the item till a sufficient wording was found while keeping its meaning as similar as possible. Second, we proposed the panels a set of up to four verbs for each of the six levels and each candidate item. We asked for each verb: *Does the respective verb fit to the candidate item*? and *Does the verb reflect the respective level of competence*? When the group agreed that a verb fitted to the item, it was included, when the group disagreed that a verb fitted to the item, it was excluded. While the moderator guided the discussion and wrote in the database, the panel determined the formulation of items and whether a verb fitted to the item. Depending on the item, it was possible that a verb occurs on two different levels.

5 OUTLINE OF THE ALGORITHM IN THE NET OF COMPETENCES

Although the whole *net of competences* is rather complex, the underlying algorithm itself is relatively simple and straightforward. The algorithm builds up on the three main components of the *net of competences* – competence dimensions, items and verbs. The goal of the algorithm is to assign a value to each sub-competence dimension. The so calculated values represent the levels of each sub-competence within the *net of competences*. The whole action space of the algorithm is spanned by the 160 items, the 32 sub-competence dimensions within the four broad competence dimensions and the 2 alternatives of verbs for each of the 6 competence levels (6 x 2 verbs).

- Each of the verbs is assigned to exactly one competence level and is therefore coded with the number of the level. Now to each of the 160 items a value between 1 and 6 is assigned depending on the verb the user has chosen.
- 2. Each of the 32 sub-competence dimensions is characterized by between three and nine items. For each sub-competence dimension, the values of the characterizing items are summed up and are divided by the number of items.
- 3. The value for each of the four broad competence dimensions is calculated by summing up the values of the sub-competence dimensions which are assigned to the respective competence dimension.
- 4. The assessor analyses the portfolio documents uploaded by the user (see section 2.2). Each document is assigned to at least one competence dimension. If the analysis shows that the document not only proves a competence, but also documents that this competence has been performed over a longer period of time, then the value of the corresponding competence is increased.
- 5. On the other hand, if documents do not prove the competence, the value of the corresponding competence is decreased or in extreme cases the value is set to zero.
- 6. In a last step, the values calculated in this way are compared with the defined reference values of the profession in which the user is interested and for which the user has applied for a trading license.

This comparison is made either at the level of the four broad competence dimensions or even at the level of the 32 sub-competence dimensions.

7. The result of the comparison is a relative complement in which for each competence dimension respectively each sub-competence dimension the competence value of the user is subtracted from the reference value. A value of zero or greater than zero indicates that the user in this competence dimension already fits well, while a negative value indicates that the user has to improve this special competences in order to gain the trading licence.

6 IMPLEMENTATION AND APPLICATION

To implement the *net of competences*, we have developed a data model to map the four broad competence dimensions (personal, social, methodological and domain competence) and the 32 sub-competences in an ICT-artifact. The 160 formulated items describing 32 sub-competence areas are stored together with the answer options (verbs) and reference values. As the ICT-artifact is currently running on a server, all changes made in the database are logged automatically and are stored comprehensively related to change protocols (i.e. a version history is fully implemented). Further items and verbs can be stored in the system for the future goal of simplifying the acquisition of a trade license. To integrate the domain-specific professional competences of each single profession, an online module to moderate practitioner panels with professional associations has been developed and tested in 15 panels. In this frontend, all items and the connected pool of verbs can be edited and changed easily. The ICT-artifact is currently available in a fully functional version for a limited group of users.

From a **user perspective**, the self assessment then works like this: an user is presented with one item after another in the self-assessment. Each item is connected to a specific pool of twelve verbs (two verbs per level of professional competence). For each item, six out of 12 verbs are randomly drawn from the pool of possible and associated answer verbs. Now, each item can be answered by choosing one out of six verbs that are presented to the applicant. The applicant is encouraged to choose the verb that best mirrors his or her estimated level of professional competence in regard to the item. We give an example:

- "I am able to the efficiency of processes in my business"
- 1. level: to recognize, to identify
- 2. level: to explain, to describe
- 3. level: to interpret, to demonstrate
- 4. level: to analyze, to test
- 5. level: to argue and justify, to evaluate
- 6. level: to develop, to refine

7 DISCUSSION AND CONCLUSION

In this section, we describe implications for theory and practice; subsequently we point at limitations and opportunities for further research.

7.1 IMPLICATIONS FOR THEORY AND PRACTICE

While the comprehensive theoretical model consisted of 32 sub-competence dimensions, we now add two components. First, we describe the development of 160 items for the assessment of professional competences. Secondly, we outline the level of professional competence by describing a set of 12 verbs attached to each item. Abstracting from the fieldwork, we introduce an algorithm that connects each component and shows how qualitative documentation of professional competences can be transformed into a quantitative judgment. In so doing, we contribute to the integration of approaches describing the content of KSC (e.g. Markowitsch et al., 2008; Dickerson et al., 2012) with approaches describing the level of proficiency and development of KSC (e.g. Freiling, 2004; Hamel & Prahalad, 2000; Guillén, Fontrodona & Rodríguez-Sedano, 2007; Hunnius & Schuppan, 2013).

Practically, the outcome of this research endeavour targets the scarcity of ICT-based assessment methods within the validation of prior learning in the European context. The structural components of the *net of competences* play together in four phases of the validation of prior learning: the *identification, documentation, assessment* and *recognition* of professional competences.

The **identification** of professional competences aims at making explicit often tacit competences from learning that took place in a setting of formal, non-formal and informal learning. This phase should be guided and facilitated by coaching techniques and social interaction.

The **documentation** of professional competences aims at combining explicit evidence of achieved learning outcome. The *net of competences* relies primarily on creating a portfolio, an "organized collection of (written) materials (either on paper and/or digital) that presents and verifies learning outcomes acquired through experience" (Bohlinger, 2017:600). It can include resumes, documentation of formal learning (e.g. school or university degrees), non-formal learning (e.g. certifications of community colleges or massive open online courses) and informal learning (e.g. letters of reference from former workplaces, testimonials from the workplace/voluntary work). Also photographs of work samples, presentations, or videos showing behavior in social interaction may be appropriate. While assembling a portfolio is described as tedious and time-consuming (McMullan et al., 2003), it strengthens the overall validity of the assessment (Bohlinger, 2017).

The **assessment** of professional competences aims at comparing *identified* and *documented* learning outcomes against a standard or point of reference (Bohlinger, 2017). A mixed-method approach is advocated as the "gold standard" (Cedefop, 2017). Taking into account different definitions of professional competence (Mulder, Weigel & Collins, 2007; Laker & Powell, 2011; Beer, Finnstrom & Schrader, 2016), several assessment methods may be relevant to accurately assess professional competences. Usually, assessment of competences departs from a self-assessment, where applicants estimate their level of competence against a standard (Brockmann, Clarke &

Winch, 2009). Subsequently, further evidence through standardized psychological testing can be gathered. However, as professional competences are closely related to action (Schön, 1990) and activity (Engeström, 1993), behavioral simulations may be required as some competences cannot be assessed through a paper-pencil test. Here, issues of standardization and validity come into play (Stenlund, 2010).

The **recognition** of professional competences aims at awarding a partial or full qualification for *identified*, *documented* and *assessed* learning outcomes and is usually done by a competent authority, such as governmental representatives (Bjørnåvold, 2000; Dreyfus, 1985). While the validation of prior learning usually happens step wise, the *net of competences* is designed in a way that an applicant can work iteratively and jump back and forth in the *identification* and *documentation* of learning outcomes before he/she uploads the documentation for assessment.

Especially the algorithm introduced in section 5 can be directly applied by professional associations to assess the documentation of professional competences and transform qualitative portfolios into a quantitative judgment. Through its fine granularity, it is possible to determine learning needs (Le Deist & Winterton, 2005) (i.e. opportunities and potentialities for learning) and thus fosters the design of effective learning intervention in regard to a specific profession. As the *net of competences* is currently fully embedded in an ICT-artifact, it may support professional associations in standardizing their assessment procedures and thus increase their legitimacy (Granovetter, 1985).

7.2 LIMITATIONS AND FURTHER RESEARCH

Besides limitations that are inherent to the research design itself (Anderson, 2001; Stoof et al., 2002; Cedefop, 2017), there are some specific to the *net of competences* as presented above. As the *net of competences* is linguistically close to qualification standards, a good command of German is currently required for applicants and assessors. Thus, it is not an entry instrument to integrate applicants into the labour market (Souto-Otero & Villalba-Garcia, 2015; Diedrich, 2013; Diedrich, 2017). Furthermore, some applicants might tend to overestimate their performance, others underestimate themselves and their performance. Others may find it difficult to choose only one verb as two would fit their level of professional competence better. Also, the visibility of validation procedures remains a challenge in general (Cedefop, European Commission & ICF, 2017), as people are not aware of their prior learning and do not count informal learning outcomes as a part of professional competences.

Further research may explore how comparative judgment could be implemented in the assessment procedures within the *net of competences* to increase the overall validity of the assessment. Comparative judgment turns out to be a valid approach to implement rank ordering of documentation of several applicants, which is strongly facilitated by ICT. In regard to the design of the *net of competences*, further research should aim at validating candidate items and verb levels by the relevant stakeholder groups. To strengthen viability in the field, further research may assess the perceived usefulness and perceived ease of use and conduct usability tests of the ICT-artifact. As outlined in section 4, it is important to determine criteria that increase or decrease the weight of a single documentation. Thus, it is important to find answers to the question, which criteria influence the trust and

trustworthiness of documentation in mediated social interaction. For example, how reputation scores influence trust in online interaction has been subject to extensive scientific research. From a technical perspective, natural language processing (NLP) and text analytics methods may be incorporated in future research. For instance, the *net of competences* could integrate methods to analyze synonyms (e.g. through ontologies), word meanings and word types (e.g. through part-of-speech tagging).

At this time, we only validated the learning outcomes of five different occupations. Although these five occupations are very heterogeneous, we currently do not have insights whether all the other Austrian occupations can be integrated into the net of competencies. Therefore, the validation process has to be continued and enlarged. Further research should also validate the applicability of the model for learning outcomes described in other national quality frameworks.

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ARTIFICIAL INTELLIGENCE AND DIGITAL REPOSITORY OF CRAFTS KNOWLEDGE FOR ROBOTIC CREATION OF 3D-OBJECTS

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ABSTRACT

The main question is: How can specific crafts knowledge (applied in handicrafts, craft skills, practical knowledge, techniques, procedures, methods, clues, etc.) be codified as digital media procedures and objects in such a way, that a user and/or a machine can reproduce the artefact? In the era of digitalization, craft knowledge is digitally transformed in two ways: (1) from analogue (written) descriptions to digital files and (2) digital object descriptions containing full guidelines for robotic production. Today, virtual and digital models represented as software objects can easily be created as real 3D-objects by using 3D-printers. A worldwide new maker culture is transforming the handicraft traditions fundamentally. Therefore, the Carinthian Economic Chamber launched the Makerspace Carinthia (see 4.1) in 2018. The Styrian Economic Chamber is currently planning a Center of Excellence, where traditional trade and craft education, combined with the new maker philosophy, will be implemented by WIFI, the Institute for

Economic Promotion of the Styria Economic Chamber. Moreover, the Styrian Economic Chamber in Austria launched a "Talentcenter" (see 4.2), where young people from 13 to 15 years of age can explore their talents, in 2016. Finally, the European competition "EuroSkills" (see 4.3) will take place in Graz, Austria, in 2020. Knowledge management and crafts research have been institutionalised in the Institute for Applied Research on Skilled Crafts and Trades, Vienna, Austria (see 4.4). The process, which transforms analogue knowledge into digital libraries or repositories is guided by knowledge management principles. These principles may be codified in AI supported rule books which should help to combine digital repositories and meta-repositories, maker spaces and 3D model databases to motivate, educate and train a new generation of producers and craftsmen. The authors introduce a concept for a Digital Content Repository of Crafts Knowledge (DICOROCK) (see 3).

Keywords: Artificial Intelligence, crafts knowledge, repository, mixed reality, 3D-printers

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KEY FINDING(S)

- There is a shift in knowledge management from static HTML pages to dynamic transactional e-services
- Transactionality increases interactionality, especially triggered by IoT, robotics, AI, VR/AR/MR, real time applications and low latency communications like 5G
- Artificial Intelligence (AI) uses three main types of technologies: expert systems, machines learning (ML) and deep learning (DL); AI is still over-estimated, we are far away from AGI (Artficial General Intelligence), e.g. the problem of data quality in ML and DL
- AGI will be achieved with a 50 percent probability in the year 2029 (Ray Kurzweil) or 2200 (Rodney Brooks)
- For AGI a paradigm shift is necessary from AI to Artificial Consciousness (AC); to really understand information AI needs personal identity and consciousness
- A digital repository is a pre-condition for AI driven robotic creation of 3D objects in the quality of human craftsmen
- 3D printing is a new paradigm for the production process; it still is in the beginning
- Even the famous Austrian Sacher tort can theoretically be printed by a 3D-printer
- A multimedia video repository platform like WKO.tv stores descriptions and metadata as videos, 3D object files and multimedia descriptions

IMPLICATION(S) FOR THE PRACTICE OF SMEs

- The authors suggest to create an open source digital content repository of crafts knowledge (DICOROCK) where crafts knowledge will be stored in all digital content types
- DICOROCK should connect to the company databases, e.g. to Firmen A-Z at WKO (http://Firmen.WKO.at), which is a database of all Austrian companies and to a multimedia digital repository, e.g. WKO.tv
- Pattern recognition in combination with DL is already a mass market technology, in so-called "Makerspaces" and "Centers of Excellence" start-ups and young entrepreneurs should learn to transform the production process into the digital domain

- Talents should be found and motivated in new infrastructures like "Talent Centers", who will boost the digital transformation process
- New digital skill levels should be defined and integrated into international and European championship competitions of young professionals like Worldsklills and Euroskills
- New organisations like the Institute for Applied Research on Skilled Crafts and Trades, Vienna, Austria support the digital transformation of craft knowledge
- Standardisation is the key to bring uniqueness and flexible production together; a digital repository like DICOROCK is a first step into this direction

1 INTRODUCTION

Knowledge management, which became standard procedure in mature organisations and companies in the mid-1990s, is currently changing dramatically. Until today, the typical role of knowledge management has been to use, collect, share, manage and create knowledge and information. The most common application of knowledge management is still the intranet or ECM (Enterprise Content Management), where employees can find all relevant information and digital workflows (business processes) according to their user access rights and security permissions. A typical intranet nowadays consists of (1) individual login of the employee, (2) search of persons and contents, (3) news and innovations, (4) annual reports, (5) information of the works council, (6) information about the history of the organisation/company, (7) human resource management, (8) finance and controlling, (9) strategy, e.g. balanced scorecard management, (10) data protection, IT-compliance and information security, (11) marketing, (12) research & development, (13) IT department, (14) facility management, (15) legal department, (16) events and event management, (17) learning (webinars, courses, tele-learning etc. (Astleitner & Schinagl, 2000)), (18) self assessment tests, (19) e-quiz (Maurer & Schinagl, 2007), (20) communities (Korica et al., 2006), (21) procurement, (22) various archives (e.g. technical documentations, business cases, production data, controlling, strategy), (23) ethics, (24) emergency, (25) Wiki (Maurer & Schinagl, 2006), (26) bulletin board for employees, (27) lunch buffet plan, etc.

At the beginning of the intranet era, static HTML pages and links to documents as PDF files were standard. Today more and more transactional e-services are being used. Written rules in e.g. compliance documents have been extracted and implemented as e-services, workflows and clickable business processes. ECM has changed in alignment with technological development since 2010. Consequently, major IT trends in business and leisure (Götschl & Schinagl, 2003), e.g. smartphones, 4G, apps, cloud, wearables, virtual and augmented reality, big data, robotics, industry 4.0, digitalization, IoT (Internet of Things), blockchain technology, machine learning, artificial intelligence, 5G, etc., have influenced knowledge management significantly. The continuous digital transformation process of the last years shows that static data with interactions and transactions performed by humans have been replaced by complex dynamic data which process and execute cyber-physical, autonomous and largely

self-organising systems directly and without human control. In such systems, transactions are performed by machines (currently, humans only control e.g. security, plausibility and performance). A transaction is an action in the virtual world (e.g. clicking on a button in an app), which has an effect in the real world, e.g. to purchase a book in a web store or to switch on the alarm system in the home. Transactionality has overtaken interactivity. The big era of interactivity (Foresta et al., 1993), which can be described as "click-and-look", is therefore over. Not humans, but data directly, control transactions. Transactionality forces standardization as well as e-service applications and data interfaces to connect applications among each other and to set up a consolidated data pool with all organisational and technical data in a big digital data repository or internal data market (big data). This data market is the source for current and future artificial intelligence data analysis. An internal data market puts a new perspective on knowledge management, because a centralised data pool is a new source of hidden knowledge. Artificial intelligence (AI) and the next generation mobile network 5G (Schinagl, 2018a), as well as virtual/ augmented/mixed reality (VR/AR/MR) and robotics, are the main innovation drivers in the knowledge society (Schinagl, 2001) for the next decades.

2 ARTIFICIAL INTELLIGENCE

What is AI today? To put it short, AI is a marketing term to increase software sales (Schinagl, 2019). This definition is not ambitious, but very pragmatic, austere and disillusioning. As a motivator and innovation driver, Al should have a broader connotation, e.g. a more human-level AI, or what is typically called "Artificial General Intelligence" (AGI). Nowadays, AI uses two old technologies and one more or less new approach. There are rule based systems, also known as expert systems, machine learning (ML) and deep learning (DL), which appeared more recently. Rule based systems go back to the programming languages LISP (1960s) and PROLOG (1970s) as well as expert systems (1970s). ML originates from connectionism, neural networks and the most influencing publication of James L. McClelland and David E. Rumelhart in 1986: "Parallel Distributed Processes". DL (since 2000) has been a further development of ML and uses input layers, one or several hidden layers and an output layer of emulated neurons (nodes). DL performs well at statistical learning, pattern recognition and big data analysis. In short, ML and DL are pattern recognition engines which must be trained using thousands of examples (e.g. pictures, sounds, data patterns). The problem of training data is that the data quality must be very high, e.g. you must show the systems thousands of cats for them to correctly identify a cat in a given picture. The problem for ML and DL is bad data, e.g. if there are lots of rabbits, dogs and cats in the data set, which have all been labelled as cats, then the system does not work properly. Bad data is missing, incomplete, inaccurate, biased or wrong data. If DL was compared to the performance of a child, the child would be able to identify a cat after only a few correct examples. If the child was then shown a crocodile and told it was a cat, the child would immediately recognise the mistake and reject the proposal. Therefore, AI still requires substantial development to reach human levels of intelligence and an AGI is only feasible in the far future. Some AI researchers already predict a next AI winter of long duration. In 2018, Martin Ford published a bestseller called: "Architects of Intelligence. The Truth About AI From The People Building It" (Ford, 2018). In it, he presents interviews with 23 people deeply involved in the development of AI, like Geoffrey Hinton, Yoshua Bengio and Yann LeCun, Nick Bostrom, Andrew Ng, Ray Kurzweil, Josh Tenenbaum and others. Geoffrey Hinton, Joshua Bengio and Yann LeCun received the 2018 Turing Award, known as the annually awarded "Nobel Prize of Computing", worth US\$ 1 million, for their work developing the AI subfield of deep learning. In the last chapter, Martin Ford asks each participant to tell him at what time there would be at least a 50 percent probability that AGI would have been achieved. Five people declined to give a guess. Ray Kurzweil suggested 2029, and Rodney Brooks 2200. The remaining 16 preferred to be anonymous voters. The 18 guesses were: 2029, 2036, 2038, 2040, 2068 (3), 2080, 2088, 2098 (2), 2118 (3), 2168 (2), 2188, 2200. The mean is the year 2099, which is 80 years from now (2019). The "AI Impacts" website (https://aiimpacts.org/ai-timeline-surveys/) shows results for a number of older surveys, which cluster in the range between 2040 and 2050. Martin Ford: "If you want to see a true thinking machine, eat your vegetables."

The authors of this paper believe that the problem of AGI is more fundamental. A computer, or nowadays an artificial neural network, e.g. realized by Nvidia GPUs using special algorithms called deep learning frameworks (e.g. PyTorch, MXNet, TensorFlow, MATLAB, NVIDIA Caffe, Chainer, PaddlePaddle, etc.), is still a syntactical engine using symbol manipulation of zeros and ones. Both a computer and an artificial neural network know nothing. They even have no information. If we, as humans, talk about information, we mean the information we have, and this is completely different to the information computers and artificial neural networks use. Human intelligence stores and processes information in a way we still do not understand completely. We know some details about neurons and the way signals are transmitted, but we do not know how information, knowledge and experience are codified in the brain. In 1980, the US philosopher of mind John Searle invented the famous "Chinese Room Argument", where he shows that an algorithmic and symbol manipulating engine, like a computer or an artificial neural network, can never understand anything. For a real understanding, we need a subject, a personal identity (Schinagl, 2017; Schinagl, 2011; Schinagl, 2010), an I, an ego, a consciousness to attach meaning to an object. We need a new concept of information and knowledge, massively extending the concept of bits and bytes. The basis for a next generation AI will be a concept for synthetic consciousness or artificial consciousness (AC). Well known philosophical terms like intentionality and phenomenological consciousness will play a major role in the architecture of new computer systems. Nowadays, a computer has no attention, because there is no consciousness which directs the attention to a certain object. All inner perceptions, known as first-person-view, like the phenomenological and subjective inner experience of joy, pain, sadness, happiness, taste or colour-perception (gualia) are not relevant in today's computing paradigm. Even if AI does not understand anything, it manages to produce impressive results. Especially fruitful is its role in preparing and opening the market for AGI. Like human intelligence, AGI also needs big data, stored in a repository. A repository is similar to an archive, but in addition to digital objects, it contains data descriptions and relations between objects (metadata). Thus, a repository is a key infrastructure for the prevention of loss of craft knowledge (Götschl & Schinagl, 2003a) and a source for a later AGI – therefore the authors propose a Digital Content Repository of Crafts Knowledge (DICOROCK).

3 DIGITAL CONTENT REPOSITORY OF CRAFTS KNOWLEDGE (DICOROCK)

How is crafts knowledge codified so that artisans can transfer their knowledge to apprentices? Take, as an example, the production of a table, which is usually perfectly achieved by a joiner with the competence of a master craftsman. A typical joiner apprentice needs the average intelligence of a 14 year-old, some competencies in space perception, language comprehension, mathematics and geometry, statics, design, special knowledge of the material properties of wood, how to process wood and safely build wooden objects by using special

woodworking tools and other components. An easy way to learn how to build a table is to read a book about table-construction, to watch a video on YouTube, e.g. "How to make a simple table", to read a wikiHOW, e.g. "The Easiest Way to Make a Table", or to ask a master craftsman, to show how to do it. The quickest way to build a stable and robust table with a nice design is to learn the procedures from a master craftsman in a joinery, where the tools, different sorts of wood and all components for the production of a table are already available. After two or three tables have been built by the master, where the apprentice has watched the steps of construction, and where the master has instructed the apprentice and has asked for help, the apprentice will soon be ready for making a table alone. The question now is, are there any robots in the world which can construct a table like an apprentice, e.g. by just watching the master craftsman, performing instructions and being a helping hand for the master? The answer today is no. But of course, there are ways to construct beautiful tables automatically by machines. This is done by complete rationalisation of all steps of production and standardisation. There is a similarity, on the one hand, to build a table in a fully specified script language in a big construction hall with lots of robotic machines (type A) and, on the other hand, with a 3D printer (type B). The scripts are different, but the necessity of standardisation and rationalisation of the processes is equal. For example, to produce tables according to type A, the following simple script is to be followed: (i) order and deliver a selected wood panel from the high-bay warehouse, (ii) put the panel on the wood cutting machine and cut out the selected size, (iii) order and deliver the pre-fabricated wooden table legs, (iv) bring the wooden table plate and table legs into the right position, so that a robotic arm can apply adhesive to the legs and plate, and press them together, (v) check the product, package it securely and deliver it to the sale warehouse. The script for a 3D-printer (type B) is even simpler, especially if a table for a dollhouse should be printed. Thousands of tiny melted plastic slices are printed layer per layer to form a solid object, e.g. our dollhouse table. The description, where the tiny slices should be positioned is provided in a highly standardised digital file representing the 3D geometry. These files usually have the extensions: OBJ, STL, VRML, X3G, PLY, FBX, etc.

3D printing is a fast and cheap way to construct objects for real world applications. The main reason for its success is that the idea for a new object is constructed as a virtual digital object, which directly represents the real object in the real world. There is hardly any difference between the virtual representation of the object in the computer and its materialistic existence – the 3D-printed object – in the real world.

In the industrial production process of type A, lots of individual steps have to be processed, but the 3D-printer (type B) prints out the object immediately in one step. If craft knowledge was to be transformed into a digital representation, the methodology of a 3D-printer, which has the full specification of the object in a digital file, should be analysed. Thus, the question arises, whether it is possible to store not only the whole virtual object, but the whole craft knowledge in a digital representation, e.g. a file, a database or a repository? For many years, the prototype and design process, model building, testing, fitting models in virtual environments, etc. have been fully digitized for mass production on the one hand, and for an individual customized edition on the other. The whole marketing and sales processes have thus been transformed into the digital domain. Only if the real material object is needed, will it be created, produced, built, or printed materially. This is called on-demand production or on-demand manufacturing. In addition to the industrial concepts of industry 4.0, digital and virtual enterprise,

a sub-culture of young innovators has emerged. A worldwide new maker culture is transforming the handicraft traditions fundamentally. 3D model repositories like Thingiverse, MyMiniFactory, YouMagine, Pinshape, NASA 3D, NIH 3D Print Exchange, TurboSquid, SketchUp 3D Warehouse, Hum3D, 123D, GrabCad, etc. have been online for several years and many of them offer free 3D models for print. Thingiverse alone offers more than 1.4 million 3D objects to download and print out on a 3D printer. Everybody who owns a 3D-printer is able to create objects on the fly, without the specific knowledge of an artisan. Therefore, we ask will craft knowledge be obsolete in the future, because all objects may be produced by standardised processes using virtual objects on platforms such as Thingiverse? The answer is no, because we need the craft knowledge as a source for scientific research and development. In the procedures of handicraft, knowledge is very often stored as special experience from several generations. Procedures are also dependent on the cultural background of the artisans. Therefore, the variations of the procedures are new data and subject for scientific research and analysis, e.g. in the manufacturing of healthy food. Scientific discussions about the value of craft knowledge – even historic craft knowledge – is one of many objectives of the Institute for Applied Research on Skilled Crafts and Trades in Vienna, Austria.

The authors suggest to create an open source digital content repository of crafts knowledge (DICOROCK) where crafts knowledge will be stored in all digital content types, e.g. scanned handwritten notes, scanned handbooks, scanned books, e-books, links to web sites with specific crafts knowledge, videos, audio books, WIKIs, digital encyclopaedias, historical archives, etc. The crafts knowledge will be primarily categorised according to the catalogue of the branches, profession groups, guilds and committees of the Austrian federal economic chamber (WKO.at). Additionally, this catalogue contains references to the most important classifications of economic activities, e.g. NACE revision 2. The DICOROCK is an open platform and may connect to the database of all Austrian companies, the "FIRMEN A-Z" at the web site http://firmen.WKO.at, which was originally developed by one of the authors of this paper, Wolfgang Schinagl in 1999. Companies sometimes have very unique crafts knowledge, e.g. the Hotel Sacher Corporation, which has been producing the world-renowned Sacher-Torte, created by the 16-year-old apprentice Franz Sacher for Prince Metternich, since 1832. If the recipe is a secret - as it is in the case of the Sacher-Torte - then the essential part of the process is missing. Nevertheless, it still makes sense for Hotel Sacher to link its unique products to DICOROCK, e.g. for marketing reasons, showing best Austrian quality and tradition. The DICOROCK platform is based on the video platform http://WK0.tv, which is a metadata repository created by Wolfgang Schinagl in 2008 with an own streaming video service. In 2017, the video streaming was transferred to YouTube, and the metadata engine synchronizes video metadata with YouTube WKO channels of the economic chambers of Styria, Upper Austria and Burgenland. Since 2017, WKO.tv is called "WKO.tv Next Generation", and it monitors the YouTube web site for new videos, also in newly added playlists, in real time. The algorithms use weak AI – a rule-based system – which dynamically adapts to new playlists and new metadata from the YouTube channels. The next stage of WKO.tv will be WKO.AI for Artificial Intelligence. It may use the DICOROCK concept for integrating craft knowledge into Austria's company database firmen.WKO.at and the multimedia video repository platform WKO.tv. A further development of WKO.AI will describe the architecture of an Artificial Intelligence system, which will automatically collect digital knowledge atoms and objects, classify and generate meta-data, and show examples, e.g. videos, descriptions, link collections and 3D-objects. The major application for phase 1 of DICOROCK is in schools, on-the-job-trainings, polytechnical schools, training centres, universities of applied sciences, etc. and in phase 2 the automatic production of 3D-objects by e.g. 3D-printers and other industrial processes. This repository is also capable of showing demo cases in mixed reality (MR) and will offer interfaces to 3D-printers for robotic production in real time.

4 SOCIAL IMPACT OF DIGITALISATION AND THE FUTURE OF HANDICRAFT

Electronics, embedded computers, sensors and actuators, cyber-physical systems, wireless networks, embedded IT-security and especially Internet of Things (IoT) will dramatically influence all professions in the near future. Computing will play a significant role in all economic branches. Many things will get network access for human-machine- and machine-machine-communication. E.g. people can communicate with their heating at home, and their heating communicates with the Outlook calendars of their family members so that the system knows when somebody is home and comfortable room temperature is needed. This will change e.g. the profession of the plumber, who needs knowledge about digital sensor technologies, network interfaces, smartphone apps, etc. In 2012, the single-board-computer Raspberry Pi for about US\$ 35 entered the market and was successfully adopted in the maker culture. In 2019, a completely new device from NVIDIA was released: a single-board-supercomputer for about US\$ 99, called Jetson Nano, which is the new toy for AI programmers using deep learning, neural networks and 4K video resolution at 60 frames per second. Due to to the enormous speed of digital transformation we have to ask how plumbers can be up to date with the demands of their customers. The answer is that they need continuous knowledge transfer about the new challenges on the market. DICOROCK offers a digital infrastructure to fulfil such a task. Another prospective infrastructure is a makerspace.

4.1 MAKERSPACE - NEW INFRASTRUCTURE FOR GENERATION Z ARTISANS

The Carinthian Economic Chamber reacted quickly to this new trend and opened a Makerspace (www.makerspacecarinthia.com) in June 2018 for innovative start-ups and entrepreneurs. The makerspace focuses on digital production, industrial 3D-printing, several types of 3D-printers, electronics laboratory, laser cutter, vinyl cutter, paint shop, welding, sandblast cabin, metal and sheet metal processing, CNC milling machine, water jet cutting system, joinery, assembly hall and more. The motivational concept of the makerspace is to explore new ideas, to create and reflect prototypes, to adapt ideas and learn from others, and to implement new ideas into the business world. The makerspace infrastructure should help innovative start-ups to implement their inventions in a creative environment quickly, lowering the risks of long and expensive prototyping cycles. The Styrian Economic Chamber has already a finished building plan and concept for a Center of Excellence, which combines the maker philosophy with traditional education for apprentices and handicraft masters in trade and craft. The Center of Excellence will be integrated into the vocational training facility WIFI Steiermark (Economic Promotion Institute of the Styrian Economic Chamber) and should be probably ready in 2022/23.

4.2 TALENTCENTER – SUPPORT FOR GENERATION Z TO MOTIVATE AND FIND THEIR TALENTS

One of the important questions of our competitive society is matching the right job to the right person. This results in the scientific discipline of talent research. It would advantageous, if one could take a test that shows, which profession or set of professional abilities best fit their talent. As we know from statistics, young people

have problems finding the right education and subsequently the right job. Young people start as apprentices with craft education and find out, that it has been the wrong way and drop out. Dropouts are nowadays a severe problem in job reality, school, higher education, and university generating disadvantages for all individuals and organisations involved. Therefore, the Styrian Economic Chamber (WKO Steiermark) has set up a Talentcenter (www.talentcenter.at) in cooperation with the University of Graz in 2016. Up to 5000 young people between 13 and 15 years of age are tested each year. Each test lasts for half a day and the test items cover logic, knowledge, motor function and dexterity, receptivity, retentivity and concentration, technical and organisational understanding, individual strengths, etc. The result is a talent report with recommendations for professions and their educational paths. The talent report should provide orientation for the young people and their parents. The results suggest options for a choice to begin a vocational training or higher education – to be motivated and gain a fulfilling job.

4.3 EUROSKILLS 2020 - "WE ARE SKILLS" AND "HEROES OF ECONOMY"

The Economic Chamber of Styria (WKO Steiermark) is aware of the importance of young talents for a competitive economy. Therefore, WKO Steiermark and the city of Graz applied for Euroskills 2020 (www.euroskills2020.at and www.euroskills.tv) and won. EuroSkills is the European championship of young professionals, a spectacular promotion of skills and most recent skills developments around Europe. Apprentices and young people should be motivated to show their skills and talents in a competition at European level. WorldSkills (www.worldskills. org) is the same championship competition at global level. The goals of EuroSkills are: (i) support of orientation to find the right job, (ii) to get to know the rich spectrum of professions and which professions have great perspective, (iii) motivation for creative handicraft professions (iv) motivation for new technical professions (v) increase in value of handicraft professions and professions lacking staff, (vi) platform to show how professions develop and change, (vii) platform to connect companies and young professionals, (viii) platform to show potentials for individual careers based on performance, output and competence.

4.4 INSTITUTE FOR APPLIED RESEARCH ON SKILLED CRAFTS AND TRADES, VIENNA, AUSTRIA

The Institute for Applied Research on Skilled Crafts and Trades, Vienna, Austria (Institut für Angewandte Gewerbeforschung) belongs to the Austrian Economic Chamber and was founded in 2016. It is a platform of a broad range of scientists and entrepreneurs interested in the development and transformation of trade and craft to discuss and reflect the challenges of a future society based on new technologies and methodologies. The Institute for Applied Research on Skilled Crafts and Trades has a special focus on education and job, society and communications, economy and labour, future and development, ethics and law, technology, art/design and knowledge management.

5 NEXT GENERATION MOBILE NETWORK 5G, ARTIFICIAL INTELLIGENCE, MIXED REALITY AND ROBOTICS

The most important innovation drivers (Schinagl, 2018a) for next generation enterprises, production, logistics, research and development are the four key technologies: 5G, AI, mixed reality (MR) and robotics. The main

advantages of 5G are high data rates over the air up to 1 Gbps, extremely short delays on IP packets at about 1 millisecond, which is essential for autonomous mobility, and global availability. The main applications of AI in the next few years will most likely be speech recognition, natural language understanding, speech synthesis, vision and pattern recognition, real-time analysis of big data and autonomous systems. Mixed reality is derived from virtual reality (Schinagl, 1988) and augmented reality, where virtual objects from a virtual world co-exist with real objects in the physical world and are linked together. This hybrid MR world can be easily entered with a smartphone or with immersive devices like transparent head mounted displays, where virtual objects are overlaid on real objects in the field of view, e.g. with Microsoft HoloLens 2 (www.microsoft.com/hololens). Robotics is a very wide field with an enormous number of potential of applications, e.g. classical handling robots with a robot arm, robo-cars, -ships, -trains, -planes, -toys and -animals, -mowers, -weapons, drones and robo-copters (Schinagl, 2018), android robots, nano robots, 3d-printers and more.

In general, the objective of handicraft is to create, operate, install, edit, transform, maintain, repair, change, safely destroy 3D-objects, and examples are to create a cake, make a table, repair a car, install a window, maintain the heating in the house, etc. Robotics has nearly the same effect as handicraft in principle, but it still lacks flexibility. Robots can operate best in completely standardised environments, where the work process is segmented into tiny tasks with a high repeat rate. Sitting on the terrace in the morning, enjoying breakfast and fine weather and drinking a coffee, people might to tell their little robocopter-drone using speech recognition to fly to the garden door, take today's newspaper out of the mailbox and bring it to them, but it will fail. At least for the next few years, this task is too complex and too general. But in a standardised environment given the garden coordinates, the position of the garden door, the mailbox and the newspaper, drone commands, a drone with a robot arm, etc. the maker scene would find a solution for such a case. This would, however, not be a general solution and not even outperform a trained dog, which could do the same, although not flying.

This example shows that standardisation is the key for automation. But handicraft is very often more unique, customised for very special applications and needs lots of experience and knowledge. The challenge is to bring uniqueness and flexible production together. Robotic production with a 3D-printer accessing a DICOROCK is a first step.

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