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## PREFACE

Information technology is an everyday means that is found in all walks of life today. This is also true for almost all areas of agricultural management. The aim of this Journal is to improve scientific knowledge dissemination and innovation process in the agri-food sector. The Journal of Agricultural Informatics has been established in 2009 by the HAAI within a project of the Hungarian National Development Plan Framework. The peer-reviewed journal is operating with international editorial and advisory board supported by the EFITA (European Federation for Information Technology in Agriculture Food and the Environment).

Agricultural informatics serves not only the development of the management systems of the industry but also obtaining and publicising information on production, organisation and the market for the producer.

Technologies into network based business systems built on co-operation will ensure up-to-date production and supply in food-industry. The sector-level approach and the traceability of processed agricultural products both require the application of up-to-date information technology by actors of domestic and international markets alike.

This journal serves the publication as well as familiarization the results and findings of research, development and application in the field of agricultural informatics to a wide public. It also wishes to provide a forum to the results of the doctoral (Ph.D) theses prepared in the field of agricultural informatics. Opportunities for information technology are forever increasing, they are also becoming more and more complex and their up-to-date knowledge and utilisation mean a serious competitive advantage.

These are some of the most important reasons for bringing this journal to life. The journal "Agricultural Informatics" wishes to enhance knowledge in the field of informatics, to familiarise its readers with the advantages of using the Internet and also to set up a forum for the introduction of their application and improvement.

The editorial board of the journal consists of professionals engaged in dealing with informatics in higher education, economists and staff from agricultural research institutions, who can only hope that there will be a demand for submitting contributions to this journal and at the same time there will also be interest shown toward its publications.

Prof. Dr. Miklós Herdon  
Chair of the Editorial Board

## Content

<i>Zsanett Angyalos, Szilvia Botos, Robert Szilagyi</i> <i>The importance of cybersecurity in modern agriculture.....</i>	<i>1</i>
<i>Róbert Barna, Bernadett Horváthné Kovács</i> <i>Elevation models on a sample area of Bőszénfa.....</i>	<i>9</i>
<i>Tamás Marczin</i> <i>Economic effects of African swine fever at Hungarian and European level.....</i>	<i>18</i>
<i>Tamás Kovács</i> <i>Role of gamification at the University of Debrecen, with special regard to the Faculty of Economics.....</i>	<i>28</i>
<i>Hasan Al Jafa, Jihad Fraij, László Várallyai</i> <i>The role of Agile management in HRM environment change.....</i>	<i>37</i>
<i>Jihad Fraij, Várallyai László</i> <i>Proposed Model For Artificial Intelligence Acceptance in Recruitment: Telecom in Jordan.....</i>	<i>46</i>

## The importance of cybersecurity in modern agriculture

Zsanett Angyalos<sup>1</sup>, Szilvia Botos<sup>2</sup>, Róbert Szilágyi<sup>3</sup>

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### ABSTRACT

Nowadays, the use of information tools has become commonplace; we can not imagine our world without their help. As in any sector, agriculture needs to use these tools as the rapidly growing population food supplier. However, keep in mind that IT (Information Technologies) assets are threatened by severe threats and significant cybersecurity risks. Precision farming is based on IT, so the threat level is high. There are several information theories about information security, and there are researches in the field of agriculture informatics. The digitalization of agriculture is essential, but it brings new problems to many farms. Such new technologies like IoT devices (Internet of Things), blockchain seem to be useable in agricultural processes, but the possible IT breach should be handled. The agro-industry IT security is more vulnerable than ever before, but the benefits of using the technology promise to outweigh the risks.

## 1. Introduction

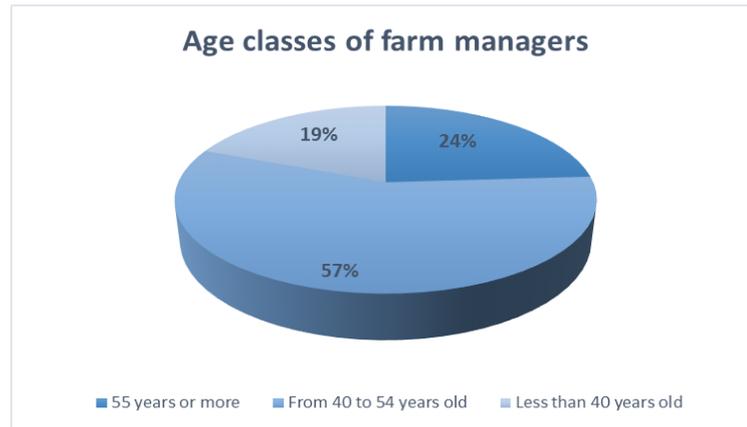
The agricultural sector plays a significant role throughout the world. The rapid development of information and communication technologies is strongly influencing the structure and procedures of modern agriculture. Today, the use of information tools has become commonplace, without their application, we cannot imagine our world. As in any sector, the use of these tools has a key role in agriculture. The problems caused by the rapidly growing population and global warming make it increasingly difficult to produce the right quantity and quality of food (Karlov, 2017). However, the spread of innovative technologies is hampered by a number of factors. In the European Union countries, primary agricultural production is still dominated by small family farms, which may not be able to afford modern systems (Jussi et al., 2020). Another major obstacle is a generational change and educational attainment, as according to Eurostat data from 2016, more than 80% of farm managers are over 45 years old and more than 50% are over 55 years old. The share of managers under the age of 40 is only 19% (Eurostat, 2016).

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**Figure 1.** Age of farm managers (according to eurostat)

The aging of the farming population and the relatively low education level are major obstacles to the spread of innovative technologies. In addition, research has shown that information barriers also significantly hinder the diffusion of technologies, as farmers must first know that such a solution exists, understand how to use it, and believe that its application can improve productivity.

The Earth's population is estimated to grow to approximately 11 billion by 2100, which means we will almost have to double the amount of food produced today by then.

Therefore, it is crucial that producers, processors, and farmers use high-tech tools/systems to optimize production conditions, use resources efficiently, and reduce waste. The use of intelligent farming technologies and precision technologies can be an excellent solution. Intelligent farming technologies include data collection and processing to improve crop fields and food quality. For example, a moisture sensor placed in the ground can be used to reduce the application of excess water. Such technologies make it possible to create the right environmental conditions for plants in greenhouses or even animals (Erdeiné, 2020).

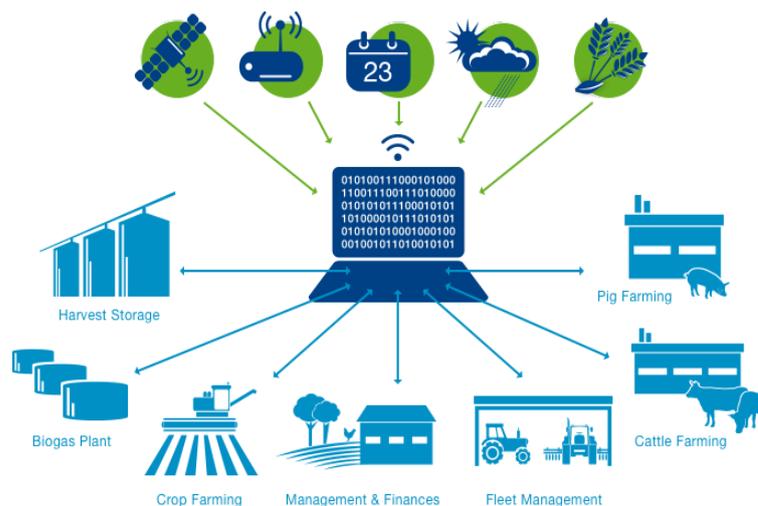
## 2. Information technology in precision agriculture

Precision farming is a complex concept. In this case, it is a set of tools and methods that, based on IT-technological developments, result in significantly different production technology solutions than before. They can be applied to make farming more efficient and effective while taking environmental and sustainability criteria into account (Angelita et al., 2020).

High-precision navigation and automatic machine steering are essential for precision farming. Software is also a prerequisite for precision farming, as continuous data collection and processing are required.

The continuous development of technology is bringing innovative solutions day by day. Thus, it is more and more challenging for many to follow technical developments and create the conditions for their application.

The determining element of the future of agriculture is the development of integrated systems, the interconnection of the existing ones (Figure 2).



**Figure 2.** Interconnected Systems

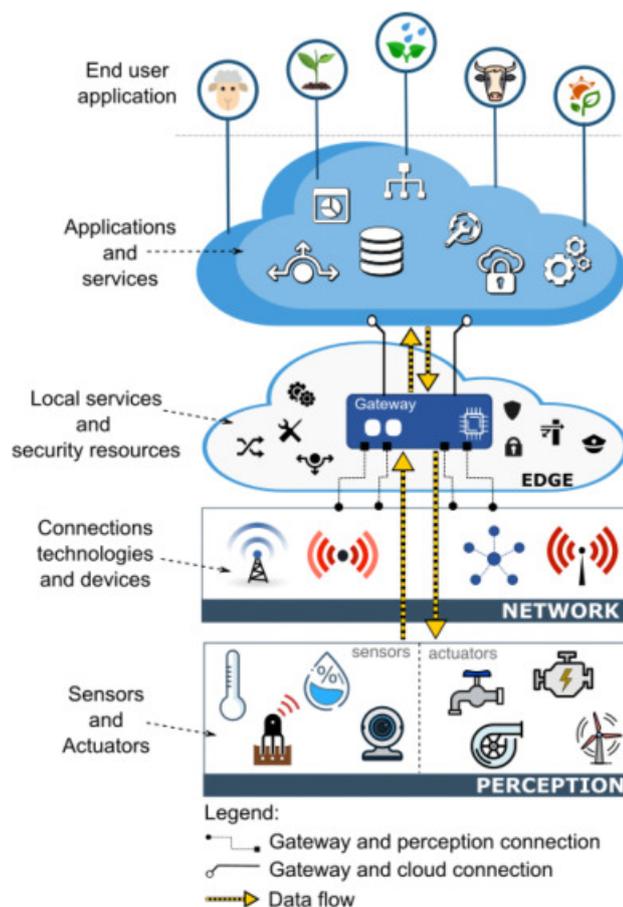
However, keep in mind that IT (Information Technologies) assets are threatened by serious threats, but by significant cybersecurity risks. What about the definition of cybersecurity? „Cybersecurity: The activity or process, ability or capability, or state whereby information and communications systems and the information contained therein are protected from and/or defended against damage, unauthorized use or modification, or exploitation.” Department of Homeland Security: National Initiative for Cybersecurity Careers and Studies – Glossary

“The activity or process, ability or capability, or state whereby information and communications systems and the information contained therein are protected from and/or defended against damage, unauthorized use or modification, or exploitation.” (DHS, 2014).

"The state of being protected against the criminal or unauthorized use of electronic data, or the measures taken to achieve this." (Oxford University Press, 2014).

## 2.1. Threats in precision agriculture

Systems connected to the World Wide Web can easily fall victim to “cybercriminals” who, on the one hand, can recover the data they have acquired and, on the other hand, paralyze the entire automated economy and cause any damage in this regard. Potential agricultural attacks can create an unsafe and product-less farming environment. Attackers in closed systems (smart farm, greenhouse, livestock farm) environmental conditions can be modified to destroy the plants and animals there. Furthermore, if the control systems of an automatic tractor, combine, drone are attacked, farmers will have unpredictable consequences, such as plant protection “accidents”, soil poisoning, severe crop losses.



**Figure 3.** Connections between different systems (Angelita et al., 2020)

Figure 3 shows the interaction between endpoints between different authorizations involved in the system. Sensors and operation systems generate data, they get instructions through applications. Gateways are used to flow one piece of this data from one network to another. In the cloud, end users can access large amounts of data and information (Angelita et al., 2020). For example, from an environmental point of view, with energy-economic information, or other relevant information, the acquisition or manipulation of which could cause significant damage to the economy. Such attacks are often called agroterrorism when an agriculture-dependent economy can easily disrupt. The report, released by the U.S. Department of Homeland Security, has elaborated on various cyber threat scenarios in precision agriculture and further emphasizes the need for research on this critical topic. A sophisticated agroterrorist attack on a major exporting country has a healthier detrimental effect on millions of consumers worldwide. Also, such attacks can undermine the confidence of importing countries.

#### **Main theories in information security**

The Confidentiality, Integrity, Availability (CIA) model is a fundamental information security element (Kim and Solomon, 2012). In the CIA model, confidentiality covers data privacy; only authorized users can access the information. Integrity covers data validity and accuracy.

Availability covers the data or services being accessible. In a proper cybersecurity environment, these three aspects of information security are guaranteed. Trendov et al. (2019) mention data security regarding agricultural big data. West (2018) discusses that there are two types of precision agriculture systems - those that have been hacked and those that will be.

In general, agricultural cybersecurity is an existing problem, especially for small and medium farms, where the farms' staff are not trained to be technology experts. Therefore, the digitalization

of agriculture brings new problems to many farms that they cannot manage professionally (Nikander et al., 2020).

### **The consequences of the attacks**

According to the World Health Organization (WHO), more than 10 million people die each year from food-related illnesses, and 600 million people get sick because food is contaminated with bacteria, viruses, chemicals. On the basis of the risks, economies do not give up the opportunities offered by IoT (Internet Of Things) systems, nor they have to give up, as they can gain a significant competitive advantage by using them. For the reasons mentioned above, farms need to be aware of such and similar threats and their prevention.

## **3. Transformation of agriculture**

Botos et al. (2015) research focused on rural micro and small to medium enterprises about their significant economic role. With their survey, they get an answer to how firms use the internet, which are the relevant ICT for them, and what it depends on. They asked several SMEs from the North Hungarian region, 106 SMEs were interviewed. The internet usage and the ICT relevance were highly represented.

Agricultural businesses are beginning to recognize the importance of digitization. The emergence of the information economy - information as a factor of production poses new challenges (Debrenti et al., 2019).

For organizations to remain competitive in this digital era and beyond, IT must embrace digital transformation and the requisite infrastructure needed to achieve it. Today, a wide range of management support systems and tools are available for the company's efficient operation. The prerequisite for the application of these systems is the appropriate digitization of enterprises and their digital readiness (Debrenti, 2019).

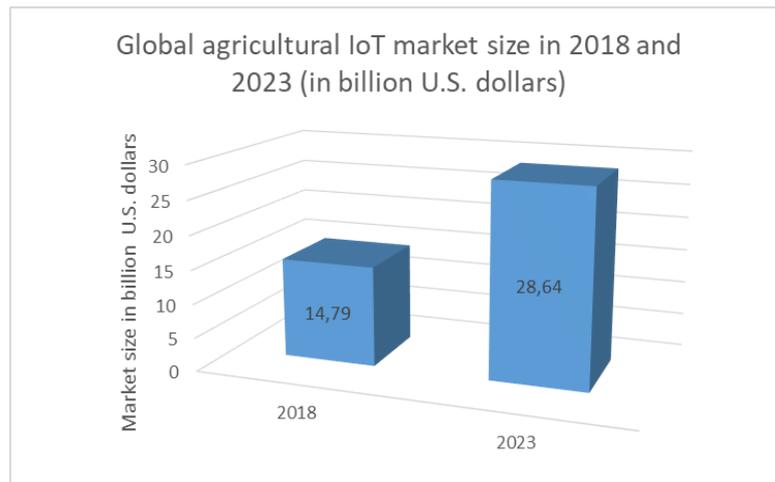
Such a new technology like the blockchain seems to be useable in agricultural processes. This technology provides so many features in food tracking (Füzesi et al., 2020). Because of the data safety and the possibility of a cybersecurity attack, it could be a potential risk in the future.

The explosive growth of IoT systems and Big Data further fuel the transformation of traditional agriculture into digital, knowledge-based agriculture, where data collection, analysis, communication, and data-based decision-making are taking place at a rapid pace (Shivappa et al., 2018).

IoT devices help with data collection. Sensors connected to tractors, trucks, fields, soil and plants to collect real-time data that analysts have instant access to. For example, data collected by intelligent climate monitoring systems can be used to map weather conditions and select the appropriate plant based on this. By storing the data, it allows farmers to export trends and develop appropriate growth strategies. When used in greenhouses, sensors can monitor temperature, soil moisture, humidity, and other variables, and even adjust environmental variables to ensure optimal plant growth. Furthermore, the sensors are able to measure the health, activity and nutrition of the livestock, thus providing real-time data on the health status of all animals. GPS technology makes it possible to track vehicles and animals' movements and can even give farmers a real-time view of the location of their livestock. Their movements can be tracked and traced back from previous data (Atac and Akleyek, 2019).

With such intelligent systems, vast amounts of data can be collected, analyzed, and used for more informed decision-making. With the help of Big Data, we can gain insight into various management operations and make real-time decisions. Besides, the sensors allow farmers to use automated identification tags to obtain data about the entire life cycle of a given product, thus helping to gather relevant information such as how the product is moved and stored throughout its whole life cycle (Sjaak et al., 2017).

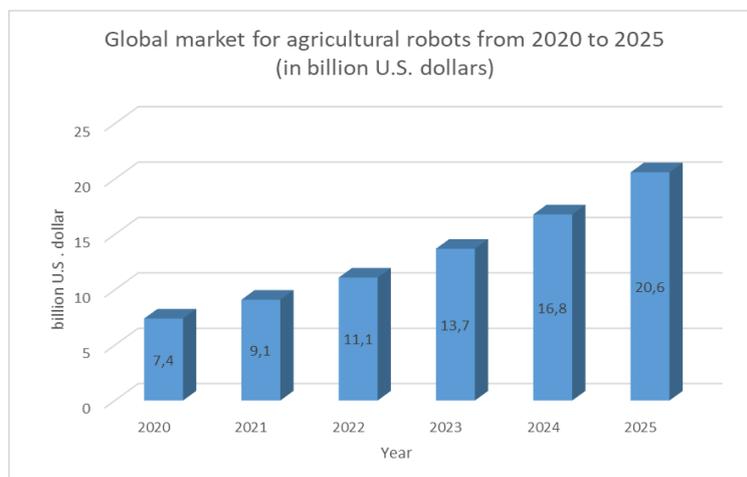
Figure 4 shows the size of the IoT device market for 2018 and 2023. The statistician predicts that IoT devices' market value in global agriculture will reach nearly \$ 30 billion by 2023.



**Figure 4.** Global agricultural IoT market (according to Statista)

There are countries where the goal is the widespread adoption of data-based technology, while robotics and artificial intelligence have already appeared in the leading markets in agriculture. The importance of robotics is shown by the fact that the global market for robots used in agriculture is projected to reach more than \$ 20 billion by 2025 (Figure 5). These innovative tools mainly help sowing, planting and irrigation, but they can also play a key role in animal husbandry, for example thanks to milking robots.

Because of this, cybercriminals pay attention to the agricultural industry, many organizations are uniquely vulnerable. After all, larger companies may have an effectively developed defense system, but smaller companies and economies have limited resources, budgets are tight, and cybersecurity is often not listed as disclosure of urgent spending.



**Figure 5.** Global market for agricultural robots (according to Statista)

## Conclusion

As the digital transformation sweeps through the agro-industry, many businesses are open to cybercriminals as the pursuit of cybersecurity far underperforms precision systems' speed. Many farmers and producers are unprepared for the threats to their systems, even they are often unaware of them. Such different threats are different in phishing emails that are designed to look real but are tricked into providing account information or downloading malware in the meantime. Malware has a wide variety of variations and is evolving. Adware tries to bombard the browser with ads, while

ransomware literally takes the computer system hostage to exclude the user from the system and release it only after paying the crisis fee.

If a farmer has to choose between a catastrophic interruption of operations and a paycheck, the paycheck is chosen, and criminals know that (Sontowski et al., 2020). Even larger companies have to struggle with recruiting people with the right expertise who provide equal and effective protection with their design. Small companies find it almost impossible to have the necessary experts, affordable people. Large economies need to protect a lot of real estates and have many opportunities to make mistakes. After all, every defense is only as strong as its weakest link.

In summary, the agro-industry is more vulnerable than ever before, but the benefits of using the technology promise to outweigh the risks. We live in a digital world where organizations that do not adopt the latest trends take the risk of lagging behind those companies that have already incorporated them into their culture. Because of this, these economies gain a significant competitive advantage.

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## Elevation models on a sample area of Bószénfa

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### ABSTRACT

Terrain models are widely used in several fields. Besides commercial Digital Elevation Models, there are open access models, as well. The available drone technology is also suitable to create elevation models. The characteristics, such as resolution, accuracy, fields of use of various models can be different.

In the present study we investigate the potential use of various DEMs on a sample field in Bószénfa, Somogy county. If the user's aim is only to get general information on surface characteristics of a given area or there is no need for high quality geodesic data, then alternative models, such as open source DEMs are reasonable options instead of expensive, commercial models.

## 1. Introduction

### 1.1. Elevation models

Digital Elevation Models are applied to graphically represent terrains, topography of fields. Practice uses several terms for elevation modelling, however the term for digital topographical models is Digital Elevation Model. Digital Surface Models (DSM) contain data of terrain and objects as well, A Digital Terrain Model (DTM) only represents the terrain without objects on it. A DSM can be assembled from aerial photos with appropriate overlaps; while a DTM is generated by active remote sensing (RADAR, LIDAR) (Barna, 2020). Elevation models' graphical illustrations are either raster or contour line maps.

A raster DEM is a dot matrix data structure that represents a rectangular pixel grid (e.g. digital photo). Each pixel is equal to the altitude measured at that point. A contour line map is a vector representation. A contour line connects the points which are in same altitude.

Several studies have been published on DEMs. In addition to the general elevation model descriptions (Fleming et al., 2010; Telbisz et al., 2013), there are studies on individual models, e.g. Rabus et al., (2003) describe SRTM, Tachikawa et al. (2011) present ASTER GDEM.

Many authors have examined the accuracy of these models, such as Höhle and Höhle (2009) or Szabó and Szabó (2010). There are articles about comparing different relief models in different sample areas (Wang and Wade, 2008; Hayakawa et al., 2008; Rayburg et al., 2009; Szabó et al., 2015; Varga and Bašić 2015; Hu et al., 2017). Elevation models provide a number of possible applications, for example, geomorphology (Badura and Przybylski, 2005; Szabó et al., 2004), flood frequency detection (Ettrich et al., 2018), or estimation of landslide susceptibility (Józsa et al., 2019).

### 1.2. Preliminary experiment

On the area of the Game Management Centre (Bószénfa) in 2018 surface data were collected through a drone flight in order to collect surface cover information (Barna & Nagy, 2020). An

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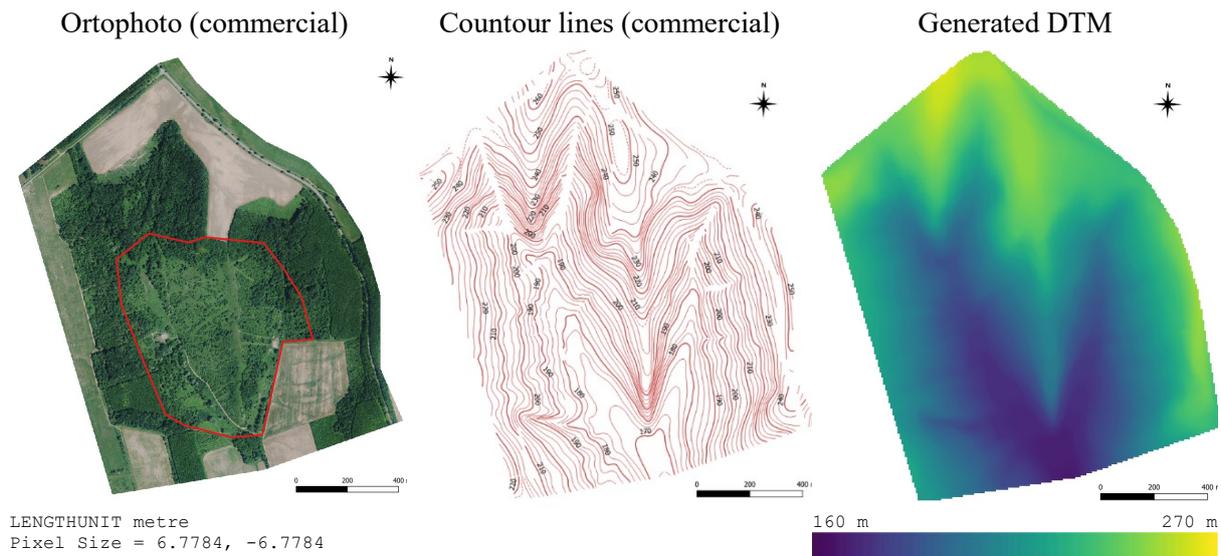
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orthophoto was purchased taken in 2015 with a spatial resolution of 40 cm/pixel and a contour line map with the HD72/EOV Coordinate Reference System (CRS) of the investigated area from the Department of Geodesy, Remote Sensing and Land Offices, under the Government Office of the Capital City Budapest (the former Institute of Geodesy, Cartography and Remote Sensing, FÖMI).

Figure 1 shows the commercial orthophoto, red line indicates the experimental field. From the contour line vector layer a Digital Terrain Model (DTM) was generating by using a GIS software. The resolution of created raster is 6.8 m/pixel. The altitude difference between the lowest and highest points is 97.5 meter (167.5 and 265 m, respectively). This generated DTM was used as the basis for the comparisons.



**Figure 1:** Orthophoto, countour lines and generated DEM of the sample area

## 2. Objectives of the study

In the study we demonstrate the descriptive statistics of various elevation models, including a commercial, three of our own records and open access models. The hypothesis is that open source models are equally exact with the commercial. We also prove that our own data from drone flight over the area has the same quality as the official models.

In circumstances, where exact geodesic measures are not necessary (as in our case), the potential use of open source models on the basis of their accuracy was also question of the analysis.

## 3. Materials and methods

### 2.1. Data

The analysis targeted the comparison of quality of various elevation modelling. The altitude values (response variables) of the models (factor variables) were taken on the sample area of Bószénfa. The compared elevation models were a) a generated DTM from official commercial contour line map; b) own drone flights (Barna & Nagy, 2020); c) four open source DEMs.

#### 2.1.1. Drone flights

On three different days (15 March n=553, 1 May n=491 and 17 June n=540) aerial photos were taken with DJI Phantom 4 Pro drone FC6310 camera at 130 meters height of flight. In order to ensure the processing quality, the set side overlap was 60%, the front overlap was 80%; and before and after the flight tracks an additional zone of minimum 50 meter was left.

An elevation model was generated from the photos taken by a drone.

Due to vegetation covering the camera cannot “see” the ground everywhere, so the terrain model contains the surface of the vegetation, too; therefore the generated model was a Digital Surface Model (DSM). The DSM was clipped to the area of the sample field and the originally used WGS84 coordinates from drone’s navigation system were converted into HD72/EOV coordinate system.

### 2.1.2. Official DEMs

The comparison was based on the Digital Terrain Model generated from commercial contour lines map described above.

The following open source elevation models were used and downloaded in GeoTIFF format: SRTM3 (CGIAR-CSI, 2020), SRTM1 (USGS, 2020) ASTER GDEM (ASTER GDEM, 2020), AW3D30 (JAXA, 2020) and EU-DEM (Copernicus Land Monitoring Service, 2020)

The open source elevation models were clipped to the area of the generated DTM in QGIS 3.16. In order to make uniform coordinate system for the comparison, the clips’ coordinates were converted to HD72/EOV.

## 2.2. Methods applied in the analysis

The generated DTM and the results of drone photos (DSMs) were compared with one-way ANOVA. Then the data were studied with QGIS Profile Tool. Further, the horizontal deviations were described with the help of Map swipe tool QGIS module.

The generated DTM and the converted open source DEMs were compared with one-way ANOVA. In the next step, the differences of altitudes were calculated of clipped overlapping layers. The QGIS raster calculator was used to subtract the altitude values of generated DTM and open source DEMs.

In each case of ANOVA, response variable was the altitude recorded for the pixels of the maps in Excel program.

## 3. Results

### 3.1. Own experiment

The surface models of the experimental area are shown in Figure 2. The drone based photos indicate the surface cover including vegetation, while generated DTM is plainer. Also the vegetation phases of the trees can be seen on the photos taken in March and later in the year.

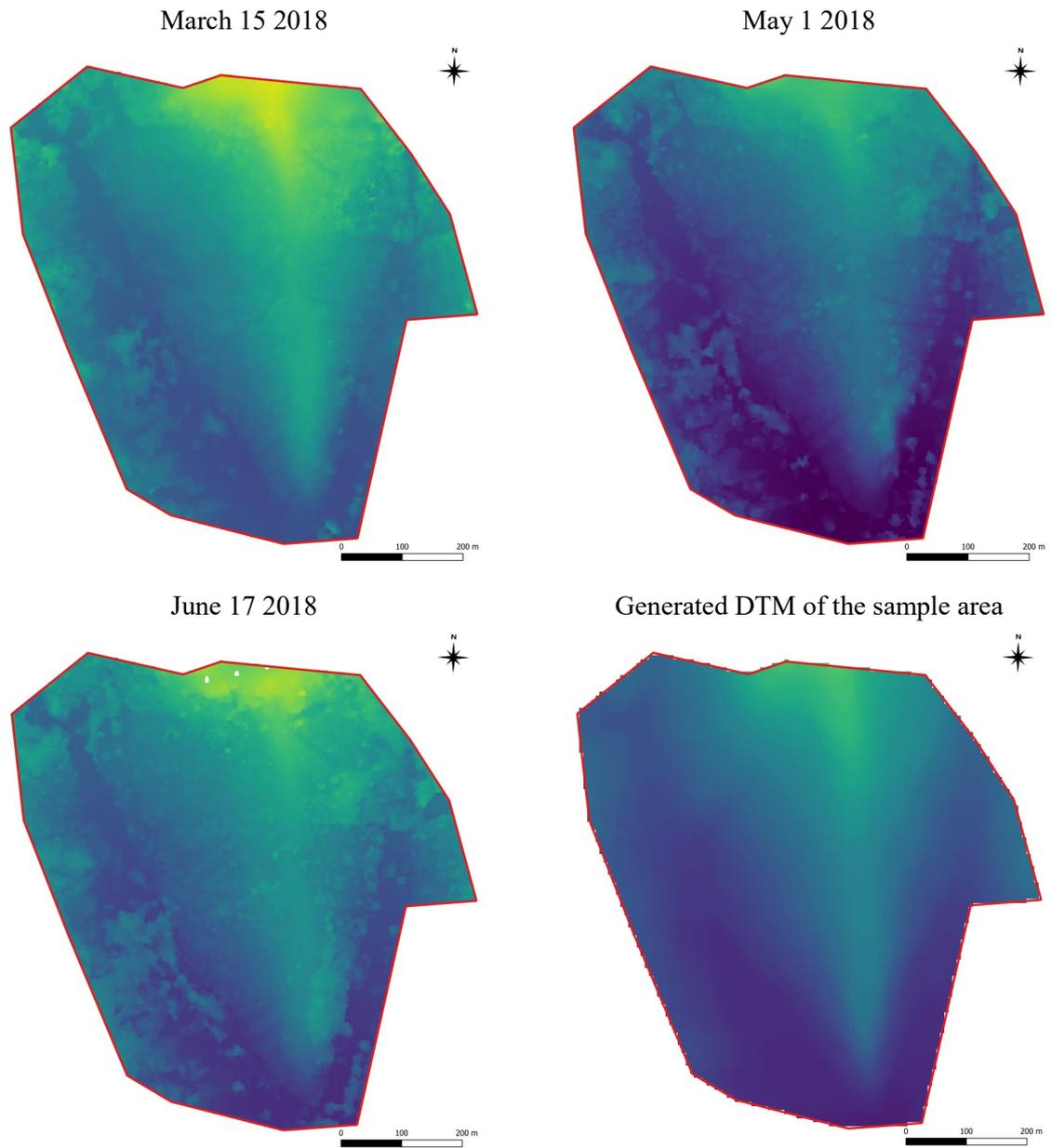
Looking at the average altitude values, the results of photos taken on 1 May are more similar to the generated DTM (Table 1). Neither the photos taken on 17 June are different from the generated DTM. However the results from drone flight on 15 March are significantly higher than the generated DTM and 1<sup>st</sup> May photos.

**Table 1:** Main statistics of the elevation models generated from drone flights

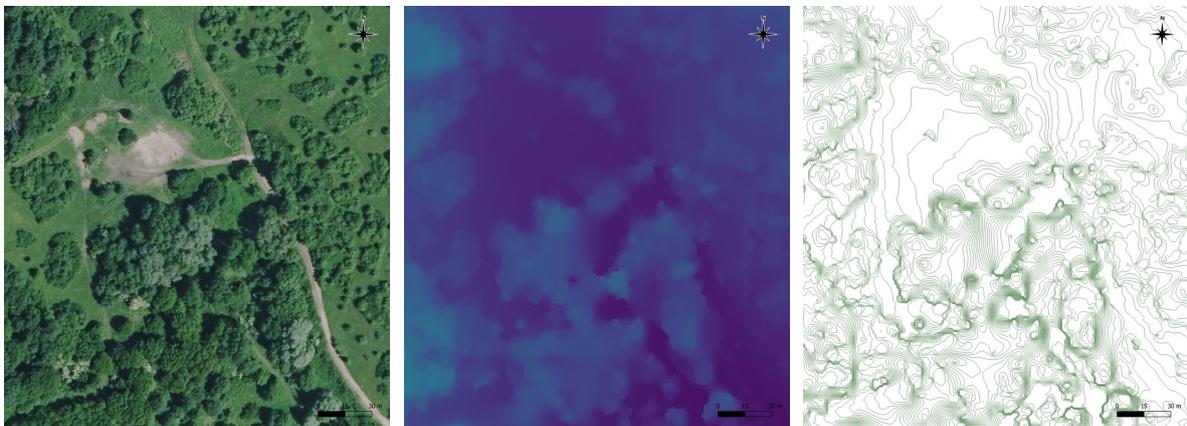
	Generated DTM	March 15 2018	May 1 2018	June 17 201
Resolution m/pixel	6.77	1.12	1.03	1.03
Minimum	170.1	184.35	157.13	173.15
Maximum	239.24	264.14	241.74	258.52
Mean	193.26 <sup>b</sup>	211.66 <sup>a</sup>	190.35 <sup>b</sup>	203.41 <sup>ab</sup>
Standard Deviation	15.39	17.46	17.91	17.05

Notes: different letters indicate statistical differences ( $P < 5\%$ ) One-way ANOVA

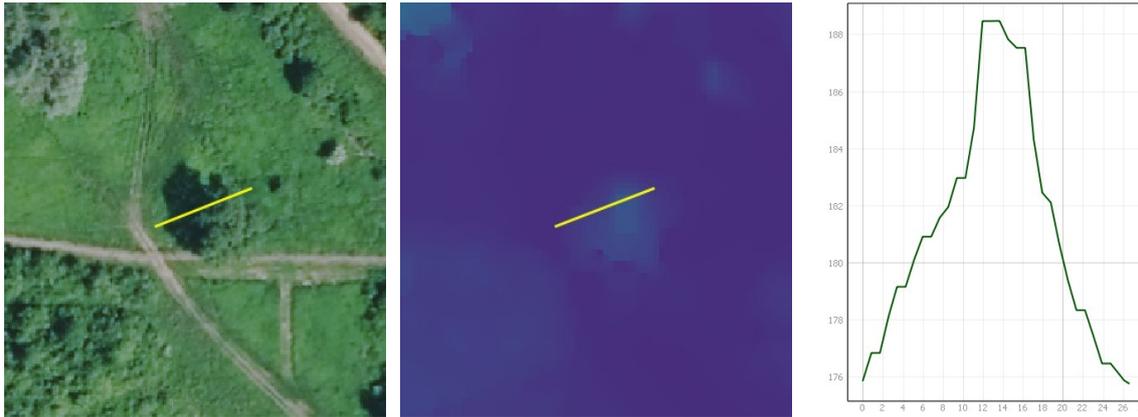
Both the zoomed in orthophoto and the drone based surface model suggest the outlines of wood vegetation of the area (Figure 3). Even a cross section profile of a stand alone tree is visible on the surface model. Figure 4 illustrates the cutting plane line of the cross section and the profile of the tree on the orthophoto and the surface model.



**Figure 2:** Surface models and generated DTM of commercial contour lines on the sample area

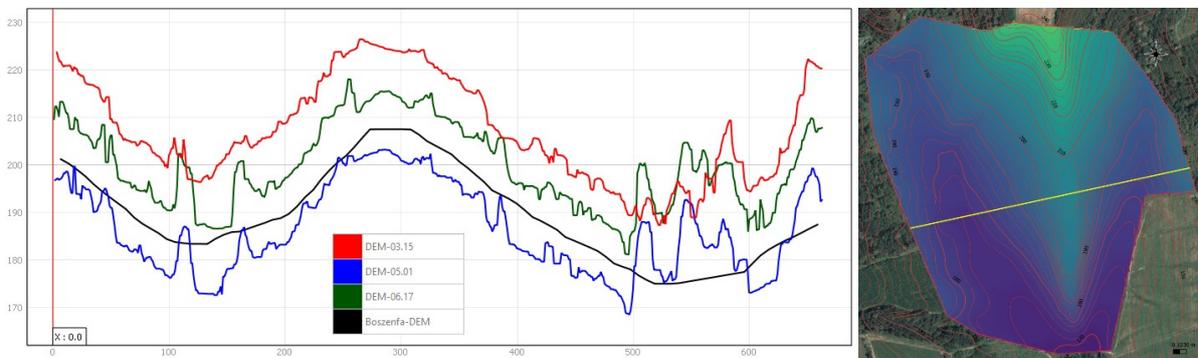


**Figure 3:** Sections of orthophoto, surface model and contour line map of wooded area



**Figure 4:** Cross-section of a stand-alone tree on the sections of orthophoto and surface model

The profile shapes of elevation models illustrate that the drone photos include the vegetation in the surface model, while the commercial surface model does not (Figure 5). Moreover, the difference of height of each flight is stable along the whole profile.



**Figure 5:** Profiles generated from various DEMs

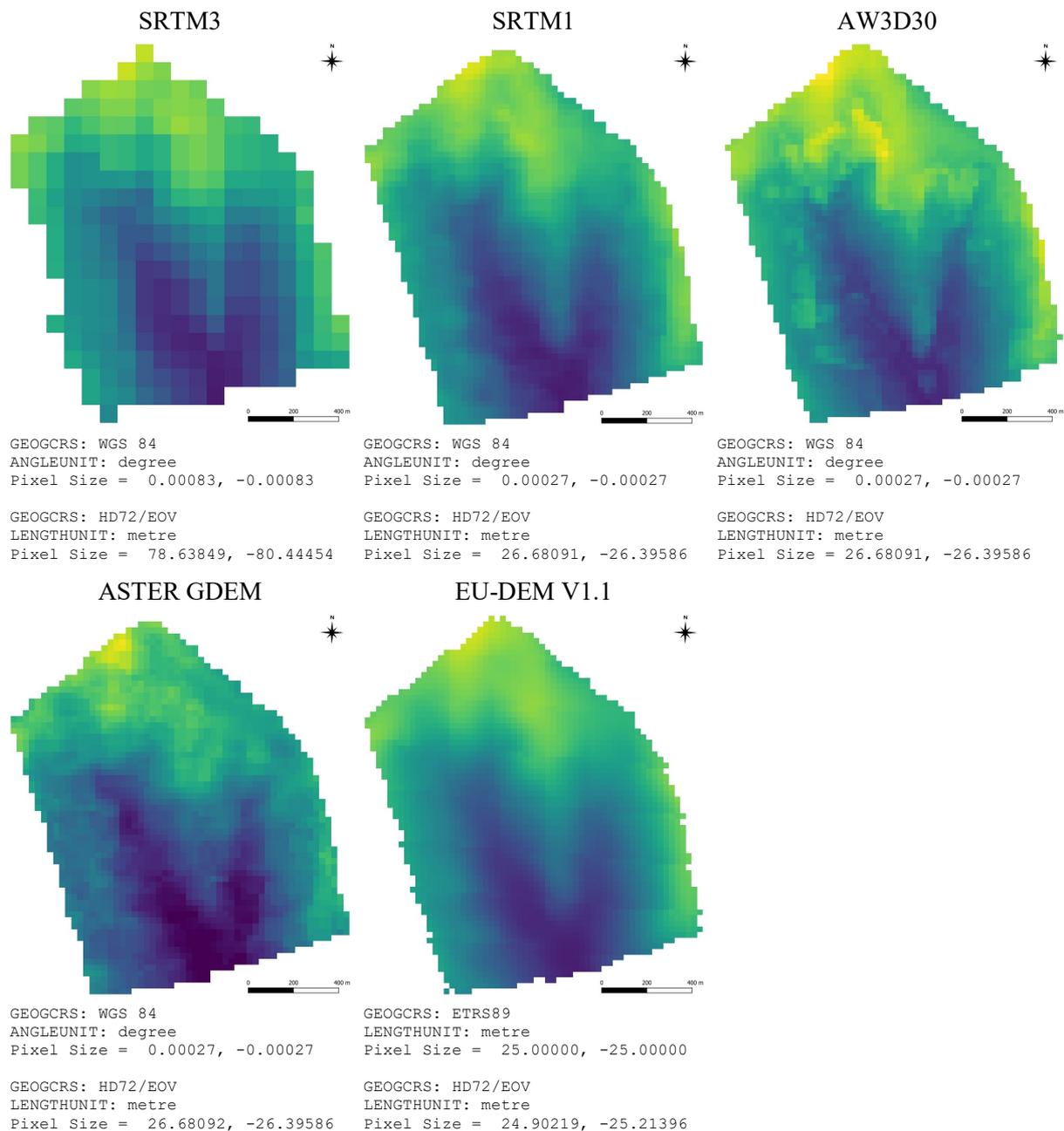
The differences can not be only found vertically in case of elevation models but horizontally in case of orthophotos, too (Figure 6). This pattern originates in the GNSS (Global Navigation Satellite System) of the drone. The receiver uses both GPS and GLONASS, but without RTK (Real-time Kinematic), which would give a cm accuracy. The GNSS receiver of the drone is 3 to 5 m accurate horizontally. In case of GNSS vertical deviation could be even greater, up to 10 meters. In cases where accuracy is required, with the help of Ground Control Points (GCP) horizontal accuracy can be increased by post-processing. Our case did not required this work.



**Figure 6:** Horizontal deviations of various drone photos (15 March, 1 May)

### 3.2. Open source DEM-s

Figure 7. indicates the sample area section of various surface models. Beneath the clipped area data represent the characteristics of the original CRS, and those of converted for EOJ and the statistics for altitudes. With the exception of EU-DEM elevation models use degree-unit WGS 84 reference system. The resolution of SRTM3 is 3 arc-second ( $\sim 90$  m); that of SRTM1, ASTER GDEM and AW3D30 is better, only 1 arc-second ( $\sim 30$  m). The EU-DEM has 25 m spatial resolution in the meter-unit ETRS 89 coordinate system. EOJ-converted elevation models' resolution is different from the original because of the different Geodetic datum.



**Figure 7:** Sections of elevation models for the sample area

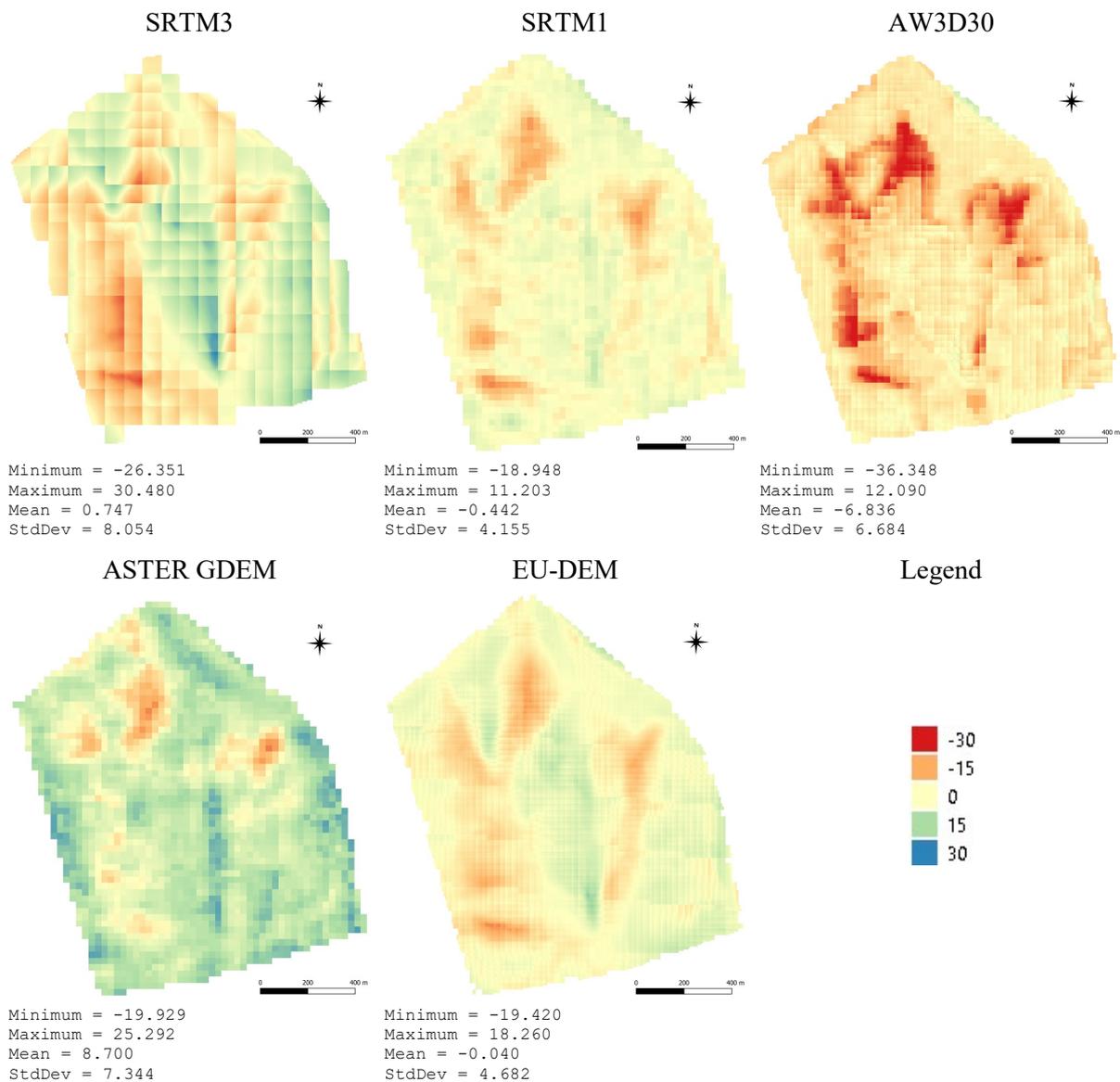
Although the differences of resolution are visible in the pictures, the most typical characteristics of the terrain can be seen. Looking at the altitude values of the above DEMs (Table 2) it is visible that SRTM3, SRTM1 and EU-DEM statistics are more similar to the generated DEM. The data of

AW3D30 is slightly higher, ASTER GDEM is lower. The surface models were compared with one-way ANOVA, which proved no significant differences between the models ( $p > 5\%$ ).

**Table 2:** Main statistics of the elevation models

	Generated DEM	SRTM	SRTM-1	AW3D30	ASTER GDEM	EU-DEM V1.1
Minimum	167.5	168	168	171	153	169.32
Maximum	264.759	261	265	274	268	262.28
Mean	214.262	213.477	214.420	220.826	205.275	214.085
Standard Deviation	24.11	23.564	23.912	24.774	24.73	23.328
<i>LSD</i> <sub>5%</sub>	21.14					

By subtracting each open access DEMs from the DTM, the difference-layers were obtained (Figure 8). These layers refer to lower (red) and higher (blue) generated DTM altitudes than those of open source DEM. Yellow colour indicates similarities between the altitudes. The raster information of the difference layers can be read under the figures.



**Figure 8:** Differences between generated and open source DEMs

According to our anticipations, there is difference between the generated from contour lines and open source models. In case of SRTM3, the difference is huge because of the difference of resolution, too. The AW3D30 elevation values – according to minimum and maximum values – are lower, than the values of the generated DEM. Differences in case of ASTER GDEM also refer to the differences of minimum and maximum values; that is the values are mostly higher than those of generated DTM. It is interesting, that the variation of AW3D30 values is lower than that of ASTER. The most similar values can be seen in case of SRTM1 and EU-DEM, both the minimum and the maximum values and the standard deviation is the closest to the generated DEM. The mean of differences is smaller than 5 centimeters!

## Conclusions

The surface model created with drone includes vegetation, therefore it can be used for DTM only post-processing. Despite of this, it shows the characteristics of the terrain; therefore the results can be used, along with the acknowledgement of measuring accuracy.

Open sources surface models are widely available. However, these use different methods, the terrain characteristics are well presented by them. Of course these open source models are not suitable for accurate geodesic analysis. According to the comparison of the models we do not suggest purchase commercial surface models only for getting general information. Out of the analysed surface models, the most similar elevation data to the commercial model is provided by SRTM1 and EU-DEM. It is expected that even more and more accurate elevation models will be available in the future.

## Acknowledgement

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## Economic effects of African swine fever at Hungarian and European level

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### INFO

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### ABSTRACT

Examining the pig sector in Europe, it can be said that the emergence of African swine fever (ASF) has a major impact on the sector. In connection with this, the aim of this article was to highlight the trends of the Hungarian pig sector, as well as the sales prices of Germany for a more accurate analysis, to give a comprehensive picture of how the Hungarian market trends developed with the appearance of ASF.

For this, a three-year cycle was analyzed using different timeline analysis methods. After evaluating this, it was confirmed that compared to the period before the outbreak of the epidemic in Hungary, market fluctuations increased, and in the trends of weekly sales prices per kilogram, the predictability decreased.

Based on this, it can be concluded that in such a globalized and price-tracking sector, it is a serious lesson for Hungary that due to its small size and low degree of integration, it is much more disadvantaged during crisis situations than other larger pig-keeping countries. All participants in the sector need to learn from this situation and, together with the policy, change the situation in Hungary as soon as possible, by raising the vertical integration of the sector.

## 1. Introduction

Nowadays, the world pig sector can be said to have grown into a comprehensive system due to globalization and various market effects, which is significantly influenced by various political, natural or social factors. These include market regulation measures introduced between major pig-keeping countries, or even changes in consumption patterns. In the present study, I would like to highlight the animal health determinants, including the economic effects of African swine fever (ASF), at European and Hungarian levels.

It can be concluded that the effect and infectivity of the virus are not unknown to the pig sector. However, compared to previous typically territorially isolated cases, there has been a steady spread since the 2007 outbreak in Georgia. Production cycles in the pig sector are typically considered to be longer, so contamination of a farm or even a country can be a significant economic factor, as re-production or exemptions can take years. In addition, an important factor is that an outbreak in a major pig-holding country can even reshape the world market, a good example for this, is China, which is currently emerging with huge import needs due to its infection. As a result of this demand, potential exporting countries typically respond with a rapid realignment of supply, which is reflected in changes in sales prices.

Based on the above factors, the study covers Hungarian market players and one of its leading integrations, as well as Germany, one of the leading pig markets in Europe.

Based on this, it becomes comparable what changes in sales prices cause the appearance of the epidemic, and how this can be managed in terms of successful management.

The main question of the study is thus how the spread and European appearance of ASF had an impact on the sales price of pigs, how certain reports of infection influenced its development. On the

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other hand, what fluctuations were shown before and after the Hungarian appearance in the given time interval, and how this affected the market.

## 2. Literature review

The virus was discovered and isolated as early as 1910 as a separate disease. By 1957, they had been expelled from Africa and reported cases in Portugal, but they were able to be resolved relatively quickly. (Viñuela, 1985) was rediscovered in 1960, but at that time it could not be eradicated, so it was discovered in Spain in several European pig-keeping countries. The virus disappeared again in 1990 due to processing regulations introduced over the years. The current epidemic broke out in 2007 in Georgia and brought to Europe. Since its announcement there, ASF has, unlike before, grown into a large-scale epidemic that continues to appear in both domestic and wild boar herds. (GOGIN et.al., 2012) Subsequently, the virus was also discovered in the southern part of Russia, a fact that was significant because the concentration of pigs in this region is particularly high and the Ukrainian-Kazakhstan border is also close. The virus has caused significant economic damage to Russian pig farming over the course of a few years. (Sánchez-Cordón et.al., 2018) Based on its investigations, it can be said that the ASF epidemic in Russia caused more than \$ 276 million in damage to the sector in 2011. The virus also spread further west, with Poland being one of these countries. Polish pig farming has never been as endangered as it is today (starting in February 2014) as a result of the spread of African swine fever. (PESJAK et.al., 2014). The epidemic has been present in the country ever since, so significant stocks have had to be eradicated recently, which has adversely affected the sector from an economic point of view. This was also supported by the article (TER BEEK, 2019), as the extermination of 8000 individual pig farms in that year has been unprecedented since the outbreak of the present epidemic. Among the infected countries, it is worth highlighting the Czech Republic, where the virus that appeared in the wild boar herd has been isolated and eradicated. There, according to an article by one of the leading professional portals, the last positive case was recorded in a wild boar in February 2018. It is an important fact that with the help of proper demarcation, all cases were discovered within a radius of 89 kilometers and it has now been reached that no positively detectable case can be found in the country (PIG PROGRESS, 2019)

After the initial small-scale impact, it can be said that the event that greatly affected the world market occurred in August 2018. Subsequently, however, the virus spread rapidly among a small number of pig farms with small numbers of animals. On August 3, 2018, China reported the first case of infection in Shenyang City, northeastern China. By 8 October, a total of 33 cases of African swine fever had been reported from eight provinces. (WANG et.al., 2018) After the eruption, a significant food industry disruption occurred in the country, due to a huge drop in the market compared to forecasts, which was caused by other animal protein sources (eg chicken, duck and other meat products). cannot be offset. According to studies, African swine fever currently affects 150-200 million pigs, with an expected 30% loss on the order of 30% higher than the US annual meat output and equal to the annual production of the European Union. (MCCRACKEN et al., 2019) In addition to stock loss, there have also been measurable changes in consumption patterns. It can be stated that both processing and consumption decreased by 10-15% in the first months of 2019. Currently, the selling price of pork is lower, which indicates that supply and demand are in balance, with the result that consumption is falling by an average of 10-15%. (PAN, 2019) An important measure in September last year was that the US and China reduced their protective tariffs, as confirmed by the article below. Referring to economist Dermot Hayes, it can be said that China's counter-duties surpassed \$ 8 in the price of each pig sold for a year. In contrast, our competitors face only a 12% tariff on Chinese exports (GLOBAL MEAT NEWS, 2019). According to current sources, China's pig population fell by 41.1% over the same period last year. China is the world's largest pork market in the world, importing 2 million tons of pork in 2018, accounting for 20% of global trade. The ASF epidemic is expected to significantly reduce production in 2019, which could mean a drop of up to 13 million tonnes. To offset this, China will increase total pig imports by 30% this year (IAGETTI, 2019)

In addition to China, in 2018, the virus was also discovered in Western Europe. One of the reports with a significant impact occurred in September 2018, when the disease was discovered in Belgium. The Belgian Food Safety Authority, FASFC, confirmed that a positive sample was found in 2 feral

pigs near the village of Étalle (HOUGHTON, 2018). With regard to intra-European meat trade, there are still barriers to achieving higher sales prices. The impetus came mainly from exports to China, where demand remains high. (THE PIG SITE, 2019)

In the light of the above, significant market changes took place in Hungary as well after the outbreak of the infection. Despite the information and animal health restrictions, the pathogen officially appeared in Hungary on April 21, 2018. Territorially, next to Gyöngyös, 200 km from the Ukrainian border, this is important because there is significant transit traffic in this region. (Náhlík et al., 2018) Following the announcement, export restrictions were introduced in Hungary. As a result, live pig exports fell measurably compared to 2017 volumes. On the other hand, it is an interesting fact that in the summer months of 2018, a decrease in sales prices was observed, however, this trend changed by 2019. “The price explosion of live pigs in April is being followed extremely slowly by changes in consumer prices. In the case of cod, we see a shift first. In August, shrimp cost 9% more and pork legs 13% more in stores than in December 2018. ” (ÉDER, 2019). There are several factors that can be observed in the price increase, which can be related to European exports, among others. On the other hand, changes in raw material prices are also important influencers.

From the above-mentioned trends, it can be concluded that the pig sector faces and faces significant challenges both globally and in Hungarian level. The ASF virus is expected to require the eradication of additional swine herds worldwide. From China’s point of view, achieving the right supply requires a huge increase in imports, which is already showing its suction effect on the European market. The Hungarian pig sector must also adapt to this market environment, from which it can profit significantly with appropriate decisions. The necessary steps and possibilities are discussed in the further parts of the study.

### 3. Methodology

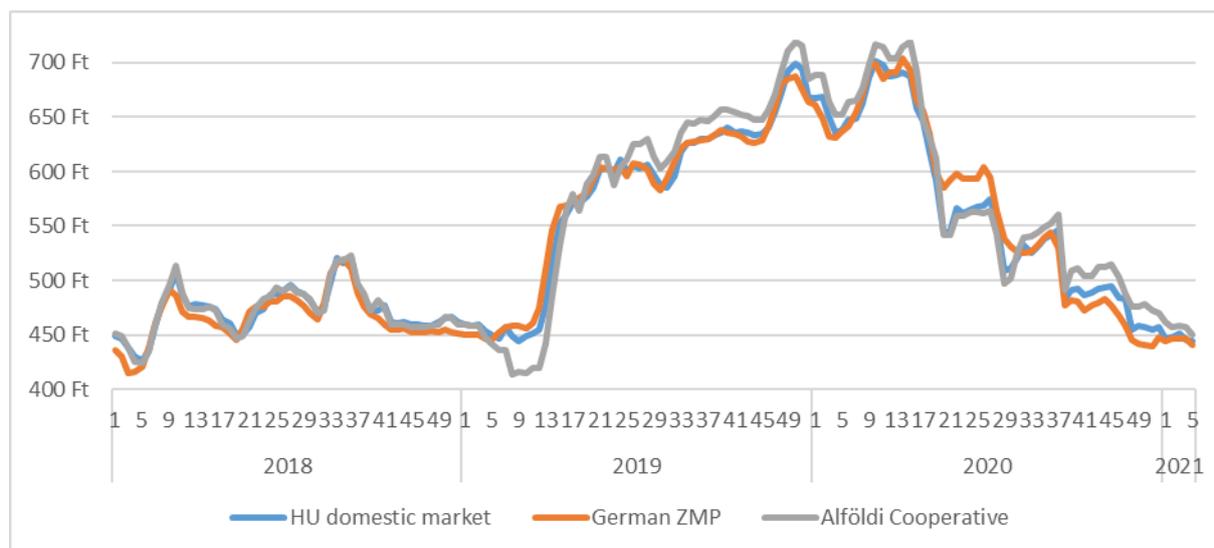
The compilation of the data set related to this article was preceded by extensive research work, the aim of which was to cover the widest possible spectrum of data and to make it as comparable as possible.

The source of the basic data was provided on the one hand by the AKI PAIR system, which covers the entire Hungarian free market system, in terms of average sales prices of live pigs, slaughterhouse meat types or even the prices of feed materials. It also provides information on E-base average prices for pigs arriving at slaughterhouses in major foreign markets.

On the integration side, the data were obtained from one of Hungary's leading producer groups. The given Cooperative can be said to be a key player in the domestic pig sector, in addition, the market model keeps in mind efficiency and annual or even longer-term balanced income, predictable average pricing, which is an important criterion for producers.

From this comprehensive database 3 markets were analyzed in this case. On the part of AKI, the German ZMP (central) price, the line forming the weekly average of the Hungarian free market was taken into account. These average prices can be said to be given by the group of pigs arriving at the slaughterhouse in commercial class 'E'. In the case of the Cooperative, the sales price of the capital pigs was included in the analysis in this case also the average price of the commercial categories “E” (55.0-59.9% lean meat) was calculated due to the exact comparability.

In the case of setting the time interval, the interval between the 1st week of 2018 and the 5th week of 2021 was determined, as thus all market trends (including today's market conditions) could be assessed from the domestic appearance of African swine fever.

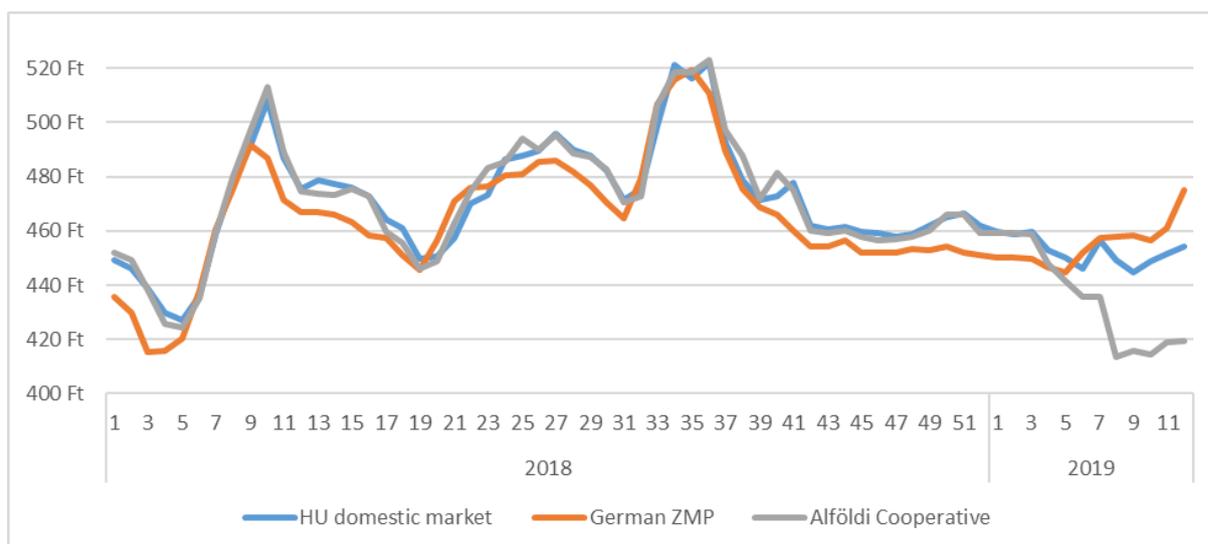


**Figure 1:** Development of sales prices covering the period (2018 - 2021) in the given markets (HUF / kg)

The prices, as mentioned in the weekly period, are included in the database they were evaluated with Microsoft Excel. Examining the curves 3 sections were separated, to which I fitted separate trend lines. Subsequently, it was possible to draw further conclusions using simple statistical indicators such as variance, standard deviation and coefficient of variation.

**(BROWN, 1998) The coefficient of variation can be considered a useful statistical coefficient, as it allows the comparison of variables without scale effects, in a form without dimension. A result in excess of 30% in value proves to us that the data are either erroneous or out of control in the experiment. Furthermore, in the present study, it is important to interpret the 10% limit, which indicates homogeneity.** 4. Results and discussion

The above summarizing figure 1 could be divided into 3 sections for more accurate evaluation. The first phase covers the timeline from week 1 of 2018 to week 12 of 2019, where the impact of the period before the outbreak of African swine fever and the market changes following the notification can be assessed. The second phase took place between the 13th week of 2019 and the 15th week of 2020, here the longer-term effects of the emergence of domestic ASF could be traced, and the effects of significant world market disturbances could also be observed in this phase. The last section presents the period between the 16th week of 2020 and the 5th week of 2021, here some markets are already experiencing an adjustment but later it will be proved that the market disturbances still exist here.



**Figure 2:** Development of weekly average prices in the examined markets between the 1st week of 2018 and the 12th week of 2019

**Table 1:** Statistical indicators for the first phase

	HU domestic market	German ZMP	Alföldi Cooperative
Standard deviation	20.43	20.90	26.04
Mean	468.42	463.42	465.50
Coefficient of variation	4.36	4.51	5.59
Variance	417.26	436.97	678.26

**Table 2:** The result of the trend analysis of the first stage

	HU domestic market	German ZMP	Alföldi Cooperative
R <sup>2</sup>	0.013	0.017	0.0879
Trend function	$y = -0.1267x + 472.53$	$y = 0.0456x + 461.94$	$y = -0.4146x + 478.97$

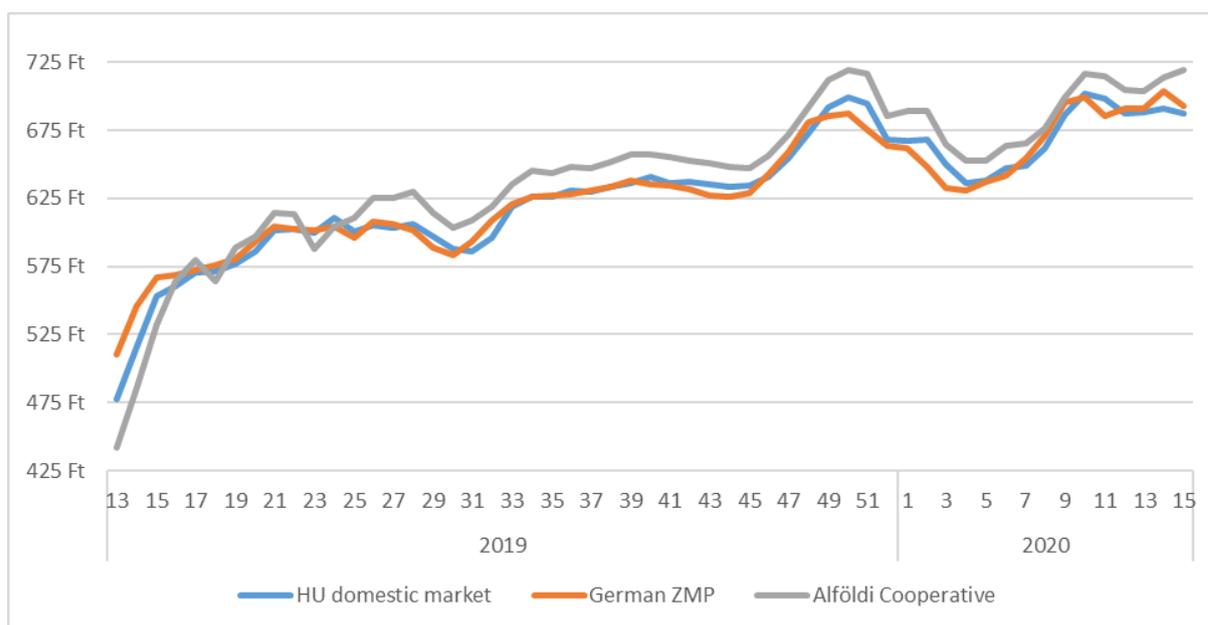
Looking at the first section it is clear that we get a relatively balanced curve based on the data. However the fluctuations in it can already be linked to the Hungarian appearance of ASF.

It can be stated that, taking into account the developments in the world market and Romania, the Hungarian slaughterhouses concluded their contracts from the beginning of 2018 by stipulating a 1-month moratorium in case of the domestic appearance of ASF. This fact also had some effect on the initial data, and then the usual market trend can be observed, which supports the demand-increasing effect of the summer period, however, on April 21, 2018, the infection was discovered in a dead wild boar in Heves county. The immediate effect of this can be clearly seen in the figure with a significant decrease in the curve from the given week 16 to week 19 and the said moratorium also came into force.

Another major leap in the curve is caused by the fact that on August 3, 2018, China announced the emergence of the infection in several provinces, which caused significant stock cuts, thus reshaping world market demand trends. Figure 2 above also illustrates the price changes of this period well.

Looking at Table 1-2 it can be clearly seen that the fluctuations of the average price values can be considered relatively stable during this period the coefficient of variation is also around 5%, which shows a homogeneous time series at this stage of the study. The value of  $R^2$  also proves to us that, based on the trend analysis a steady increase in steady fluctuations can be observed in the data of the first stage.

However, based on previous studies, it is important to examine why the results obtained in the case of the Cooperative are so compared to other markets. This may be answered by the fact of the embargo mentioned earlier, after which a price reduction was applied in the contracts of its largest slaughterhouse partners in order to reduce the loss. This factor also played a significant role in terms of revenue and market homogeneity.



**Figure 3:** Development of weekly average prices in the examined markets between the 12th week of 2019 and the 15th week of 2020

**Table 3:** Statistical indicators for the second phase

	HU domestic market	German ZMP	Alföldi Cooperative
Standard deviation	47.04	42.40	56.47
Mean	629.31	629.76	642.40
Coefficient of variation	7.48	6.73	8.79
Variance	2213.02	1798.07	3189.03

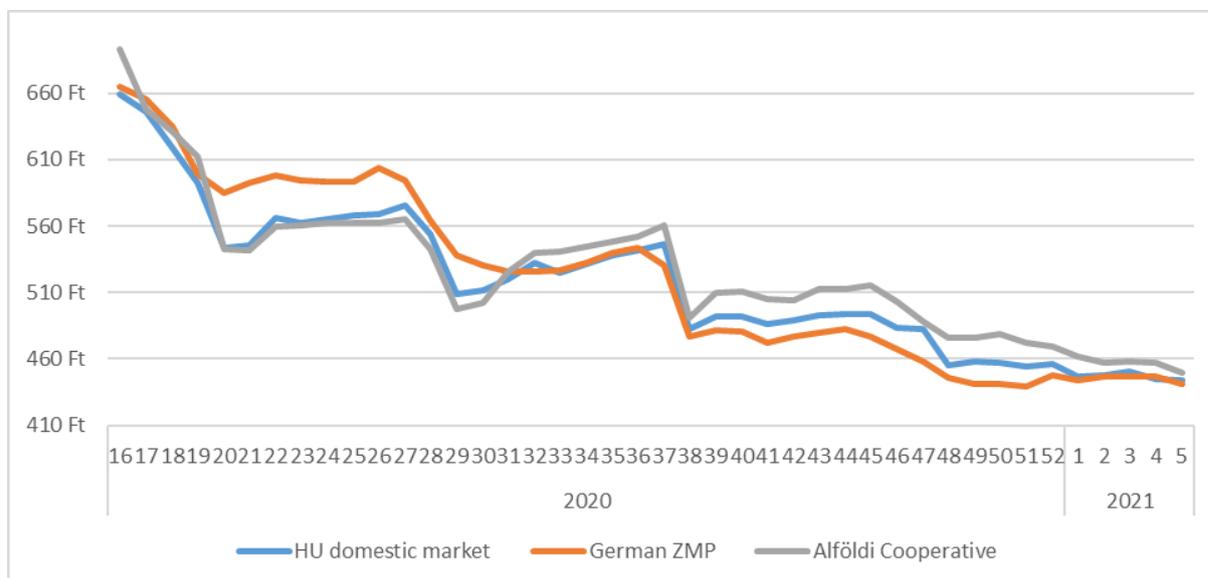
**Table 4:** Results of the second stage trend analysis

	HU domestic market	German ZMP	Alföldi Cooperative
$R^2$	0.8013	0.8284	0.7585

Trend function	$y = 2.6285x + 555.72$	$y = 2.409x + 562.31$	$y = 3.0698x + 556.44$
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Examining Section 2 of the timeline it is clear that market trends show a significant change. Here, the value of all indicators is more prominent than that of the previous period. However, the value of the coefficient of variation still shows a homogeneous level, increasing to 7-8% compared to the previous value of around 5%. The value of  $R^2$  also shows a significant upward trend, which may be due to the fact that the loss of stock in the Chinese market is gaining ground on the world market due to the increasing number of infected areas appearing there. This effect also indirectly affected Hungary, as well as the values of the German market.

In this case too the question arises as to why the Cooperative's indicators are developing as described above. There are several explanations for this. On the one hand the loss-minimizing effect can still be observed in the contracts of large Hungarian slaughterhouses which is also reflected in the price deduction here. It should be noted that the free market is less confronted with this factor due to its shorter-term contracts. On the other hand, as evidenced by the average price line, the cooperative increased its export activity in the previous year, but at that stage it reached a volume that is measurable in its revenues.



**Figure 4:** Development of weekly average prices in the examined markets between the 16th week of 2020 and the 5th week of 2021

**Table 5:** Statistical indicators for the third section

	HU domestic market	German ZMP	Alföldi Cooperative
Standard deviation	55.15	67.19	53.33
Mean	517.25	520.44	526.29
Coefficient of variation	10.66	12.91	10.13
Variance	3041.32	4514.18	2843.30

**Table 6:** Results of the third stage trend analysis

	HU domestic market	German ZMP	Alföldi Cooperative

R <sup>2</sup>	0.864	0.9228	0.7653
Trend function	$y = -4.1785x + 607.09$	$y = -5.2611x + 633.55$	$y = -3.8028x + 608.05$

In the case of the third stage it can be said that its examination revealed tendencies that were almost non-existent in the time series analyzes of the pig sector so far. An example of this is the value of the coefficient of variation, which is above the homogeneous value of 10% for the whole period. In addition, it reaches almost 13% in the German market. These are also supported by the trend analysis as for all functions the parameter  $b_1$  was negative which shows a significant decrease for us.

It can be said about this period that the year 2020 started very well as the prices of capital pigs were over HUF 500 / live kg, the demand was particularly strong. Restrictions imposed due to the COVID-19 epidemic interrupted this process. By the 20th week, capital pig prices had fallen to HUF 410 / kg live, but the biggest problem was that the number of slaughtering had fallen drastically due to the outage of the HORECA sector.

In the summer months, the situation slowly returned to normal, the market reached equilibrium, the price of 420-430 HUF / kg of live pigs was realized. However, in September 2020, Germany reported ASF infection in the wild boar herd. Following the notification, German exports to the Far East were restricted. As a result, prices began to fall across Europe. By the 38th week it was close to 390 HUF / live kg, then in the 48th week it reached its lowest point (this time fell in the 4th week before Christmas) to 360 HUF / kg, which did not change until the end of the year. This trend continued in early 2021.

It can be considered an important fact that in the test results and values mentioned in the previous sections, the cooperative achieved an advantage in the given case. This is due to the fact that the previously mentioned export strategy showed its impact on this year so the impact of the world market and the decrease in demand for the coronavirus epidemic also became somewhat offset.

The above findings are supported by previous studies. They all found that as a result of the ASF infection, the costs of some producers increased, on the one hand, which is relevant to us, that their incomes decreased, and on the other hand, they became less predictable. (FASINA et al., 2011)

Based on the given study, it is worthwhile to analyze the effects of ASF from several aspects in the future, either to examine several markets or the relationship of different actors within a given market in relation to the infection. In addition, over time, with the expansion of the amount of data, it will be possible to include even more accurate measurements, as well as new test methods.

#### 4. Conclusion and Recommendations

From the above it was concluded that the domestic market was significantly affected by the domestic appearance of the ASF epidemic. As from the producer's point of view, in addition to the decrease in demand, the transformation of market channels also caused sales difficulties. The reason for this was that several market participants also served the Far Eastern demand, which became inaccessible with the domestic appearance of ASF, on the other hand, leading European producers in several cases drained their accumulated stocks on the Hungarian market, which caused further market disturbances.

Examining the impact of ASF from the point of view of processors it can be stated that the management of major slaughterhouses in Hungary was greatly endangered by higher risk-taking, which was reduced by price deductions and corresponding contracts.

Based on these it can be concluded that the domestic impact of the ASF epidemic is clearly measurable in the examination of sales prices, be it free market participants or a horizontal integration. In addition, the last section of the time series under study also shows how exposed Germany, as one of the leading pig-keeping countries in Europe, is to the effects of the epidemic, which then collapses in price-following markets.

Furthermore, it is worth highlighting at the cooperative with a well-thought-out strategy how to reduce market disturbances in its own activities. As presented, the identified export market potential for the final stage indicators was a significant improvement over the other two markets, both in terms of the higher average sales price they achieved and in terms of time series homogeneity.

In conclusion, I would certainly like to emphasize that the study has once again demonstrated the impact of full globalization on the world's pig sector. This is supported by the fact that a pandemic affects all pig-holding regions of the world to some degree. A serious lesson for Hungary is that due to the size of its production and the low degree of integration, it finds itself in a much more disadvantaged situation during crisis situations than other larger and more developed pig-keeping countries. All actors in the sector need to learn from this situation and, together with the policy, change the situation in Hungary as soon as possible, ie raise the vertical integration of the sector to the level of Europe's model countries (eg Spain).

The above has been confirmed by several studies, which have found that ASF is currently the main threat in the European pig sector. This can only be offset if a comprehensive regulation eliminates the infection from Europe, as has been the case in the past. (JURADO et al., 2018)

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## Role of gamification at the University of Debrecen, with special regard to the Faculty of Economics

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### ABSTRACT

With the spread of technology and Internet, the way of teaching has changed in recent decades, as opposed to traditional personal practice, with the current pandemic situation bringing to the fore various forms of distance learning that have posed increasing challenges for both educators and students at all levels of education. In many places, lecturers may experience a negative shift in the motivation and attention of university students, so that distractions in class or appearances in classes become more frequent than technical problems. At the same time, there is a huge increase in the amount of time spent on individual video games among young people. Gamification seeks to promote the connection between the fun experience of games and learning in education. Research has highlighted that some elements of games effectively contribute to learning, and the method can also have a number of positive benefits for higher education too. Nevertheless, many higher education institutions have not introduced gamification into their programs, nor are they included in the individual recommendations. The aim of the study is to explore the assessment of the method of gamification among the students and lecturers at the University of Debrecen, on the spot of the Faculty of Economics and Business. As results of the research, it can be stated that the students of the Faculty are on average less familiar with the method compared to the lecturers, however in general perception of gamification among the two groups can be said to be positive.

## 1. Introduction

Gamification is a modern way of arousing certain intrinsic motivations in the fields of education, human resources and marketing. The point is that we use certain playful elements and mechanics in a non-playful environment (Deterding et al. 2011). Throughout their lives, more and more children are using digital devices to relax at home, so these young children already have a good level of proficiency in handling various ICT devices. With these capabilities, game elements can be easily adapted in primary education, either digitally or offline. Of the offline solutions, most use the PBL (points, badges, levels) system, for example, to measure diligence by collecting “diligent bees” or to display behavioural measurements by collecting “suns” and “stormy rain clouds” on the wall board. With these solutions, teachers can also facilitate the transition between kindergarten and school for students. Mikó examined the storyline-based approach to this in art and drama courses among lower grade students (Mikó 2018). Applying a narrative known from gamification can create a learning environment through young people’s imaginations that can motivate them to work together (Mitchell 2016). It is also used in many ways to overcome learning difficulties. YanFi and co-authors presented a playful method used in elementary schools to help computer use for visually impaired students (Yanfi et al. 2017), but Gooch and co-authors used it in motivating dyslexic youth (Gooch et al. 2016). Among the domestic aspirations, the development of the music island application is outstanding in the field of art, where they try to help students learn with the help of the music application using ICT tools (Szabó 2018).

Among technology-based knowledge transfer, the potential of smartphones has also been explored in education. Su and Ching’s findings support Gabrielle’s findings (Gabrielle 2002) that there is a

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positive relationship between students' motivation and outcomes (Su and Ching 2015). Carvalho and colleagues have put together a kind of framework for gamification in high school, where they have sought to promote student activity, motivation, and easier understanding, among other things (Carvalho et al. 2015). Huizenga and colleagues (Huizenga et al. 2009) developed a game-based learning activity for secondary education on mobile phones that combined situational and active learning with fun. They found that gamification is a huge opportunity to increase student engagement and to move motivation and learning in a positive direction, which Schwabe and Goth also highlighted as a result of previous research (Schwabe and Goth 2005). In addition to this, a number of studies cover the use in foreign language education (Garcia 2013; Huynh et al. 2016). Several studies have already demonstrated (Soboleva 2018; Trajkovik et al. 2018) that games play a key role in our personality development in both childhood and adulthood, as this is when we can self-forgetfully acquire cognitive and affective skills (Frost et al. 2012; Pásztor 2013). It strengthens our belonging to the community, supports our moral development, improves our ability to communicate, and also makes us happy in addition to many other physiological effects. In terms of gender, several authors have examined the question of who spends more time playing. Several authors have argued that men play more and at the same time have a more positive relationship with technology than women (Greenberg 2010; Funk and Buchman 1996; Lucas and Sherry 2004; Hartmann and Klimmt 2006). One of my goals is to map the possibility of gamification, especially based on its role in higher education according to the domestic and international literature. My specific goal is that, as a result of my research, the Faculty of Economics of the University of Debrecen should improve the perception and awareness of gamification among lecturers and students. To that effect, I conducted a questionnaire survey as a quantitative method. In line with the literature and the objectives of the research, I formulated the following hypotheses:

H1: The gamification method is less known among students studying at the Faculty of Economics of the University of Debrecen than among faculty members.

H2: The general perception of gamification among students and lecturers is positive at the UD-Faculty of Economics.

H3: Those who say gaming would increase interest would find the lessons more enjoyable and would be more motivated.

## 2. Methodology

In terms of material, I chose the questionnaire from the quantitative methods during the primary data collection. The target group of the questionnaire is primarily students and lecturers participating in Hungarian higher education. Within this, students in vocational, secondary, or grammar schools who plan to continue their studies in a higher education institution, as well as undergraduate students at BsC and MsC level. On the faculty side, I measured the opinions of PhD students and faculty involved in teaching, regardless of status. Due to the appropriate segmentation, I examined the research questions from the two sides, so I asked the questions from two different perspectives (teachers, students), but with the same content elements. In addition to descriptive statistics, I used the Mann-Whitney test from the non-parametric tests for the analysis, as most of the variables are not normally distributed due to the Likert scale (1-5). I also used logistic regression analysis to perform each estimate and to fully support the hypotheses. The reason for using it is that the prerequisites for the method are less strict. Of these, it is important that multicollinearity between variables is not allowed and that independent variables should refer linearly to the dependent variable. One of its advantages is that it does not require a normal distribution (Hosmer et al. 2013). Its use is most often encountered in predicting events and in measuring dependent effects for dependent and independent variables. We distinguish three types: binary (dichotomous), multinomial, and ordinal, which must be selected according to the given measurement level (Gasso 2019). From the regression coefficient we can calculate the odds ratio, which is the odds of the occurrence of something in the examined groups that is many times higher than those in the reference group. Parameters are estimated iteratively with the maximum likelihood method instead of the least squares method compared to the linear regression (Bartus 2003).

The primary research was carried out using CAWI (Computer Assisted Web Interviewing), an online query method, for which I used the service of Google Forms. In preparing the questionnaire, I took into account the applicable GDPR and data management laws, and did not collect sensitive data on the respondents. The questionnaire was anonymous, in which participation was voluntary, and I used its results only in aggregate. In addition to sociodemographic issues, the range of questions includes knowledge of gamification as well as knowledge of applications that use gamification. Statistical analysis was performed with the SPSS 22.0 software, while path analysis was performed with the SmartPLS software. In addition, Microsoft Office Excel 2016 was also used to create the figures and perform some calculations.

### 3. Results

#### 3.1. Demographic presentation of the studied sample

The following table illustrates the demographic results of the two surveys. The most important demographic characteristics of the questionnaire are detailed in Table 1. Due to the segmentation along the narrowed target group, the results cannot be considered representative. The number of items in the two studies was  $N = 401$ . The gender ratio for the student questionnaire was 60% male and 40% female ( $N^H$ ), while the proportion for men in the instructor questionnaire was 47% compared to 53% for the female instructor ( $N^O$ ). The average age of the respondents was 20.9 years for the students and 40 for the lecturers. The teaching experience was on average 13 years among the respondents, which is due to the high proportion (28.4%) of PhD student completion.

**Table 1.** Characteristics of the respondents (sociodemographic)

<i>Item</i>	<i>Category</i>	<i>Student</i>		<i>Instructor</i>		<i>Sum</i>
		$N^H$	(%)	$N^O$	(%)	$N$
<b>Gender</b>	Men	137	60.9	27	47.1	164
	Women	213	39.1	24	52.9	237
	<b>Sum</b>	<b>350</b>	<b>100</b>	<b>51</b>	<b>100</b>	<b>401</b>
<b>Avg. Age</b>		<b>20.9</b>	-	<b>40</b>	-	
<b>Avg. teaching experience (years)</b>		-	-	<b>13</b>	-	
<b>Education</b>						
	Primary schools	7	2	-	-	
	High school	278	79.4	-	-	
	BSc/ College degree	52	14.9	-	-	
	MSc/ University degree	12	3.4	-	-	
	PhD or more	-	-	52	-	
	<b>Sum</b>	<b>350</b>	<b>100</b>	<b>51</b>	<b>100</b>	<b>401</b>
<b>Residence</b>						
	Capital	6	1.7	2	2	
	City with county rights	95	27.1	34	66.7	
	City	159	45.4	13	25.6	
	Village	90	25.7	2	5.9	
	<b>Sum</b>	<b>350</b>	<b>100</b>	<b>51</b>	<b>100</b>	<b>401</b>

$N^H$  notes the student questionnaire, while instructors are presented by  $N^O$ .

Source: Own resource, 2021

In terms of educational attainment, the majority of graduates have a secondary education (79.4%) and 14.9% had a BSc or college degree. This suggests that a significant proportion of respondents are undergraduate students with no tertiary education, which may result from the snowball method. By type of residence, it can be said that those living in a city with a county status and those living in a city together make up 72.5% of the student sample ( $N^H$ ), while those in the capital and village account for

only 27.4%. In the case of educators ( $N = 0$ ), cities and towns with county status together account for 92.3% of the sample, compared with 7.8% for those living in the capital and villages.

**Table 2.** Responders by universities and faculties ( $N = 401$ )

	<i>Student</i>	<i>Instructor</i>	<i>%</i>
Faculty of Economics and Business (UD -FEB)	202	50	62.8%
Faculty of Health (UD -FH)	21		5.2%
Faculty of Science and Technology (UD -FST)	19		4.7%
Faculty of Informatics (UD -FI)	13	1	3.5%
Faculty of Medicine (UD -FM)	15		3.7%
Faculty of Agricultural and Food Sciences and Environmental Management (UD -FAFSEM)	38		9.5%
Faculty of Engineering (UD -FE)	5		1.2%
Faculty of Pharmacy (UD -FP)	2		0.5%
Faculty of Public Health (UD -FPH)	8		2.0%
Other university	13		3.2%
High school	14		3.5%
<b>Sum</b>	<b>350</b>	<b>51</b>	<b>100%</b>

Source: Own resource, 2021

Regarding the University and faculties (Table 2), 63% of the respondents were related to UD -FEB, 9% to UD -FAFSEM, while 20.9% of the other faculties of the University of Debrecen compose the complete sample ( $N = 401$ ). Taken together, the fillings attributable to the University of Debrecen accounted for 93.3% of all fillings, other universities for 3.2%, while high school students in the process of further education accounted for 3.5% of the sample.

### 3.2. Preliminary gamification knowledge of the respondents

To examine the propensity to use a particular technology, it is worth reviewing the gamification backgrounds of the fillers. The measurement of knowledge and use of gamification is detailed in Table 3, where “I don’t know” was given a value of 1 on the Likert scale, while regular use was marked with a value of 5. The following table illustrates the distribution of student and faculty responses. It is striking that 34% of students are unfamiliar with gamification, compared to only 20% on the faculty side. The second group included those who had heard of the concept but had not yet applied it or did not know it. This rate was 30% in favour of students, while 25% of faculty members marked this answer. The proportion of those who used it for teaching or learning was 21% to 29%. Surprisingly few regular users, as 2% of students marked this option, while 6% of responses from the teacher’s side.

**Table 3.** Gamification backgrounds (G1)

	<i>Student</i>	<i>%</i>	<i>Instructor</i>	<i>%</i>
I do not know.	118	34%	10	20%
I’ve heard it before but haven’t tried it yet or don’t know about it.	106	30%	13	25%
I have used it a few times but not for learning / teaching.	45	13%	10	20%
I have already used it for learning / teaching.	74	21%	15	29%
I use it regularly for learning / teaching.	7	2%	3	6%

350	100%	51	100%
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Source: Own resource, 2021

Based on Table 3, there is a difference in the preliminary gamification knowledge of the completing students and instructors, which is supported by the results of the Mann-Whitney test illustrated in Table 4. There is a significant difference between the ranking means ( $p < 0.001$ ). The average knowledge of the responding students on the five-point scale was 2.274, while the prior knowledge and use values of the instructors were 2.765.

**Table 4.** Examination of knowledge and use of gamification

Status		N	Rang avg.	Rang sum.
G1. Gamification methodology	Student	350	195.34	68367.50
	Instructor	51	239.87	12233.50
	Sum	401		
Mann-Whitney U	6942.500			
Wilcoxon W	68367.500			
Z	-2.662			
Asymp. Sig. (2-tailed) (p-value)	.008			

Source: Own resource, 2021

Based on the results, it can be said that there is a significant difference in the prior knowledge of students and teachers about gamification. The knowledge of the instructors has a higher value in the matter compared to the students. Therefore, I found my hypothesis H1 to be statistically sound and proven, so I accept my hypothesis.

### 3.3. General perception of gamification

We can only talk about the possibilities of using gamification and the intention to use it if we know the general perception of the respondents. During the positive assessment, I examined the problem from three sides, openness, motivation, and necessity. Its criterion is that the average of both student and faculty responses reaches a value of 4. In the case of openness (G2), in terms of motivation (G3), I examined the variables and the need to measure the need for variables (E2), the averages of which are shown in Table 5.

**Table 5.** General perception of gamification among students and instructors

Variables	Average of student responses	Average of instructor responses
Openness (G2)	4.177	4.254
Motivation (G3)	4.120	4.098
Need (E2)	4.060	4.137

Source: Own resource, 2021

**Table 6.** The result of the general assessment of gamification by status

	Status	N	Rang avg.	Rang sum.	Mann-Whitney U	Wilcoxon W	Z	p value
G2. Openness	Student	350	199.23	69732.00				
	Instructor	51	213.12	10869.00				
	Sum	401			8307.0	69732.0	-.862	.389
G3. Motivation	Student	350	200.65	70226.50				
	Instructor	51	203.42	10374.50				
	Sum	401			8801.5	70226.5	-.172	.864
E2. Need	Student	350	198.82	69586.00				
	Instructor	51	215.98	11015.00				
	Sum	401			8161.0	69586.0	-1.050	.294

Source: Own resource, 2021

To examine this difference in the perception of students and faculty, I again performed a Mann-Whitney test for the previous three variables (G2, G3, E2) in the dimension of status (student or faculty). Looking at the results in Table 6, it can be said that no significant difference could be detected between the means of the two samples ( $p > 0.05$ ), so it was proved that the general assessment of both students and lecturers was positive ( $> 4.00$ ). The previous findings and the values in the table support my acceptance of Hypothesis H2.

Based on what has been read in previous literature, according to which gamification is an excellent method for motivation, improving enjoyment value (eg flow experience) and arousing interest in the fields of marketing, education and human resources, I examined in line with my third hypothesis that in higher education to what extent do the variables go together, do they show a significant positive correlation in the pros / cons of gamification. The results of this are presented in Table 7. Because ordinal variables were compared, the results were calculated using Spearman's rank correlation, according to which values below 0.2 are weak, values between 0.2 and 0.6 are medium, while values equal to or above 0.6 show a strong correlation between the two variables.

**Table 7.** Correlations between motivation, interest, and enjoyment value in pros and cons

		PRO1_interest	PRO1_motivates	PRO1_makes the courses more enjoyable
PRO1_interest	Correlation coefficient	1.000	<b>.571**</b>	<b>.600**</b>
	p- value		.000	.000
	N	412	412	412
PRO1_motivates	Correlation coefficient	<b>.571**</b>	1.000	<b>.544**</b>
	p- value	.000		.000
	N	412	412	412
PRO1_makes the courses more enjoyable	Correlation coefficient	<b>.600**</b>	<b>.544**</b>	1.000
	p- value	.000	.000	
	N	412	412	412

Source: Own resource, 2021 \*\* $p < 0.01$  (2-tailed)

The previous table illustrates the correlations between motivation, interest, and enjoyment value in pros and cons. We can see that for all three variables we can observe a positive correlation at the significance level of  $p < 0.01$ . Based on these, the arousal of interest can be considered moderate with a rank correlation value of 0.571, while they show a strong correlation with a value of 0.6 when experiencing the lesson more enjoyable. Since the results show a significantly positive correlation, I consider my hypothesis H3 to be accepted.

In the study of ordinal logistic regression, I measured the effect of openness, motivation and activation on gamification, the results of which can be seen in Table 9, where in terms of variables we can say that in one case a significant difference can be measured based on the grouping factor (status). In this sense, the activity-increasing effect of gamification is judged differently by teachers and students ( $p < 0.001$ ). Compared to students, the log value of the odds ratio for teachers to fall into a higher category increases by 0.6912 ( $p = 0.001$ ), which in practice means that teachers consider the activating effect of gamification to be higher than students.

**Table 9.** Ordinary logistic regression by status

Dependent variable	Independent variable	Coefficient	p-value
Openness (G2)	Status	0.8432	0.399
Motivation (G3)	Status	0.0024	0.992
<i>Activity (G5)</i>	<i>Status</i>	<i>0.6912</i>	<i>0.009</i>

Source: Own resource, 2021

## Conclusion

Overall, it can be said that gamification can be applied in many fields based on the literature, and it can play an important role in the field of education. It can be used to increase motivation regardless of training level, to make monotonous lessons more enjoyable, but even to arouse interest. The study highlights the perceived and real differences between knowledge and use of the method among the students of the University of Debrecen, including the students of the Faculty of Economics, and the lecturers of the Faculty. As a result of the research, it can be stated that the students of the Faculty are on average less familiar with the method compared to the lecturers. One of the reasons is the active publication of the research results I have done, lectures at conferences and my lectures on the topic in professional forums. The lower knowledge and use of gamification methods by students may presumably be a lack of awareness that has not been explored in current research, so exploring the causal relationships of this may form the basis of another study.

The general perception of gamification among the students and the lecturers can be said to be positive, which I was able to prove with significant results. Among the gamification influencing factors learned during the literature review, I examined motivation, activation, necessity, and the development of interest / commitment in the dimension of status (student and teacher). As a result of these studies, a positive relationship was highlighted, so these variables go hand in hand with the assessment of gamification, and I even showed that they fall significantly into each category. In this sense, the activating effect of playfulness is rated higher by educators than by students. As a limitation of the article, it should be mentioned that the results of a non-representative survey were analyzed, however, it can serve as a kind of guideline for the leaders of the Faculty to compile training plans and make recommendations to the lecturers. Among the grouping factors, a future study could form the basis of gender and generational perceptions of gamification.

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# The Role of Agile Management in HRM Environment Change

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## ABSTRACT

The Agile approach proved to be effective in building self-managed software development teams that can quickly respond to rapid changes and adapt to ambiguous and complex business environments with fast-changing requirements. After the pandemic, and as a cause of worldwide lockdown, companies struggled to survive. Most companies started shifting their work processes and environment to handle ambiguity using Agile methods and tools. The company's transition to Agile is usually led by HR, which played an essential role in this change, managing the talent and choosing the best processes to benefit the organization and avoiding other rigid processes and consider them wastes. Some Agile methodologies can add tremendous value to the organizations, while applying other methods can be harmful. Today, companies seek to reinvent their working practices by incorporating the Agile approach to improve flexibility and meet increasingly competitive market demands. This study examines the Agile management role in the HRM environment transformation and its effect on the new reality of adopting technologies in all HRM.

## 1. INTRODUCTION

The Human Resources (HR) role in companies' Agile transformation has evolved over the last years, leading the cultural, recruiting, and people management, which significantly impacts the successful implementation of the agile project management approach. Agile is partially an extension of lean thinking into software/product development (Medinilla and Medinilla, 2012). Agile is based on self-organizing and multi-functional teams' iterative growth in a way in which disciplined project management is required. The foundation of Agile is the definition of what to do and what not to do in software development. The idea started with the development of Extreme Programming (XP) in the 1990s. The complete framework and principle of the approach were announced in 2001 by a team of developers who created the agile manifesto. Agile represents and collects ideas and methods collected from Lean management, Extreme Programming, and Scrum without focusing on a specific complete method (Meyer, 2014).

Human Resources Management (HRM) is based on two models: hard and soft models. In practice, some elements of both models are applied by many organizations. The key difference is whether the emphasis is placed on the person or the resource (Truss *et al.*, 1997). Modern HRM sees workers as a critically important asset to the company. HRM not only serves the employees but also develops and maintains them as an asset that critically values the organization. The core element for assessing the success or failure of HRM is organizational success (Cleveland, Byrne and Cavanagh, 2015). HRM as a project and processes focused on departments and their operations and tasks to ensure that the routine

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procedures are well operated. Before Agile, technology projects had a high failure rate, which caused an impact that slowed the world's fast software development. Therefore, the traditional project management methods questioned whether it is suitable for all projects (Bhatta and Thite, 2018). The significant difference is presented in the ambiguity and uncertainty of requirements caused by the fast-changing and competitive world. This new type of projects required new principles and methods with flexible requirements that can be changed through the projects. In this study, the researchers will investigate the agile business partner's role in practices and how accenture uses HR to transform itself into an agile organization.

## 2. LITERATURE REVIEW

The agile manifesto was first announced in 2001 and illustrated those flexible principles with a new way of thinking about project management. Software development management has started shifting to this new approach and race to adjust its processes and procedures. The aim is to take advantage of the agile approach, which successfully transformed the software development life cycle into a more successful one and use it in other projects within the organizations (like HR projects). "Agile" is not just a collection of software techniques but also a movement, an ideology, a cause. This ideology has shifted fast to other organization departments (Sutherland, 2009). Agile isn't only for technology, the HR department was the first to be affected by it, especially the first principle in the agile manifesto "organizations should value individuals and interactions over processes and tools" (*Agile Manifesto*, 2001). Since the beginning, HR played a significant role in companies agility transformation. On the other hand, it faced many challenges in HR digitalization fast conversion, so it is a combined benefit for both (Cappelli *et al.*, 2018)

Agile mindset and tools can add a significant impact on selecting HR strategy (Varshney, 2020). While HR behavioural and structural changes required for agile transformation, to rebuild the processes to support organizational transformation. The HR role in companies Agile transformation has evolved over the years, leading the cultural, recruiting, and people management, which significantly impacts the successful implementation of the Agile approach. HR has generally played a support role in e-HRM project management, while In Agile, HR plays a central role since it is based on people. The contribution of HR to the agile transition is considered a requirement. HR may play a drastically different role in every organization. In an agile organization, there could be three potential positions that HR may play. The first is a form of "administrator" working mainly on behalf of the top management as an agent executing procedures. The second would be a "moderator," who attempts to be searching for the needs of all stakeholders-managers, workers, and shareholders. This position usually refers to internal customers when HR relates to clients. The third position, HR, focus on providing value to external customers as an "Agile business partner". In making the transition smoother, their competence with individuals and soft skills is of great importance. To produce and improve services more effectively with higher quality, an organization must embrace the agile concept to become the quickest to realize an opportunity, link it to a win consumers needs and then become a market leader.

While HRM is considered a key factor in the success of project management (Popaitoon and Siengthai, 2014), it is still obvious that the gap between them still exists in practical and academic research (Bellini and Canonico, 2008). On the other hand, agile for HR would mean embracing the mindset, adding the human first, and centralizing its processes based on humans. Agile Similarly acts in software development to build a business improvement process and define the value based on customers. Several problems have been raised within the HR department, such as: managing people initiatives that could take months or getting lost, and the HR team focuses more on policies and organizations than on people. Many employees were not developing the skills they require, even within HR itself, "Everyone was working on their own thing," says Tracey Waters, director of people experiences at Sky. HRM and project management are recognized as crucial factors for organizations. HRM activities can't be distinguished from project procedures. In other words, HRM practices can be dealt with and recognized as project activities (Zavyalova, Sokolov and Lisovskaya, 2020). The beneficial influence of HRM on project performance is well confirmed by many researchers (Khan and Rasheed, 2015). Agile management works side by side with project management. It has shifted to more comprehensive

applications that can be adopted in many other projects (Deloitte, 2016). Thus, it should also be applied to HRM teams and projects (Lenka and Singh, 2019).

### 2.1. Using E-HRM as Tool to Boost Organization Agility

Transformation means moving from a rigid control system to a more versatile and adaptive process. This change will require cultural shifts to promote systemic reform. In the late 1990s, as e-commerce spread across the business world, Electronic Human Resource Management (E-HRM) was first established (Olivas-Lujan, Ramirez and Zapata-Cantu, 2007). HR role begins with a conventional approach using physical, mechanical, and logical techniques. These approaches increased the effectiveness and efficiency of organizational work in managing human resources within the organization. It then transformed into a more strategic one that addresses the social and psychological needs of employees. The employees were also placed in a systemic position as an essential resource for organizations' economic value. The perspective of the strategic role of human resource management is becoming increasingly important in the competitive era.

E-HRM has been used synonymously with virtual HRM (V-HR), Human Resources Information Systems (HRIS), web-based HR, the Comprehensive Human Resources Integrated Systems (CHRIS) and portals of HR in this respect. E-HRM aims to ensure the implementation of HRM goals more broadly. HR objectives have been traditionally broken down into four primary forms (Poppulo, 2019). In this topic, they stated that HR defines the organization's structure to drive productivity, ensure effective communication within the organization, find talented staff, and embrace wider advances in culture and ethics. These forms serve as an approach to fulfil the organization goals. The function of HRM will contribute to developing a culture of creativity and superior efficiency, and this is because HR is no longer just about operational activities and personnel management. In terms of cost savings, productivity gains, and growth capability, it is a strategic unit that provides market value, both of which are outcomes of adopting agile methods. It needs to begin with its human capital if the company is going to become agile.

### 2.2. Transforming HR Environments

One of the difficulties that HR leaders face is prioritizing the resources of HR to achieve the highest outcome. The problem with the old HR process-focused environment is shown in figure 1. Its outcome was focused on processes and regulations, investigating which processes need people and adding them based on that. The main aim was to reduce the risk and standardize the work through policies. This was done due to the lack of data and information that can be gathered using technology. Implementation of workforce management applications is accelerating and will be increasingly used in organizations where flexible and agile scheduling is needed.



Figure 1. Process Focused Approach used in HRM (Gurchensky, 2019)

According to (Bondarouk, 2011), administrative e-HR apps are “very mature with some movement from in-house to software-as-a-service solutions”. These e-HR apps are now seen as heading towards a host solution or complete outsourcing. The use of technology and adopting E-HRM practices raised HR efficiency. It allowed data gathering, which shifts the HR scope from cost measured based on value-creating. The value is created by achieving a defined outcome which is a part of the organizational goal. This value-creating approach transfers the HR department’s focus from the reaction, policy, and processes to a distinct future view. Having a team of HR members focused on outcomes illustrated in figure 2, which are definable and measurable. These outcomes represent the customer, employee, and stakeholders expectations for achievements provided by the organization work.



**Figure 2.** Outcomes-Based approach in HRM (Gurchensky, 2019)

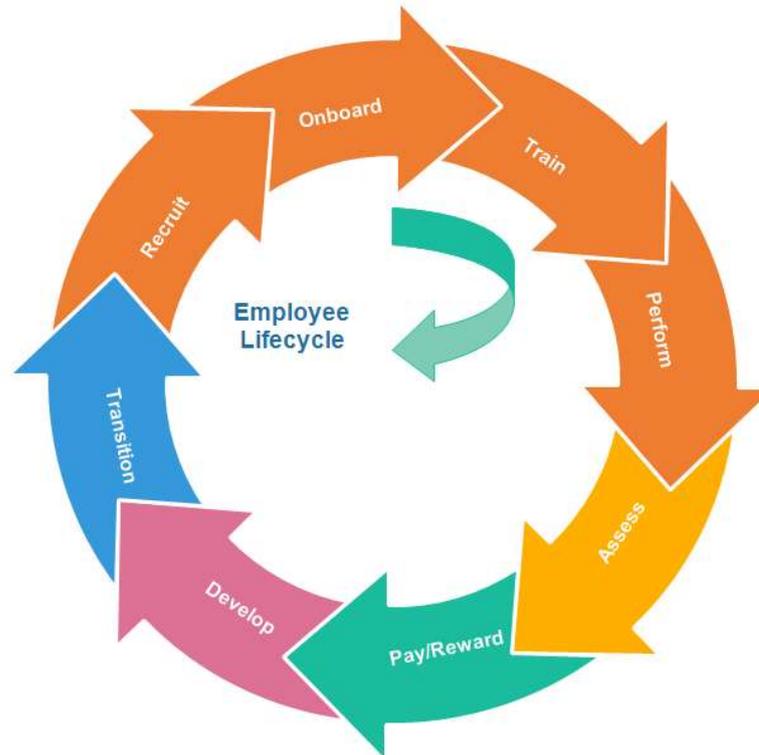
Over the last years, according to Gurchensky (2019), over 70% of the HR market has been shifted to an entirely new environment which is cloud-based. This change has been comprehensive and affected the whole HR functions. It changes the HR role from administrative personnel department to a critical business unit that defines the organization’s strategic income. The report shows how outcome-based HR leadership defines where the organization is headed by getting the ultimate use of available resources, removing roadblocks, and adopting the agile first principle to embrace individuals over processes and tools. In other words, the entire HR structure and roles have shifted from the process-focused approach, as shown in Figure 2, where the focus is on leaders instead of teams as in agile project management. Agile defined the team as a self-organizing group of software developers and other individuals such as customer representatives (Gurchensky, 2019). This team is responsible for the ongoing tasks (Meyer, 2014). Agile defined new roles and gave the teams some responsibilities of the traditional manager. To accomplish this transformation level, HR needs a clear scope, executive support, and practical execution. Moreover, Gurchensky (2019) showed a growth rate of HR environment transformation. Over a 20% increase of respondents who considered the HR functions provide a strategic value. On the other hand, the highest growth in leadership view shown in the survey’s executive opinion, more than 50% confirmed seeing the HR contributing strategic value.

Companies shifting beyond strategic view and outcome-focused HR environment transformation, new HR functions, and continuous improvement principles are needed, especially in an ambiguous work environment requiring applying the agile approach. In this environment, requirements and business outcomes can be frequently changed, and goals can be achieved in various ways. In HR, improving the

continuous data flow in the HR and its supporting technologies is considered the only way to meet the requirements of an outcome focused approach to HR.

### 2.3. Talent Management Applications

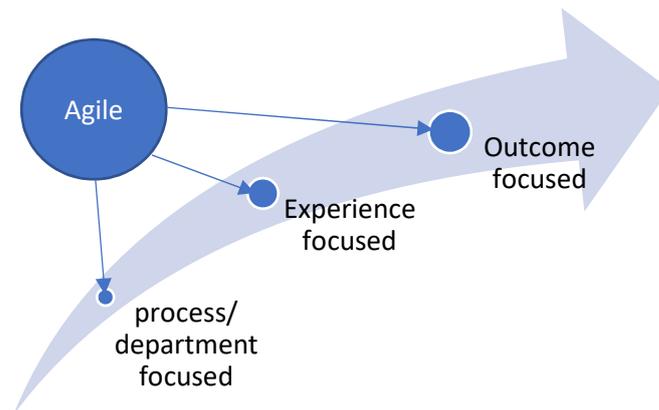
The Talent Management (TM) solutions' main goal is to help companies in their employee lifecycle (figure 3) processes that include managing acquisition, performance, development, rewards, and succession of their workforce.



**Figure 3.** The experienced-based approach in HRM (Gurchensky, 2019)

Controlling TM processes and their supporting applications as a strategic management tool to achieve functioning results. According to Gurchensky (2019), companies are currently re-evaluating their approach to key process areas traditionally managed with TM applications: recruiting, performance management, and learning. The performance of processes focusing on annual events, key roles, and confidential assessments has transformed into continuous feedback and more agile models. The aim is to select a set of processes that suits this area to improve it and empower transparency and trust within teams.

Significant problems have been reported about learning technologies that follow consistent reporting forms and event management models. As a solution, A high need to adopt agile methods can overcome the difficulties of changing programs' design and personalize it for each employee. The environment transformation diagram is shown in figure 4 illustrates the need for adopting agile management tools and methods in HRM to overcome challenges and disadvantages.



**Figure 4.** Agile outcome focused HR, an HR Leadership Model (Authors)

### 3. MATERIALS AND METHODS

Systematic literature review was introduced to narrow existing literature and examine research patterns and best practices on agile project management's effect on E-HRM practices. Three search engines were used in the literature review part (Scopus, ScienceDirect and Google scholar databases).

First, a search was performed using keywords relevant to the subject, the keywords were ('Agile') and ('E-HRM') or ('HRIS') ("EHRM"). Subsequently, the search was limited to the last ten years, from 2011 to 2021. The findings were also limited to management and IT-related results. In the Scopus database, the findings were just six papers, and they were not explicitly relevant to the nature of the study. Also, the exact keywords were used in the ScienceDirect database. Sixty articles resulted in a search process, and a few were relevant to the study's nature.

However, the findings were more convenient in the Google scholar database. Eight hundred papers have been identified as a result of this study. The final step was taken to pick and filter the relevance of the candidate studies in addition to the professional articles published in the agile HR community. Eventually, a systematic analysis of all candidate studies was carried out to select the studies specifically relevant to the research subject. Finally, after this systematic examination, more than 20 studies were finalized to analyze them.

### 4. DISCUSSION

#### 4.1. HRM Models

Many strategic HRM models appeared and studied by scholars in the past, the most famous five models are: Matching model, Harvard model, Contentextual model, 5-P model, European model (Budhwar and Khatri, 2001). These models have also been applied to test their efficiency and disadvantages in companies around the world, such as in Britain (Budhwar, 2000) , Russia (Zavyalova, Sokolov and Lisovskaya, 2020), India (Budhwar and Khatri, 2001) and many other countries.

Many disadvantages appeared with these models, and many lay in the communication area. In (Budhwar, 2000) study, he analyzed the five models and their weak points. Soft Harvard model focuses more on the human aspect of the organization and their relationship, managing stakeholders and involve them with the process making (Legge, 1995). This HRM model considered to be related more to Agile methodology, as aAgile management empowered teams and involved stakeholders (Meyer, 2014).

One of the soft model disadvantages mentioned by Buldhwar study was the need for enhancing communication to maximize commitments. A similar problem has been reported by (Bellwood, 2018) in the software development teams, The HR was discouraging the tech employee by normal

half year assessment in its HRM reward system. A set of measures was standardized as usual and HR employee had to give a number showing the bones that they will get. Still, what actually was happening in an Agile team where the team operates differently, the technology employee was being demotivated, cause in a fast-changing requirement and ambiguous environment, the outcome can't simply be measured by rigid or straightforward metrics, a one by one interview and enhancing the communication and feedback system, this application presents agility and flexibility in the employee's reward system, empowering people to make decisions within the organization.

#### **4.2. Experience collected within the Agile HR transformation**

But there's a little question whether agile uncertainty or implementing it half-heartedly for projects can be harmful; teams should select suitable processes and tools to avoid this. The path to working this way must take place on more minor scales. According to (Faragher, 2019), managers who go with it as one size fits all and deal with it as a general package will turn the idea entirely away from their staff. One might hear that some organizations are grouping a big number of employees in front of a powerpoint presentation to inform them about the organization attitude or culture. It should not be limited to take part in an informative session, the wisdom must be understood and capable of being employed where it is appropriate, not as a rule. Moreover, Jo Tolland shared his experience in running agile sessions and training without even mentioning the word Agile if possible, to cut out the terminology, too much of it can block the concept for some people.

A pick and mix approach to implementing agile concepts may help HR shift items before being used more broadly. Boggs added that some organizations started to use scrums in the recruitment process only. They have then felt the scrums' success and began to tell their success story among their colleagues from another department, which encouraged and motivated them to adopt the same method. Ed Houghton says that many of the agile foundations are to be welcomed in HR, such as creativity, iteration, and co-creation through multiple teams. He also added: "There is an emphasis on pace above all else, which is a real risk when applied to HR programs. Even fans of the agile movement agree that HR elements may not be all suitable and efficient to take the change, particularly in areas where rigidity is non-negotiated. In HR, some procedures and projects are repetitive and organized for reasons, and a left-field approach might not benefit them.

The IT HR team used agile to deliver its new approach, operating in cross-functional project teams consisting of an HR business partner, an HR consultant, a business supporter, and a related center of excellence. One big lesson was that if we wanted to be more 'agile', one should include product end-user in the project team, while we used people to assist in the IT work. For instance, they asked IT to provide these queries when they developed a technical interview toolkit rather than trying to write them in HR. Recently, in four 'agile' sprints, the team delivered HSBC's graduate program, using complementary instruments such as kanban and holding daily retrospectives.

### **5. CONCLUSION**

Over the years, the strategic Models of HRM have been developed to overcome market new challenges, the most common models still have significant weaknesses listed by many scholars such as (Budhwar, 2000) who recorded the most famous models disadvantages and the relation between the agile project management and HRM architecture (Zavyalova, Sokolov and Lisovskaya, 2020).

By analyzing various HRM models in this research, the soft Harvard model was found to be the most relevant HRM model to Agile management, taking into consideration its communication problems and the need for adding flexibility to deal with the strategic ambiguity and uncertainty, this is proposed to be done and enhancing it by agile concepts and methods. This study reviewed previous studies to find the possible improvements areas of the HRM models by adopting agile management and reviewed most recent practitioner practices and valid techniques to use within the HR environment transformation to agile. In addition to summarizing the role of embracing the Agile mindset which can benefit HRM environment change by empowering teams and involving customers.

In the last ten years, HR played a pivotal role in companies Agile transformation, on the other hand, HRM started shifting to E-HRM. The whole HR environment has been affected, and agility played a vital role in this transformation, movements to agile HR already started by 27 HR practitioners who have announced the agile HR manifesto in <https://www.agilehrmanifesto.org/> (Agile people, 2021).

Agile transformation is not limited to software development anymore, it has become a must for companies to survive the rapidly changing environment. Before the pandemic, 70% of the companies already started to shift the HR environment to be more agile (Gurchensky, 2019). Thus, after the pandemic reshaped companies environment and shifted them to remote working, the remaining percentage of companies which are about 30%, should start adopting the agile approach to help them survive in the digital reality. Moreover, COVID-19 has forced companies to work remotely because many processes have switched to be online based. With the environment change, the agile approach could be the only approach to overcome fast transformation challenges and ambiguous fast-changing environment.

Especially in the HRM as a strategic process, the core element has become the personnel and outcome-based other than the process-focused approach. Scrum and Kanban tools have been experienced to be beneficial in HRM. At the same time, there are many other tools can also be used and tested in companies. The success relation between HR and agile management urges the need to have a complete framework that can shape the HRM to agile management. Many practitioners proposed such frames, such as sky company in the UK. Still, there is a need to validate those suggested approaches by researchers. With a lack of research in this area, there is no existence of a comprehensive strategic model to overcome the ambiguity and be applied in HRM. There is a need to take the best practices from the agile approach in software development and test them in the HRM.

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# Proposed Model for Artificial Intelligence Acceptance in Recruitment: Telecom in Jordan

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## ABSTRACT

Organizations often aim to conveniently and rapidly provide their clients with a competitive value, so many organizations have taken advantage of the enormous technology and communications growth and introduced their services electronically and switched from 'traditional management' to 'electronic management.' In this context, HRM was designed to be EHRM, and the implementation of AI in the HRM is being presented at the time of the digital world. However, many organizations still have difficulties, particularly in developed countries, regarding the level of consumer acceptance of these services. There is still little awareness of user recognition of the use of AI in HRM services. In addition to this, previous literature research on the adoption of AI in HRM was mainly performed in developing countries. This study's primary objective was to provide a theoretical discussion and propose a theoretical framework for adapting HRM AI in the telecom sector in a developing country such as Jordan. Also, it addresses the variables that may influence the level of acceptance of the extended UTAUT2 model and describes the variables that affect the level of acceptance.

## 1. Introduction

Information technology (IT) in the human resources sector is an indispensable tool for achieving competitive advantages among organizations. Since its growth, many factors have affected human resources management (HRM), including the IT revolution. HRM techniques have been used to improve process performance with the help of early machine innovation. The idea of the Human Resources Information System (HRIS) has therefore grown exponentially, drawing the attention of organizations and HR representatives to its confirmed contribution to cost-saving and competitive advantage. It also attracts researchers' interest in determining its actual impact and clarifying its adoption drivers across different market sectors. Practitioners have observed the advent of EHRM (Electronic Human Resources), reflecting the use of technology services in HRM (Saxena and Kumar, 2020). EHRM has dramatically contributed and provided more strategic value to the extension of HRM within the sector. This developed an interactive method on which all performers, whatever their geography or location, emphasize the HR position by replacing conventional approaches with more technologically dependence (Sivathanu and Pillai, 2018).

Moreover, while HRIS was primarily directed at being utilized by HR workers in companies, EHRM played a significant role in including other customers and stakeholders in the decision-making process, thus adding to the HRM more strategically. Today, industry 4.0 is stated to have made substantial changes in the economy at large and HRM, in particular. Rapid technological developments, such as Artificial Intelligence (AI), alter occupations and roles that contribute to imperative competitiveness and embody potential market behaviour. As a result, HRM used AI-solutions in its processes to improve efficiency and consistency. While there is no consensus, researchers used a variety of terms such as

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Smart Human Capital to apply to AI-based HRIS 4.0 (Thomas *et al.*, 2020), Human Resources Management 4.0 (Liboni *et al.*, 2019), and Intelligent Human Resources Management Knowledge Processing (Zhang and Wang, 2006). Recently numerous AI-based HR technologies have become more appealing to organizations and HR managers. These intelligent HR systems offer solutions that automate time-intensive processes without intervention from human beings. Given its lengthy and costly service, the early HR characteristics of recruiting and selection involved AI's function. AI is the new constructing block that can be vouched in HRM, in which recruiting employees, especially talents, can become more effective. Recruiting the most talented applicants side to side with focusing on diversity is a big challenge organization usually face (Upadhyay and Khandelwal, 2018). AI can now overcome these challenges and support recruitment processes. However, organizations often overlooked harnessing the latest technologies in the human resources departments, which slows this section down. Given the fact that HRM has become the heart of the organizations, where all parties are connected, reliance on AI has become a must in the era of transformation that we are witnessing nowadays (Popenici and Kerr, 2017).

The technological implementation and deployment has attracted university students' attention and culminated in various frameworks for the performance of technology, for example, the Technology Acceptance Model (TAM), Diffusion of Innovation Theory (DOI), The Unified Theory of Acceptance and Use of Technology (UTAUT). These models were developed to identify variables that substantially impacted new technology reception and implementation. Although AI in HRIS suggests that HRM functionality should be significant, consistent with the industry 4.0 age, research related to its adoption and HR-professional attitudes towards HRIS is alarming.

This research is intended to review the theories that explain the user acceptance of new technologies, and then, developing an extended framework model based on UTAUT 1 and UTAUT 2 to serve the best in the environment of a developing country like Jordan, more especially the acceptance of the Jordanian telecommunication companies in adapting AI in the recruitment process.

## **2. Context of Jordan**

In 2001, it was reported that 85 percent of Jordanians had never been logged in to the internet and never found important information online (Al-Hujran and Al-dalahmeh, 2011). However, in 8 years duration, the situation has changed. (Microsoft, 2019) performed a study on AI adjustment in the Middle East and Africa. Considering Jordan as a developed country in providing the readiness environment to use AI is the subject of this report; the researchers are concerned about the results that contributed to the Jordanian background. Microsoft has granted Jordan's business environment a trusted certificate by confirming that most local companies are ready to use AI. The main reason was also that the government is developing its infrastructure and fostering Arab and foreign investment. The study also showed that 62 percent of Jordanian companies believe that artificial intelligence relates to executives, and 48 percent seek AI integration opportunities with their businesses. This study focused on Jordan's Telecommunication sector.

The move to AI is a continuous journey along the path with some companies than others. When dealing with early adoption, the vast majority of surveyed organizations have not progressed beyond the early pilot phases. Beyond the early stage and already accelerating in the released maturity phase, specific organizations are clear leaders in their respective sectors. Those organizations think they are advanced because AI technologies are already being used in their business.

### **2.1. Telecommunication sector in Jordan**

Jordan's population boom over the last decade and the migration of refugees into the country are in several respects a unique market. The telecommunication sector of Jordan is dynamic and dominated by three leading regional companies. With 4,045 employees, Jordan's telecommunications industry created unlocking revenues of \$1,423,771,401 in 2018. It is expected that by the expansion of networks, the launch of the new, emerging innovations such as 5G, the Internet of Things (IoT), data security, automation, artificial intelligence (AI), Blockchain, and Machine-to-Machine (M2M) would intensify the eventual development of the telecommunications industry.

In Jordan, the telecoms market has begun to see convergence and thereby improve its productivity in sharing its networking properties. The implementation of AI could be constrained by various possible challenges, including data protection and safety, capabilities and expertise; consumer and customer readiness; legal and regulatory environments; infrastructure; market strategy, costs, knowledge, and awareness (Kritzinger and Smith, 2008). Barriers to organizational readiness include the absence of new education methods, information, and understanding barriers that restricted the spread of the AI systems in Jordan (Dmour *et al.*, 2020). Perhaps the most significant obstacle to AI adoption is the technology's lack of maturity. As the number of business intelligence solutions increases, the best business development solutions are challenging to keep up with the lack of AI expertise, and data analysis is another significant barrier to AI adoption. The telecommunications industry may be particularly vulnerable to this problem, although the limited number of AI experts poses a challenge to all sectors. Computer scientists and data analysts may prefer other industries to apply their skills without proper incentives. This may imply that businesses will eventually have to find partners to help launch their solutions for AI. In this case, the cost of adoption may become a new challenge.

Using regular and updated acceptance models is an attempt to investigate the perception of technology by people (Aburumman, *et al.*, 2020). This study aims to propose a framework model to test the acceptance of using AI in the HRM in Jordan's telecommunication companies, considering the sector and the business environment availability.

### **3. AI in HR:**

AI is the main computer science component. It is the part that focuses on the construction of intelligent machines capable of carrying out tasks commonly of the intelligence of the human being (Builtin, 2019). Artificial intelligence can also be defined as every computer or automatic device automatically programmed to think like the human brain to serve different vision, understanding, thinking, and solving tasks.

Studies in technology and company with specific emphasis on AI, IoT, and Machine Learning facilitate decision-making based on priorities that make smart systems complicated and ambiguous (Haldorai, *et al.*, 2020). These systems can also achieve human functions dynamically and knowledgeably, such as modifying, fixing, understanding, and utilizing the numerous forms of data (Popenici and Kerr, 2017). It has also improved every organization's potential to offer high-quality, effective governance (Nasrallah, 2014).

There are various applications and systems in the age of technology that can provide organizations generous support. Today, employers can use AI for virtually all activities, particularly in HRMs, which can be electronically sourced, screened, matched, and rated (Mondal, 2020). Adopting and applying AI has been a straightforward path to accomplish organizations' goals (Rieder *et al.*, 2020). This paper proposes a model of acceptability for AI usage in HR in Jordan's telecommunication companies.

#### **3.1. UTAUT2 model and Adoption of AI**

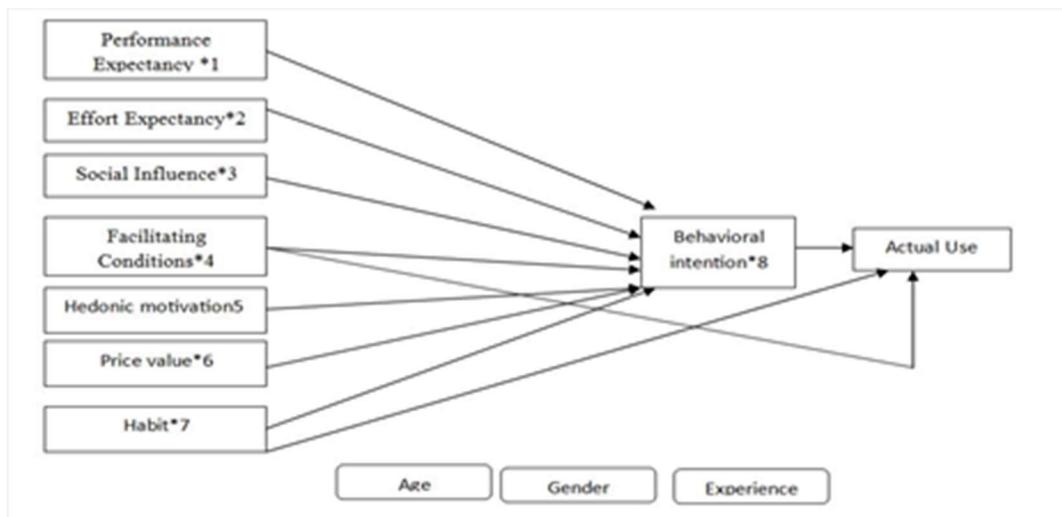
The distinction in recognition of any modern technical know-how is also focused mainly on technology acceptance models in the literature. These models also clarified the reasons that measure these technologies' acceptance (Raghavan *et al.*, 2020). One of the most important frameworks of technology acceptance study Davis, Bagozzi and Warshaw, (1989); Park, (2009) was the Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA). In addition to its utility, it has been observed that TAM is once forecasting less than 50% of embracing scientific cases (Venkatesh and Davis, 2000a; Park, 2009). Thus, on the grounds of a comprehensive literature review on technical acceptability (Venkatesh *et al.*, 2003a), the UTAUT model was suggested that will eventually help to overcome TAM's vulnerabilities.

UTAUT has become a common choice as this structure incorporates some variants from eight robust theories, including the TRA (Fishbein, 1975), the TAM (Davis, *et al.*, 1989), which provide four

essential elements of scientific acceptance, such as performances expectancy, efforts expectancy, facilitating conditions and social influence.

This framework is thus perceived to help significantly understand customers' intention to accept new technologies such as AI systems. Using AI will thoroughly comprehend the individual characteristics of UTAUT employers (Rishi *et al.*, 2017). Acquisitions, reviews, and training of new human capabilities in companies will be adorned with AI's implementation. It allows workers to make smart decisions and to develop the best expertise at the desired moment. The assessment of the adoption of any emerging technology is also focused on models of technology acceptance.

These models usually describe the predictive acceptability variables (Venkatesh, Chan and Thong, 2012). One of the most important modes of technology acceptance study was the technology acceptance model (TAM) and the Theory of Reasoned Action (TRA), regarded as the application of the theoretical theory of psychology (Fishbein, 1975). In this study, the researchers decided to use the UTAUT2 acceptance model because it is the most recent acceptance model. Moreover, It is underpinned by the eight previous theories of acceptance. UTAUT2 is more flexible, and it can predict 70% of the cases of adoption when comparing it with other models, which can only predict 40% of these cases (Venkatesh *et al.*, 2003). In (figure 1) below, it shows the extending model of UTAUT2.



**Figure 1.** Extending the Unified Theory of Acceptance and Use of Technology (UTAUT2) (Venkatesh and Thong and Xu, 2012)

- **Performance Expectancy (PE)**

In the UTAUT2 model, Performance Expectancy (PE) defines end-user compartmental purpose. It will show "the extent to which an end-user feels that utilizing the application software can help achieve a specific solution or job efficiency" (Venkatesh *et al.*, 2003). One may trust the success of digital technology (Mohd Suki and Mohd Suki, 2017). It looks like a presumed utility, trust, job flexibility, relative advantages, and an expected outcome of a particular technology (Ahmad, 2014). During early testing, the researchers found a significant influence on their behavioural purposes as well as mental health facilities (Alan, Hu and Barua, 2018) on their performance. Therefore, a person's expectation of performance can impact his decision to use new technologies such as AI to attract talent.

- **Efforts Expectancy (EE)**

"The ease correlated with utilizing the device" is clarified in Effort Expectancy (Venkatesh *et al.*, 2003). Simple accessibility of technology tends to drive customers to adopt the technology (Dwivedi *et al.*, 2017). The user-friendliness of the system was sure to increase the desire to use that particular method (Salloum and Shaalan, 2019). A significant and successful AI predictor is called an initiative expectation (Lu, Hsu and Hsu, 2005). Prior research revealed substantial and positive collaborations for effort perceptions in a related area. The study of mobile banking services (Ghalandari, 2012) indicates that consumers tend to make optimistic use of technology, provided that there is less effort required to

use or manage an individual system. (Onaolapo and Oyewole 2018) found the important positive connectivity of smartphone user preferences. Other findings also show that the expected contribution to technology is being made visible for customers (Alalwan *et al.*, 2014).

- **Social Influence (SI)**

In social terms, a person believes that the people around him are essential in deciding to use the new way (Venkatesh *et al.*, 2003). Acceptance of technologies relies on social effects and not just on people (Youngberg, Olsen and Hauser, 2009). Amongst the most significant social considerations in the preference for technology usage for citizens is the perceived performance of innovations (Amin *et al.*, 2008). The social effect of personal technology engagement can be evaluated (Venkatesh, Chan and Thong, 2012). It is noted that individuals have psychological pressure, such as friends, relatives, employers, etc., which may also impact a willingness to act (Tarhini *et al.*, 2016). In this sense. Several scholars have analysed the positive and significant impact of technology's interpersonal usage in social regulation (Arman and Hartati, 2016). There have been merged views on the effect of social effects on behaviours since the impact of utilizing AI was also found in absenteeism (Chatterjee and Bhattacharjee, 2020). However, we see significant indicators in the above literature that technologies like IA's social influence are also a good predictor. The following theories are then established in the subsequent discussions.

- **Facilitating Conditions (FC)**

The citizens' behavioural ambitions to use technology are another driving factor (Salloum and Shaalan, 2019). It was described as the degree to which an individual believes that there are organizations and technical infrastructure for system use (Venkatesh *et al.*, 2003). The FC components are consistent with other structures and behavioural control (Lee and Lin, 2008). Moreover, FC plays a vital part in applying and using technology for people and organizations (Chiu *et al.*, 2012). The FC AI systems can be recognized explicitly through technological services or consumer instruction. Clear relations were developed to promote influences and behavioural intentions (Yi *et al.*, 2006). Uddin *et al.*, (2019) reported that evidence for the electronic systems' behavioural impact is essential.

- **Hedonic Motivation (HM)**

HM is defined as The fun or happiness obtained by technology (Venkatesh, Thong and Xu, 2012). HM was potentially found to be a significant factor in forecasting the decision to implement IS study technologies (Alalwan *et al.*, 2014). In this research, consumers who feel enjoyable and entertaining to use AI systems and are more focused on the course topics are more inclined to use it. Hedonic inspiration may vary as individuals with diverse cultures and demographics.

- **Price value (PV)**

According to Venkatesh *et al.*, (2012), PV, the cognitive trade-off between the potential advantages and the monetary expense of utilizing individuals' applications is established. If the edges of following a given scheme are higher than the financial costs, the price benefit is positive. It is anticipated that in this analysis, as users feel that the advantages of using the system are more significant than the monetary costs, they will most likely use the AI systems.

- **Habit (HB)**

HB is described as the degree to which people appear to execute behaviours spontaneously due to learning accrued from their experience of utilizing such technologies (Venkatesh *et al.*, 2012). According to (Venkatesh *et al.*, 2003), Habit has been recognized as an alternative determinant of the utilization of technologies and behavioural purposes. This study predicted that if people have more habitual device behaviour, they are more inclined to follow it. It is clear that the acceptance model for the adoption of technology typically focuses on the general influences affecting end consumers in general to embrace emerging technologies. These frameworks may be applied to modern developments and offer an analysis of the factors affecting their acceptance. For the following purposes, UTAUT2 is

to be implemented (Venkatesh, Chan and Thong, 2012). UTAUT2 was drafted from 8 past theoretical frameworks and hypotheses; therefore, UTAUT2 is an integrated model strongly endorsed by literature theories. In evaluating the acceptance of usage of technologies and actions, UTAUT2 is more versatile than other theoretical models. Besides, UTAUT2 is reasonably reliable, and 70% of the IT adoption cases can be predicted instead of the further consumer adoption (TRA, TAM, TPB) models, which can only estimate approximately 40% of cases (Venkatesh *et al.*, 2003). UTAUT2 may refer to nations, age ranges, and technology in various countries. It may recognize other vital variables that can lead to growing UTAUT's deployment to a wider variety of market technologies. UTAUT2 is a credible model used in a wide variety of technology implementation studies (Mornizan Yahya *et al.*, 2011). In the developing world, UTAUT2 has primarily had rarely been tested. This paper attempts to follow UTAUT2 to explore the acceptance of AI in HRM from Jordan's point of view as a developing country. UTAUT2 was eventually repeatedly utilized for analysing the successful influences shaping adoption and usage of technical purposes (Alazzam *et al.*, 2015).

#### 4. Proposed Research framework

The purpose of using AI is connected to a feeling of deciding the aim of a person to perform a particular task (Fishbein, M., & Ajzen, 1977). A significant indicator of the fundamental actions which express the purpose is the intention to use AI (Zhang and Gutierrez, 2007). Action in support of acts that define one's goal of using AI is intended as a vector mediating (Nasrallah, 2014). Various types of studies indicate that behavioural intent is the most significant comportment predictor. In their most recent studies, Chatterjee and Bhattacharjee, (2020) stated that the behavioural purpose has a beneficial and essential impact on actual implementation to incorporate AI. In most UTAUT models, behavioural objective thus depicts a substantial influence on a person's definite AI preference. In this study, the researchers extended the UTAUT2 model adding the Trust variable for the reasons shown below.

##### 4.1. Trust

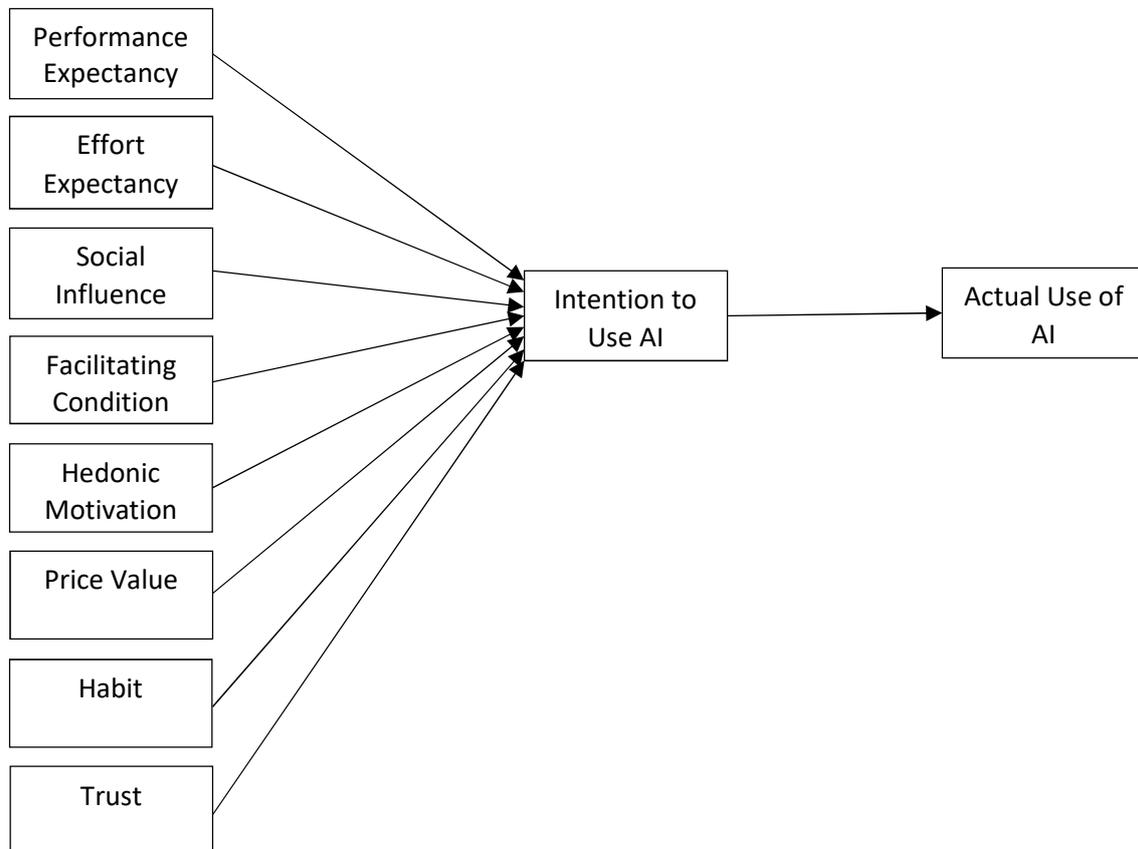
In developing countries, Trust in new technologies is considered to be a barrier (Malik 2020). A study from the Association of Arab Advisors based on a survey found that businesses in Jordan have the infrastructure to adopt AI systems. However, the study states that Jordanian companies require more IT awareness to restructure their functions and practices more efficiently. On this basis, in the Jordanian telecom industry, IT literacy and confidence are a big topic. Many businesses need to become conscious of the effects of AI adoption and why investment in this form of technology is required. Simultaneously, the Government of Jordan recently authorized an AI national committee to track the technology implementation into various government economic sectors. This committee will make sure to stay in touch with the needed innovations and developments of the Industry 4.0 revolution. Moreover, regulations and rules related to the budget investment will be allocated to support businesses to adopt AI in Jordan, especially in the public sector (Times, 2019).

The constructions in UTAUT2 are meant to affect the conduct of AI facilities. UTAUT2 does not, though, answer trust-related problems. It does not clarify why separate configurations for the same app configuration may be introduced (Tsiknakis and Kouroubali, 2009). Therefore, combining all these independent variables was assumed to reflect better the factors that will decide how AI applications are expected. The trust in utilizing this modern technology is a significant variable in the current study sense, and several researchers have demonstrated Trust in their studies.

The definition of Trust is the psychological beliefs of a trustworthy individual that they are not opportunistic and ready to be susceptible to other parties' behaviour. For some time, a clear determinant of technology adoption has often existed in the field of study (Pavlou, 2003). However, after an invention on the Internet that led to the rise of e-business and accelerated technological growth, the attention of technology adoption was increased. Although many ideas linked to trust have been introduced, prior research on well-supported trust conceptualization in a technology acceptance context has been addressed (Mayer, Davis and Schoorman, 1995). The literature used the corporate Trust paradigm to explain the understanding of confidentiality in the company's acts and encourage the trusted knowledge of the ages' technological preparations described three aspects of religion, sincerity, abilities, and solidarity (McCloskey, 2011). Integrity is related to trustworthiness about the trustee's conformity

with the values generally agreed, that is, the trustee would be truthful, ethically maintain his commitments. Competence is the presumption that the trustee group has the ability and the qualifications to meet its expectations (Mayer, Davis and Schoorman, 1995). The advantages are the degree to which the trustee's perceptions are thought to benefit the trustee. They are usually viewed as goodwill. In addition to its correlation with the user's intent to implement modern technologies, it is preserved that trust in new technology or invention comparatively favourably has to do with its perceived. This presumption is premised on the trust as a personal guarantee that the trustee's faith in device effectiveness and anticipation of success increases. Finally, it appears, according to the literature as mentioned earlier, that the Trust may influence the degree of acceptance as an independent component, which is why this suggested structure has been established to provide a clearer interpretation of the prior acceptance factors (Figure 2).

## 5. Suggested Study Framework



**Figure 2.** The proposed research framework (Authors)

UTAUT2 has used several Information Systems (IS) studies that examined the background of new technology adoption and deployment by individuals (Oliveira and Martins, 2010). In summary, a significant number of experiments have employed UTAUT and have shown a robust explanatory uncertainty. Therefore, using the UTAUT2 model with its developments should make a massive difference in the certainty issues.

Also, two moderating factors, age, and gender are omitted from the model adopted. The reason is that these systems programs are similarly accessible for women and men. Everyone has access to technology since the age variable, and the voluntary dimension have both been removed. Besides, the suggested system also employees' expertise as a moderating element in moderating the usage of new system facilities (Al-Shafi and Weerakkody, 2010). (Venkatesh *et al.*, 2003) they were proposed that enhanced experience could reduce the effect on the EE, SI, and (H) execution. This analysis presupposes that familiarity with the Jordanian Telecom sector AI adaptation in recruitment processes might have a moderating impact (Table.1).

**Table 1.** Studies of The Research Model's Constructs

	Factor	Previous Studies
Performance expectancy	(Venkatesh <i>et al.</i> , 2012)	
Effort expectancy	(Venkatesh <i>et al.</i> , 2012)	
Behaviour Intention (BI)	(Friedrich and Hron, 2010)	
Facilitating Conditions (FC)	(Venkatesh <i>et al.</i> , 2003)	
Social influence	(Jong and Wang, 2009)	
Actual use	(Venkatesh <i>et al.</i> , 2012)	
Habit (HT)	(Venkatesh and Chan and Thong, 2012)	
Trust	(Alshehri <i>et al.</i> , 2012; Lian, 2015)	

## 6. Methodology

In this study, 19 relevant studies from different publications were retrieved to analyze the research in-depth concerning the use of acceptance models. These related papers have been analyzed and discussed. Therefore, this study should be viewed as a qualitative review of the material to propose an expanded UTAUT2 model. Moreover, while there are various studies based on different acceptance models, this study concentrated only on studies based on the UTAUT2 model. As a result, the current study may be seen as a subgroup of related studies, which seek to add value compared to a general analysis of the acceptance models for research. Also, further studies will be conducted following this analysis to test the expanded model using a quantitative approach.

## 7. Results

In evaluating technology usage and behavior recognition, UTAUT2 has more excellent stability than other theoretical models. A consistent model is used in a variety of technology tests. It was tested primarily in developed countries but not so thoroughly in developed countries. Therefore, the purpose of this study is to follow a UTAUT2 structure to explore whether the Telecom sector in Jordan would accept AI in Jordan from the business point of view. However, proposing this model for the telecommunication sector will have more opportunities and chances. An extended model was proposed considering the Trust variable to help explain the adoption of AI in Jordan's telecommunication sector. In other words, UTAUT1 and UTAUT2 models didn't focus on the Trust variable among their theories, especially in the telecommunication sector of developing countries where the Trust in new technologies is a big challenge. As a result, the Trust variable in this study will give us a deep understanding of the process of new technologies acceptance.

## 8. Conclusion

This research is being considered as a standing base of more studies that will be carried out in this field. This paper has proposed a deeper understanding of the main factor that affects the acceptance of AI in the telecommunication sector in Jordan. Researchers can build many studies to explore more aspects related to the main ones. For example, the Trust variable can get deeper better to extend the impact of security and privacy in this field. Moreover, this research can explore the moderating variable that may affect the acceptance of AI in the telecommunication sector, such as education, experience, and employee training.

The result of the research chain that will be carried out due to this study will give us a big picture of the challenges and opportunities in adopting AI in the telecommunication sector in Jordan, which may be a reference for many researchers to conduct their research under the umbrella of this study in different sectors or geographical locations and cultures.

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