

# Historical development of the aim towards digitalization of information and the reflection of these processes in poultry sector

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**Citation:** Petkov, E. (2022). Historical development of the aim towards digitalization of information and the reflection of these processes in poultry sector. *Zhivotnovadni Nauki*, 59(2), 53-62 (Bg).

## Abstract

Digitalization as a process of information transformation does not happen suddenly, but has historical stages of development. These stages are interrelated, and each is fundamental to the next one. Although there is no clear boundary between the stages, the technological advantages that characterize each of them can be considered as clearly marked characteristics of the periods. Thus we can divide the historical development of the digital technologies so far into 5 different stages. Based on this we have built a timeline, showing the sequence of their appearance and the estimated time of their implementation into poultry practice.

The study also confirmed the fact that digital technologies are entering extremely fast, due to several things: 1) The ability to collect increasing amounts of information, which requires the creation of a new type of carriers, such as digital. 2) The large amount of information generated daily in poultry practice further favours their rapid assimilation. 3) The low added value of the final product and the risky nature of the investment also make the owners in the sector extremely receptive. All that has been said so far characterizes the poultry industry as a favourable field for testing new digital applications and their entry into animal husbandry.

**Key words:** digitalization, poultry farming, historical development, historical stages and time lines

## Историческо развитие на стремежа към Дигитализация на информацията и отражението на тези процеси в птицевъдния сектор

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## Резюме

Дигитализацията, като процес на преобразуване на информация, не възниква изведнъж, а има своите исторически етапи на развитие. Тези етапи са взаимно свързани, като всеки един

от тях е основополагащ за следващите. Въпреки, че на пръв поглед няма ясна граница между тях, то за такива все пак може да се приемат технологичните възможности, които го характеризират. По този начин можем да разделим историята на развитие на дигиталните технологии до момента на 5 етапа, като въз основа на това изградихме времева права, показваща последователност на появата им и предполагаемото време на внедряването им в практиката.

Също така направеното проучване потвърди факта, че дигиталните технологии навлизат изключително бързо, поради няколко неща: 1) Възможностите за събиране на все по-големи количества информация, което налага създаването на нов тип носители, каквито са дигиталните. 2) Големият обем от информация, генерирана ежедневно в птицевъдната практика, благоприятства допълнително бързото им усвояване. 3) Ниската добавена стойност на крайния продукт и рисковият характер на инвестицията също така прави собствениците от сектора изключително възприемчиви.

Всичко казано досега охарактеризира птицевъдния бранш като благоприятно поле за изпитването на нови дигитални приложения и навлизането им в животновъдството.

**Ключови думи:** дигитализация, птицевъдство, историческо развитие, исторически етапи и времева права

## Introduction

Digitization is the process of converting information from an analog format stored on an analog carriers to a digital format (i.e., electronic) in which the information is organized into bits and stored on digital devices (O'Donnell, 2017). According to Lankshear and Knobel (2008), the result of all this is the presentation of information (usually analogue), by generating a series of numbers that describe a separate set of its points or samples (sampling). The result is called a digital representation, or more precisely a digital image of the object, as well as a digital signal form. An older concept, such as that of Taylor (1984), defines "Digitalization", not simply as a process of converting information from analog to digital (i.e. electronic), but a process in which it is organized into bits. In modern practice, digitized data is in the form of binary code, written in the form of a series of numbers 0 and 1, which facilitate computer processing. Very often, however, the term "Digitalization" is associated with "Digitization" and has acquired citizenship as its synonym, but according to Brennen and Kreiss (2016), "Digitalization" is a purely conceptual term that is closely related and often used in a broad literary sense. The authors examine each

term in detail and argue that both have analytical value. According to them, unlike digitization, which is a material process for converting analog streams of information into digital bits, digitalization is more the way in which many areas of social life are restructured around digital communications and carriers infrastructures. Therefore, "digitalization" is defined by some authors as one of the main trends changing society and business (Parviainen et al., 2017), but also causes changes for companies due to the transition of digital technologies in the organization or operating environment (production, marketing / marketing, management / management solutions, R & D / consulting and raw material supply / logistics). This will inevitably sooner or later cover every sector of animal husbandry, and each industry will go its own way of "digitalization" or "digitization" under the influence of a common factor, such as an increase in the volume of information.

## Nature and significance of the information

Questions about the existence of information and its nature and properties began to be addressed in 1948 by Claude Shannon with the

publication of the work "Mathematical Theory of Communications". He first explained the information that exists around us, outlined its volume and allowed us to understand its nature and character. According to Information Theory, information itself exists unchanged with the existence of the object and is a consequence of its very existence, as well as of its interaction with the surrounding objects (Shannon, 1948). Due to this property, it is possible for it to exist even after the object is no longer available, as an imprint of its interaction with the surrounding objects. However, the Information Theory only hints at the immeasurable amount of information that exists and is generated around us. This was later confirmed by the father of modern information science, Prof. Robert Taylor and his followers. Much later, in 1967, he confirmed the definition of information. According to him, it is an exchange of data between individuals – the exchange of signals in the plant and animal world, the transmission of signs from cell to cell, from organism to organism. This large volume of existing information requires it to be compressed for easier storage and transmission in generations, but also to be easily accessible and usable after a period of time so that it is as identical as possible to the original source (He et al., 2010). This also raises the demand for newer and lower-volume materials when storing information in writing (Zadok et al., 2004). The textual information gives the beginning of the search for lower and lower volume and durable material carriers, on which it can be stored unchanged for a longer time.

### **History of the pursuit of digitalization of information and the processes for its processing**

The appearance of computers is the history of human desire to improve the processes of storing information over time, maximally compressing and encoding it in order to organize it. This is mainly done for more efficient and easy storage, but also to facilitate the process of possible search and future use of this same information if necessary (Mattessich, 1952). Therefore,

since before the computer era and digitalization, various methods for classification, archiving and coding have existed and been used, which aims to facilitate the work with the then only possible analog data carrier (paper) (Bricklin, 2009 b; Frankston, 1999). This process is most clearly characterized by the search for ways to arrange the analog information in a tabular form. These simple techniques are still the basis of almost all familiar programs using spreadsheets. This method predates digital technology by almost half a century, relying on a system of uniquely coded leaflets that indicate the spatial arrangement of the information in the archive (in which room, row, shelf, shelf and section of the shelf is the analog carriers) and is best suited to digital storage systems (Raubenheimer, 2017). In the history of the development of digital systems, the desire of a person to collect and store information around him, and later to track certain moments chronologically, leads to the creation of entire processes for easier use and efficient storage. Digitization is only one of these processes, and depending on the development of the possibilities for information processing, 5 main historical stages can be distinguished. They are consistent in chronological terms and although the boundary between them is extremely thin and overlapping, they still differ in the possibilities for storage, acquisition, operation and use of the acquired information. Their chronological order is inevitable and indisputable because each of them is fundamental to the next.

*Stage 1: First applications for administration of farm productivity information or first attempt to digitize analogue information in animal husbandry*

Before the advent of our familiar programs such as Excel and Access, spreadsheet development was part of an old analogue data classification process. Their electronic version was borrowed from computers and preceded the appearance of the computer (Raubenheimer, 2017). Thus, the prototype of the spreadsheet preceded personal computers in time, and one of its earliest versions was called the "spread sheet" and was the work of Kohler from as far back as 1952

(Mattessich, 1952). This version is intended for accounting and the actual computerization of a spreadsheet was done by Richard Matesich, who borrowed Kohler's idea only 9 years later (Mattessich, 1961, 1964). However, the first application was not released on the free market until 1969 as a program called LANPAR, named after its creators Rene Pardo and Remy Landau (Pardo, 2000). In turn, it is followed by far closer to current analogues spreadsheet programs such as Apple II: VisiCalc (Power, 2004). According to Grad (2007), VisiCalc marks the beginning of the competition we see in program developers today, as it is based on the personal experience of its creators Dan Bricklin and Bob Frankston with calculations in working with paper carriers in their student years (Bricklin, 2009 b, 2015; Frankston, 1999; Power, 2004). Grad (2007) considers this important, as spreadsheets can be called the "first battle for supremacy of software developers" preceding the battles for a better operating system for Microsoft and Apple. It was not until 1980 that Microsoft entered the competition to introduce its first Multiplan application two years later, then replaced by the first versions of LOTOS (Kapor, 2007). It will take Microsoft developers another 5 years to get to the familiar first versions of Excel and Access and 11 years to make their creation popular as part of the Microsoft office suite. This introduction of spreadsheets, according to Raubenheimer (2017), is one of the main reasons to expand the target group and increase sales of computers, taking them out of the then image of people as "another word processing machine". In this way, their application changes, as people gradually begin to perceive them as a kind of electronic secretary, administrative assistant or task organizer, eliminating much of the work that has so far been done by man (Campbell-Kelly, 2007). According to Raubenheimer (2017), digitizing the processes of using a spreadsheet prevents the personal computer from remaining just a hobby, tool or type of gaming machine to this day (Hesse & Scerno, 2009). The first stage is not rooted solely in the creation of digital carriers. Specialized applications are being created for the type of activity, and although for each of the livestock sectors

its "starting point" is chronologically different, for the poultry industry it started in 1994 with a simple program called FCS. Programs such as FCS or Farm Business Stateman Software Series have been around since 1984, but it will take another decade for this idea to reach companies in the poultry industry. The program is relatively simple and is based on the ideas of Thomas Prey and Danny Klinefelter, for periodic recording of production data, but although it is the first program of this kind, it is not widely used. The mass use of this type of specialized programs or files began only after 1994 in the poultry industry.

Due to the extremely strong intensification of the poultry sector, data administration applications are rapidly coming into use in imported parent flocks of broilers and laying hens (Karkh et al., 2019). For the first time in Bulgaria ".xls" format files based on Excel were introduced in Bulagro-97 AD, at the end of 2000. They are provided free of charge by the company Bovans Ltd. when charging parents for a commercial four-line hybrid ISA-Brown. They are advertising materials for the purpose of filling in by the companies and returning the information on paper to the company producing parent herds. The file is based on the Harris principle (1988) and the already popular Microsoft Excel program in the 90s. A tabular template is made in it, in which some of the main productivity indicators are periodically applied in certain places. Mainly, data on feed consumption, number of deaths and after 20 s.v. number of eggs laid. Primary data from the template are used to calculate derivatives by which egg production curves are constructed, modelling them using production information (Miyoshi et al., 1996). Such models are still used today in most companies, although such documents are no longer relevant and in view of the development of new technologies are not offered by companies producing commodity and breeding material. They have been replaced by online-based platforms that allow the same tabular principle to be used, but in an interactive environment. This example described above best expresses the first most basic and accessible way of data digitization. The process involves the construction of an internal structure, which is based

on digital devices that manually or automatically feed data to a computer for further processing and storage. In this way, the capabilities of the above-mentioned programs are most often used, the most common of which is currently Excel, as well as some Access-based applications.

*Stage 2: Electronic forwarding of information through the appearance of the first e-mails or the birth of the World Wide Web as an opportunity to transfer digitalized information in space*

The history of postal services, similar to spreadsheets, precedes the invention of digitized versions. It is an example of digitizing an entire analog process to make a connection between distant spatial or even geographical objects and individuals sharing the need to use the same information (Brown, 1972). Although the analog version of this service has been around for nearly a few millennia, the digital version has been around for about 55 years (Harris, 2016). It was started by Ray Tomlinson in 1971 with ARPANET, who introduced the “@” email sign. According to Tom Van Vleck, however, the start may have been given ten years earlier without being made public, as it was originally intended solely for military purposes (Van Vleck, 2016). During this period, the exchange of documents by e-mail was still not allowed when one of the two in the chain was offline. This will only happen with the advent of Web Mail in 1995. Hotmail (1997) and Gmail (2004) followed, and the latter will mark the beginning of the next step in information sharing.

With the start of the Internet age, a new, better form of application is being created for spreadsheet-based programs, as files can be sent online. This makes it easier for management and consultants (in cases where the company uses consulting services), especially with the advent of electronic mail applications (Crocker, 2012). This makes it possible to send documents over long distances at a speed unattainable for postal services (Harris, 2006, 2016). Although the second stage is short, not so widespread and important for poultry companies, they still use it to this day in their personal and business correspondence. The impetus for the use of e-mail is given by the

pressure from the companies supplying and producing parent material to hatcheries and farms offering commodity hybrids for meat and eggs. In the beginning, this aims to provide feedback on the characteristics of the product and is a purely managerial technique. Subsequently, the managers of the poultry companies themselves began to impose it in their subordinate hierarchical structure. At a later stage, they use it for deliveries (feed, packaging, etc.), as well as in their relationship with the distributors of finished products. At a later stage, they use it in deliveries (feed, packaging, etc.), as well as in their relationships with distributors of finished products. Subsequently, with the advent of breeding associations, it was used as a way to quickly exchange documents with them. Although this stage is chronologically less than a decade long and is rapidly being replaced by new document sharing applications, its emergence is fundamental, not only for the subsequent stage, but also for each subsequent stage.

*Stage 3: Emergence of the first static internet platforms for online information sharing for advertising purposes or opportunities to share information via the Internet without file transfer*

This next step was taken with the appearance of cloud and web-based applications as a huge repository for information of all kinds. The stage itself is expressed in the construction of online-based presentation platforms, which do not require specialized software, but simply a computer with Internet access. These are the so-called web-based content management systems. These systems are the basis of open source products such as WordPress, which are widely used by all companies to present their products on the web. The breakthrough was made by managers of companies such as Google, which in 2004 began spending 98.8% of their budget on advertising on web-based platforms (Interactive Advertising Bureau, 2006). This idea was quickly taken up by other companies, through the promotion of free and subsequently paid platforms for use by hosting companies. Thus, according to Kumar and Sethi (2009), in 2004, 627 million users worldwide used Internet platforms to offer goods

online. In 2005, online sales in the United States alone reached \$ 86.3 billion (up 23.6 percent from 2004), and three years later that amount rose to \$ 117 billion a year. Therefore, the first in terms of using the capabilities of the new business model (hosting services), providing digitalization, are the managers responsible for product sales (Evans et al., 2004), who see the possibility of low-budget and widely available method of advertising their products in search engines (Kumar and Sethi, 2009). According to Bakos (1997), the Internet not only benefits consumers by reducing advertiser costs, but also reduces the cost of searching for the product by the consumer. According to the author, Internet advertising helps sellers by providing them with various options, frequent updates, which are sometimes not possible, and in most cases are expensive in traditional markets. Thus, the outcome of the so-called "Browser War" (Swartz, 1997), set with the advent of the World Wide Web and the confrontation between Microsoft's Internet Explorer product and Netscape's flagship Navigator, would be a de facto clash mastering a larger market share on users of browser services, and their attention for the purpose of active advertising (Harris et al., 2021).

In poultry farming, this direction was quickly mastered at the third stage, and exclusively for the purpose of low-budget advertising of the products. This is due to the nature of the goods produced in the poultry sector, namely low-value-added low-value products (Lampkin, 2005), where the profit is reduced to 0.12 BGN per kilogram of poultry meat (Valkov, 2015) or less from one penny per egg category L (Belorechkov, 2018). This type of product reduces the ability of the companies to use expensive media for more effective advertising (Klasova, 2004). Therefore, all companies in the industry have taken advantage of the capabilities of WordPress and Facebook, to date there is almost no poultry company that does not have its own page on these platforms.

*Stage 4: Emergence of the first dynamic internet platforms for online information sharing or the ability to work more than one person in the*

*same document in real time regardless of distance*

The fourth stage is purely technologically applicable and designed more for the control of production processes. It started with the advent of Dropbox in 2008 as a cloud-based data warehouse. In 2012, Google's "Gmail" joined with its Gmail app, Google Drive. That same year, three companies with Google's Gmail, Microsoft's Hotmail and Yahoo! Mail "on Yahoo!, as the leader is" Gmail "and according to Nusbaum (2021), this is due to Google Drive (Chopra and Mahapatra, 2017; Mamoun et al., 2020). This type of product makes it possible for files containing primary information to become the workspace of more than one remote individual, as a new level of digitization where real-time results can be accessed and shared with anyone in need along the chain. Thus, the information is real and up-to-date, as it is filled in, processed and seen simultaneously by all stakeholders no matter where they are, which is extremely important in making adequate decisions by management. With regard to this area of the fourth stage of digitization of information in poultry, the application is mostly "Gmail" and mainly for administrative purposes, with no information on how many and which companies use applications such as Google Drive to work in the same spreadsheet file to more than one natural remote person. Initial dating is also not possible, but their entry into the poultry industry coincides with or is immediately after gaining wide popularity in this type of information exchange systems. This stage resembles many third parties, but the difference between the two is that in the third stage the shared information is static and cannot be changed by anyone other than its sender. In the fourth stage, the information is dynamic and changes, and corrected by each of those entitled to access, without compromising each other. This gives the next step, while each participant can access the change history of the others through the change history function in the file itself. Another advantage that is similar to the previous step is the inability to lose the file due to a crash in any of the workstations that have access to it, because they do not physically

own it, and it is located on a separate server. This complements the security of the information, but also opens up new questions about the security of access to it. This problem will be solved only in the next stage.

Nevertheless, the emergence of the 4<sup>th</sup> stage turns out to be a turning point to a large extent, as it makes the exchange of primary data electronically almost unnecessary, as everyone responsible in the hierarchical system has access and fills in the information directly in a common file. Here we still do not go beyond the framework of the prototype programs of this system (Excel and Access). All this will be overcome in the next stage of the development of digitalization.

*Stage 5: Emergence of the first cloud-based internet platforms with levels of access and responsibilities or specialized cloud-based platforms for working with different information flows*

The need to take advantage of the cloud space to store huge amounts of information, led a number of software companies to develop alternatives to the then document management systems, but now cloud-based, giving rise to platforms similar to Dropbox and Google Disc, but more specialized. On the other hand, through a number of programs for the assimilation of Big Data, set in projects under the 7<sup>th</sup> Framework Program, such as Fractals, etc., led to the emergence of specialized cloud-based platforms that are closely specialized in animal husbandry. According to Verdouw et al. (2017 a, b), the Smart Agri-Food and Fractals projects (2014–2016), as part of the FIWARE accelerator program, should encourage the introduction of such Internet-based technologies for future small businesses employed in the livestock and agriculture sectors. According to European agricultural policy, specifically focused on the development of SMEs and start-ups, this should be the future desired vision for the industry within the concept of the "Internet of Things".

Five years ago, companies offering digital electronic scales for weekly control of poultry flocks decided to replace the first stage spreadsheets with cloud-based software solutions for

monitoring and keeping a record of performance indicators. They were immediately followed by producers of breeding material and breeding parent flocks. Very soon, companies with more than two structural units located in more than one location followed, initiating the sharing of information over the Internet, facilitating the administration of production, and remote decision-making. In 2016, specialized cloud-based platforms appeared, such as „Poultics“ (2016), „Livestocks“ (2018), etc., which were closely specialized in poultry farming in Bulgaria. Similar developments, in which IAS-Kostinbrod participated, due to the nature of the small farm in the country managed to enter only the poultry sector, where most of the companies are large farms and have more than one centre where poultry is raised. The entry of cloud-based software solutions and the Internet of Things was also favoured by the decision of the Ministry of Agriculture and Food to select and share all selection and zootechnical books in the country online. The sharing of up-to-date information, visible both from the specialists who fill it in and from the management staff of the enterprise and the control body in the person of each breeding association, through a cloud-based platform is currently being introduced in the poultry sector. In the future, it is possible that this circle of stakeholders may include, if desired, control bodies such as the BFSA and the SFA of the MAF, as well as consumers and / or the consumer protection agency.

### **Chronological development of events**

In chronological terms, all this can be summarized schematically as follows (Fig. 1).

Fig. 1 gives us a visual idea on which to understand the stages of development of digitalization worldwide, comparing it with the development of a highly intensified industry, such as poultry and especially the speed with which companies in the industry absorb this innovation. It is no coincidence that poultry farming is the first industry in which the possibilities of new carriers and software products are being exploited. This

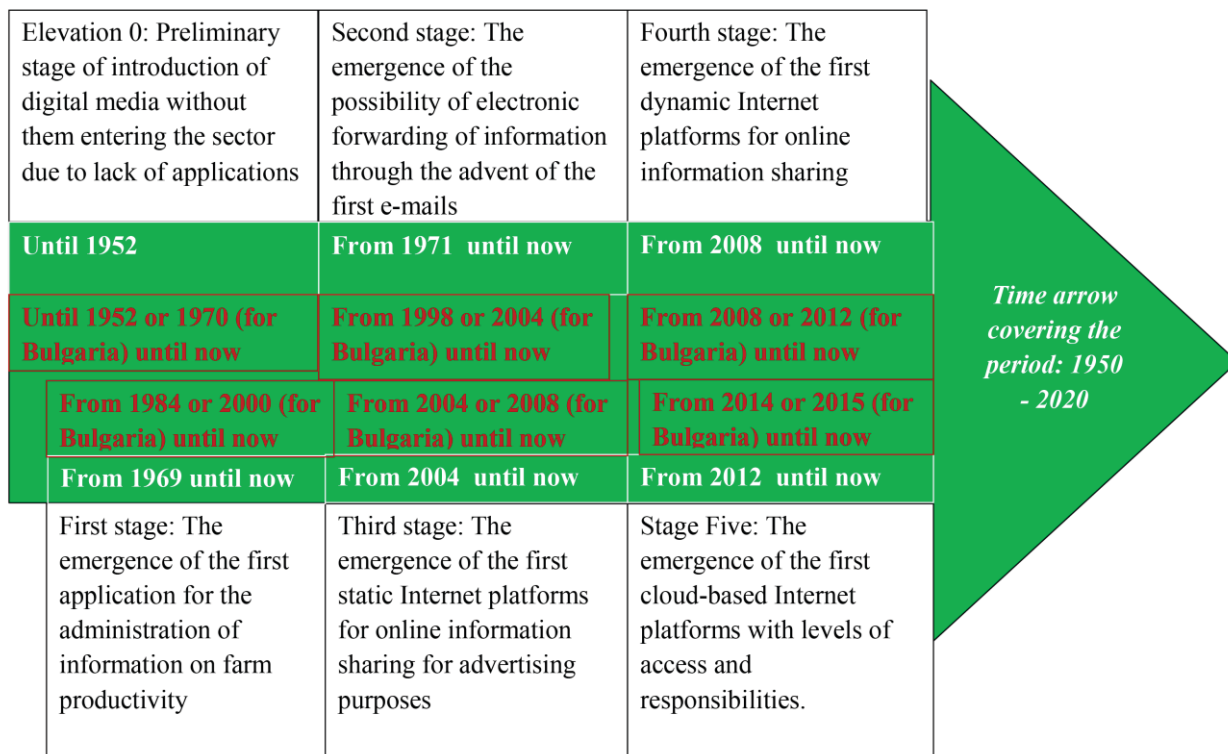


Fig. 1. Stages of development of digitalization and the pace at which they enter the poultry industry

is due to the much more advanced intensification of this industry. Extremely short production cycle (Belorechkov, 2011) and low added value (Valkov, 2015), according to some authors (Lampkin, 2005) give investors in the industry to seek ever higher guarantees for investment security, which makes them open to most market innovations that can directly or indirectly increase security and provide additional guarantees for the good condition of assets. The arguments set out above will remain valid in the future as well, making poultry farming one of the best fields for testing and entering into practice at every next stage in the development of digital technologies.

**Conclusion**

Tracking the development of new technologies shows that the whole cycle can be summarized in 5 consecutive and interconnected stages. With the advancement of new technologies, it is becoming clear that it is possible to collect more

and more information, which requires the creation of a new type of carriers, such as digital. The rapid volume of information, the low added value of the final product and the risky nature of the investment further favour their rapid assimilation in poultry practice.

**Acknowledgements**

The article presented the results from research activity as part from project DIA-GRO with agreement № KII-06-H-26/10 from 19.12.2018, funded by Bulgarian National Science Fund (BNSF), Ministry of Education and Science (MSE).

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